# Chapter 3
# Affected Environment

This chapter describes current environmental and socioeconomic conditions at Eufaula Lake and in the surrounding area. It describes each resource that could be affected by the revisions to the SMP and MP and by action on the rezone and lease request at Carlton Landing and on the individual zoning requests. The information in this chapter also serves as a baseline from which to identify and evaluate potential environmental and socioeconomic changes resulting from actions under consideration. The information has been provided in only enough detail to understand the effects of the alternatives on the environment and depicts conditions as they currently exist based on the most recent available data. The environmental consequences of the alternatives for revising the SMP and MP and for actions on the requests for rezones and a lease of USACE land at Carlton Landing are discussed in Chapter 4.0.

During the preparation of the Draft EIS, it was determined that the proposed actions would have minimal to no effect on a number of resource categories. These categories include: agricultural lands, air quality, climate change, water supply and flood storage, hazardous materials, navigation, energy, land use compatibility, public infrastructure and utilities, social services and community facilities, and environmental justice. Therefore, these resource categories are not discussed in detail in the EIS. Information on these categories was collected and analyzed in reaching the conclusion that there would be little to no effect from the proposed actions, and the information on the affected environment and environmental consequences for these categories is found in Appendix H.

## 3.1 Vegetation, Wetlands, and Aquatic Habitats

### 3.1.1 Area of Analysis (Vegetation, Wetlands, and Aquatic Habitats)

The area of analysis, or the study area, focused on the USACE-owned lands which include the lake and a narrow band of uplands of varying widths around the lake above elevation 585 feet above mean sea level. The study area also included the lakeshore at the proposed Carlton Landing development. The field surveys were focused on habitats within the USACE-owned lands around Eufaula Lake, while the habitat types described in this section pertain to a broader area that includes the six-county area surrounding the Lake.

### 3.1.2 Regulatory Setting (Vegetation, Wetlands, and Aquatic Habitats)

Section 1502.25 of the NEPA regulations require that EISs be prepared concurrently and integrated with environmental analyses and related surveys and studies required by other federal statutes (40CFR 1502.25). With respect to terrestrial and aquatic habitats those statutes and guidelines include the Fish and Wildlife Coordination Act, the Clean Water Act, Executive Order 11990 Wetlands Protection, Executive Order 13112: Invasive Species, and ER 1130-2-540 Management of Natural Resources and Outdoor Recreation at Water Resource Projects. These regulations are described in Section 1.6.

### 3.1.3 Terrestrial and Aquatic Habitat Data Collection

To fully understand the existing habitat types and conditions, a terrestrial and aquatic habitat map was developed that identifies the locations and quantities of habitat types in the study area. Existing available data was collected that assisted in the development of the new habitat map including existing habitat maps of the Eufaula Lake area, reports pertaining to these habitats, reports pertaining to the occurrence of federal and state listed species, aerial photographs, topographic maps, soils maps and reports, wetland maps, bathymetric maps, and other data from sources listed in the Terrestrial and Aquatic Habitats and Natural Resources Inventory Report in Appendix B.

A base map of terrestrial and aquatic habitats of the Eufaula Lake EIS study area was developed based on the maps, aerial photographs, reports, and data as described above. Each habitat type location in the Eufaula Lake study area was represented by a polygon on the habitat map. The polygons were then digitized to provide quantitative data on each habitat type.

Each major terrestrial and aquatic habitat type was field verified and visited for additional data collection. The habitat maps were modified following field verification. After the habitat types were verified, transects were established in each of six terrestrial and three aquatic vegetated habitat types. The species composition of the canopy, sub canopy and ground cover strata (if present) was determined along these transects to provide a qualitative description of the habitat types in the study area. Lacustrine habitats (littoral and limnetic) were assessed based on the EPA Lake and Reservoir Bioassessment and Biocriteria: Technical Guidance Document (EPA 2007a) and the National Lake Assessment (NLA) Field Operations Manual (EPA 2007b).

The lake habitat assessment consisted of both watershed and in-lake observations. The in-lake observations included measurement of physical and chemical parameters and a shoreline habitat assessment based on the EPA Environmental Monitoring and Assessment Program (EMAP) lake habitat assessment methodology (EPA 1994). This shoreline habitat assessment methodology includes a littoral zone assessment component and a riparian zone assessment component. The shoreline habitat assessment characterized the terrestrial and aquatic habitats at the shoreline. Additionally, the assessment of littoral lacustrine habitats was used to evaluate potential changes in vegetation that may occur under each of the alternatives.

A detailed description of the data collection and analysis methodology is provided in Appendix B.

### 3.1.4 Vegetation Communities

The upland vegetation and terrestrial habitats present within the Eufaula Lake study area were classified according to the level IV Oklahoma ecoregion map. Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. They are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. The four ecoregions located within the Eufaula Lake study area are the northern crosstimbers (29a), scattered high ridges and mountains (37a) and the lower Canadian hills (37e) of the Arkansas River valley, and the Osage cuestas (40b) of the central irregular plains (**Figure 3.1-1**).

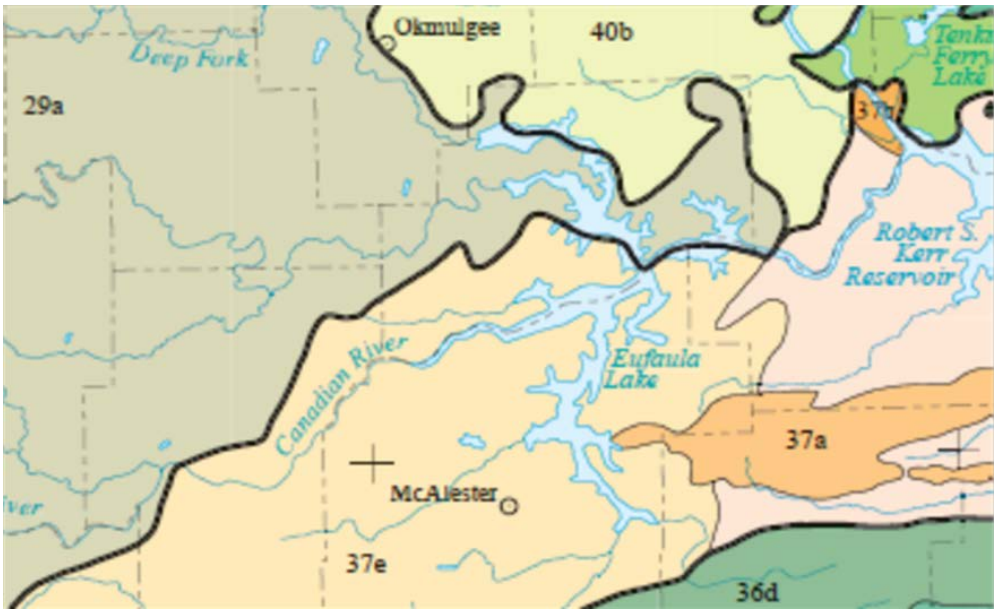



**Figure 3.1-1. Level IV Ecoregions Located around Eufaula Lake** (Woods *et al.* 2005)

Each of the four ecoregions is made up of a variety of natural vegetation communities (**Table 3.1-1**). As described by Hoagland (2000), these communities are dominated by characteristic plant associations that greatly influence the fauna found within. Vegetation transects were established in April 2012 and included at least two transects for each vegetation community. Transects were located to capture habitats in all four ecoregions and were positioned in an even geographic distribution around the periphery of the lake. All plant species present in the canopy, understory, and ground cover were noted and dominance was determined.

**Table 3.1-1. Primary Natural Vegetation Communities and Vegetation Associations Found within the Eufaula Lake Study Area**

| Vegetation Community | Dominant Plant Associations* |
|---|---|
| Crosstimbers | Post Oak—Blackjack Oak—Black Hickory Forest |
| | Post Oak—Winged Elm Forest |
| | Post Oak—Eastern Red-cedar Forest |
| Oak-Hickory Forest | Post Oak—Black Hickory Forest |
| | Post Oak—Shumard Oak—Bitternut Hickory Forest |
| | Chinquapin Oak—Shumard Oak Forest |
| Oak-Pine Forest | Shortleaf Pine—Post Oak—Blackjack Oak Forest |
| | Shortleaf Pine—White Oak—Black Oak Forest |
| Bottomland Hardwood Forest (Forested Wetland) | American/Red Elm—Sugarberry—Green Ash Temporarily Flooded Forest |
| | Pin Oak—Pecan—Deciduous Holly Seasonally Flooded Forest |
| | River Birch—Sycamore Temporarily Flooded Forest |
| | Water Oak—Red Elm—Shumard Oak Temporarily Flooded Forest |

| Vegetation Community | Dominant Plant Associations* |
|---|---|
| Savanna | Broomsedge—Persimmon—Smooth Sumac Herbaceous Association |
| | Post Oak—Blackjack Oak—Little Bluestem Woodland Association |
| | Lespedeza Herbaceous Association |
| Prairie | Big Bluestem—Switchgrass Herbaceous Association |
| | Big Bluestem—Little Bluestem—Indian Grass Herbaceous Association |
| | Sunflower—Western Ragweed Herbaceous Alliance |

### 3.1.4.1 Crosstimbers

The crosstimbers is one of the most widespread and abundant native habitat types located within the Eufaula Lake study area. It is found throughout the study area but is most common within the northern crosstimbers and lower Canadian hills ecoregions on the western side of the lake. Crosstimbers are also present on the rocky hilltops along the northern shoreline within the Osage cuestas ecoregion. Within the study area, crosstimbers habitat was sampled at the proposed Carlton Landing development (lower Canadian hills ecoregion) and within the Deep Fork Arm of the Eufaula Wildlife Management Area (WMA) (northern crosstimbers ecoregion).

The Crosstimbers community is dominated by post oak (*Quercus stellata*) and blackjack oak (*Quercus marilandica*). In several areas, these two oaks may comprise as much as 90 percent of the canopy cover (Hoagland *et al.* 1999). Within the Eufaula Lake study area, blackjack oak is more common in western areas, but post oak is the dominant species throughout. Other common canopy species include black hickory (*Carya texana*), eastern red-cedar (*Juniperus virginiana*), and winged elm (*Ulmus alata*). Within the two habitat transects, canopy percent cover was 65 to 80 percent. Similar species are present throughout the sub-canopy; however, fewer blackjack oaks and more eastern red-cedar and winged elm make up the understory. Smooth sumac (*Rhus glabra*) is also dominant. Sub-canopy percent cover fell between 5 to 40 percent at the transect sites.

Crosstimbers are generally considered open woodlands, thus have a more significant ground cover layer than other forest types found within the study area. Observations at the two transect sites documented that post oak, little bluestem (*Schizachyrium scoparium*), and species of switchgrass (*Panicum* sp.) dominated the ground cover community. The presence of many tree seedlings from a variety of species demonstrates that tree recruitment is high, which is a good indicator of forest health.

In sites that are drier and/or have a higher frequency of fire, the crosstimbers community has a more savanna-like structure (ODWC 2005). The Deep Fork transect site was located on a dry hilltop above the floodplain and exhibited this structure, with less complete canopy and sub-canopy coverage and a ground cover layer dominated by little bluestem. However, over the majority of the Eufaula Lake study area, relatively little crosstimbers habitat exists in this open mosaic condition as it has gradually changed to a more uniformly forest-like condition over time.

### 3.1.4.2 Oak-Hickory Forest

The oak-hickory forest community closely resembles the crosstimbers community but is not dominated by post and blackjack oak to the same extent. In addition, oak-hickory forests tend to occupy sites with

greater precipitation; whereas, crosstimbers are primarily located in drier areas. The oak-hickory vegetation community is found in all four ecoregions and throughout the study area, but it is most common within the lower Canadian hills and scattered high ridges and mountains ecoregions along the southern half of Eufaula Lake. For this vegetation community, two habitat transects were located within the North Canadian Arm of the Eufaula WMA (northern crosstimbers ecoregion) and along Jones Creek Road adjacent to the James Collins WMA (scattered high ridges and mountains ecoregion).

Within the study area, the dominant canopy species found in the oak-hickory forest community include post and Shumard (*Quercus shumardii*) oaks, black and mockernut (*Carya tomentosa*) hickories, and winged elm. Oak-hickory forests have more tree diversity than crosstimbers, and a total of 17 tree species were found within the canopy and sub-canopy at the two sampling sites. The dominant species within the sub-canopy included the black hickory, post oak, and winged elm that were found in the canopy and also included green ash (*Fraxinus pennsylvanica*), slippery elm (*Ulmus rubra*), and red mulberry (*Morus rubra*).

The amount of ground cover within the oak-hickory forest community depends on the openness of the canopy. Within the study area, the oak-hickory forests tend to take on the characteristics of open woodland and support a variety of herbaceous plants. At the two sample sites, a total of 19 species were identified in the ground cover layer. Dominant species include Mexican plum (*Prunus mexicana*), mint (*Mentha* sp.), poison ivy (*Toxicodendron radicans*), red mulberry, roundleaf greenbrier (*Smilax rotundifolia*), and bedstraw (*Galium* sp.). Several additional vine species were also common including muscadine (*Vitis rotundifolia*), trumpet creeper (*Campsis radicans*), and Virginia creeper (*Parthenocissus quinquefolia*).

In comparison to the crosstimbers transects, very few tree species were observed in the ground cover of oak-hickory forests. The high density of herbaceous ground cover can smother tree seedlings and may inhibit tree recruitment. This could cause a decline in forest health as older trees die off and are not replaced.

#### 3.1.4.3 Oak-Pine Forest

While not as common in the Eufaula Lake study area as crosstimbers and oak-hickory forest, several large tracts of oak-pine forest can be found within the lower Canadian hills and scattered high ridges and mountains ecoregions. Oak-pine forests are particularly common along the shorelines of Evergreen and Brooken Coves in the northeast, Hickory Point in the southeast, and Roundtree Landing in the east-central portion of the lake. The oak-pine forest community is comprised of a mosaic of woodlands and forests dominated by shortleaf pine (*Pinus echinata*) and several species of oaks and hickories (Hoagland 2000).

Within the study area, oak-pine forest habitat was sampled at Roundtree Landing adjacent to the proposed Carlton Landing development (lower Canadian hills ecoregion) and at Hickory Point Recreation Area (lower Canadian hills ecoregion. The dominant canopy species include shortleaf pine and winged elm on the higher slopes of Roundtree Landing and shortleaf pine, eastern red-cedar, and green ash within the lowlands of Hickory Point Recreation Area. Additional canopy species include white oak (*Quercus alba*), post oak, black oak (*Quercus velutina*), and hickories (mockernut, black) on slopes and elms at lower elevations. The transect at Roundtree Landing reflected the historic open woodland condition with a canopy cover of 60 percent, while the Hickory Point site had a canopy cover of 85 percent, which reflects the growing transition in the region from open woodland to forest. The dominant species within the sub-canopy included canopy dominants like shortleaf pine and winged elm and also included green ash at Hickory Point and mockernut hickory on Roundtree Landing. The sub-canopy was more diverse than the

canopy with 15 total species observed including hawthorns (*Crataegus* sp.), plums (*Prunus* sp.), dogwoods (*Cornus* sp.), and hackberry (*Celtis* sp.). Percent cover of the sub-canopy was approximately 50 percent for both sites.

The amount of ground cover within the oak-pine forest community at the two sampling sites varied widely. The rocky hilltop oak-pine forest on Roundtree Landing contained an herbaceous percent cover of eight percent, whereas the wetter, gradual slopes of Hickory Point approached 90 percent cover. Ground cover at Roundtree Landing was dominated by upland grasses and contained many oak, hickory, and winged sumac (*Rhus copallinum*) seedlings. Due to nearby campgrounds, the Hickory Point site contained species associated with human disturbance including Japanese climbing fern (*Lygodium japonicum*), Japanese honeysuckle (*Lonicera japonica*), greenbrier, and poison ivy. Christmas ferns (*Polystichum acrostichoides*), Virginia creeper, lowbush blueberry (*Vaccinium pallida*), little bluestem, and false indigo (*Amorpha fruticosa*) were also present.

### 3.1.4.4 Bottomland Hardwood Forest

While upland forests may cover the greatest aerial extent within the study area, bottomland hardwood forests represent the most widespread habitat. Occurring along streams and on shallow lakeshore slopes, these riparian forests are found in all four ecoregions and are most common along the many tributaries that feed into Eufaula Lake. Bottomland hardwood forests serve important roles in erosion control, water quality maintenance, and wildlife habitat (Hoagland 1998). Within the study area, bottomland hardwood forests were assessed within the Mill Creek (lower Canadian hills ecoregion) and Deep Fork (northern crosstimbers ecoregion) Arms of the Eufaula WMA and at Brooken Cove Recreation Area (lower Canadian hills ecoregion). Mill Creek and Deep Fork are examples of riverine wet forests, whereas Brooken Cove is an example of a lakeshore wet forest protected in a sheltered cove. For the purposes of this assessment, forested wetlands are considered part of the bottomland hardwood forest community as the two are often synonymous due to similarities in species composition and hydrology. Emergent and scrub-shrub wetlands are included in the discussions on aquatic habitats.

The canopy of the bottomland hardwood forests is the most diverse of all forest canopies located within the study area with a total of 17 species observed. Within more riverine habitats, dominants include American elm (*Ulmus americana*), black willow (*Salix nigra*), boxelder (*Acer negundo*), slippery elm, pin oak (*Quercus palustris*), and water oak (*Quercus nigra*). Within the forested wetlands along the lakeshore, dominant canopy trees include river birch (*Betula nigra*), pond cypress (*Taxodium distichum imbricarium*), and sycamore (*Platanus occidentalis*). Canopy percent cover is high in bottomland hardwood communities and ranges from 70 to 90 percent. Sub-canopy dominants include river birch in lake margins at Brooken Cove and American elm, green ash, and hackberry along the shores of Mill Creek and the Deep Fork River. Due to the dense canopy, sub-canopy percent cover is slightly less, ranging from 40 to 50 percent.

The herbaceous ground layer within bottomland hardwood forests is often characterized by sparse clumps of wetland vegetation sporadically distributed within barren, muddy areas of decaying organic matter. Therefore, percent cover is low, ranging from 5 to 35 percent. Dominant species include river oats (*Chasmanthium latifolium*) and switchgrass (*Panicum virgatum*) within protected lake coves and rushes (*Juncus* sp.) and sedges (*Carex* sp.) in riverine riparian forests. Several vines are also common, including Virginia creeper, trumpet creeper, greenbrier, and poison ivy.

While a good portion of historical bottomland hardwood forests within study area stream systems, especially along the large rivers, were inundated by the construction of the Eufaula Lake reservoir, the

riverine areas surrounding the lake maintain some of the largest tracts of bottomland forest in the region, primarily due to protection provided by the Eufaula WMA. Some activities that may reduce the size and quality of bottomland forest habitats are evident in the study area, including the channelization of small tributaries and the removal of riparian forests for residential, commercial, and recreational land uses. Many homeowners have removed vegetation for landscaping reasons or to improve lake access. In several areas, steep banks and flood control measures sever the connection between streams and floodplains. The vegetation on these steep banks is often replaced by riprap and invasive weedy grasses and shrubs that provide little habitat value to wildlife and may contribute to declines in water quality.

### 3.1.4.5 Savannas

In drier areas, trees thin out and are replaced by large areas dominated by grasses and shrubs. These open woodlands and savannas are fire-maintained plant communities that rely on frequent fires to reduce the densities of oaks, pines, and other tree species (ODWC 2005). Dominant species include post oak, blackjack oak, shortleaf pine, buckbrush (*Symphoricarpos orbiculatus*), sumacs, and persimmon (*Diospyros virginiana*).

Within the Eufaula Lake study area, savanna habitats are predominantly found within the Osage cuestas ecoregion along the northern lake shoreline but can be found intermittently throughout the study area in the remaining three ecoregions. Savannas are generally embedded within other, larger habitat areas or serve as a transition habitat from the open prairies to densely wooded oak-hickory and oak-pine forested habitats (Boren *et al.* 1997). In more open areas with a lower tree density, portions of the crosstimbers may be better classified as oak savannas (Johnson and Risser 1975).

In April 2012, savanna habitats were sampled at Elm Point Recreation Area in the southeast corner of the lake (lower Canadian hills ecoregion) and at Gentry Creek Recreation Area along the lake's northern shoreline (Osage cuestas ecoregion). As expected, the canopy cover of the two savanna sites was low, with a percent cover ranging from 15 to 30 percent. At Gentry Creek, a wet savanna community is present with persimmon as the dominant canopy species and hackberry as a sub-dominant. At Elm Point, a drier oak savanna community is present and dominants include honey locust (*Gleditsia triacanthos*) and Shumard oak, with slippery elm, black locust (*Robinia pseudoacacia*), and green ash present as sub-dominants. The sub-canopy in savanna habitats are just as sparse as the canopy layer with percent cover values ranging from one to ten percent. Sub-canopy dominants at Gentry Creek include persimmon, while Shumard oak and red mulberry are dominant at Elm Point.

Species diversity in savanna habitats is greatest within the herbaceous layer. Dry conditions and thin tree and shrub layers enable the growth of many grasses and forbs (Penfound 1962). Within both sampled savanna habitats, Chinese lespedeza (*Lespedeza cuneata*), an invasive from eastern Asia dominated the transect sites. The presence of this invasive is likely due to significant human use of both recreation areas. In areas with high levels of human use, soils may be disturbed which creates an opening for invasive species to become established and human activity may transport invasive species from one site to another. Other dominants at Gentry Creek include blackberry (*Rubus* sp.), switchgrass, and panic grasses. The savanna at Elm Point appears to be closer to the historical condition, dominated by big bluestem (*Andropogon gerardii*) and upland sedges. Other species present include little bluestem, western ragweed (*Ambrosia psilostachya*), broomsedge (*Andropogon virginicus*), spider lily (*Hymenocallis lirisome*), asters (*Symphyotrichum* sp.), and mint.

#### 3.1.4.6 Prairies

The final primary vegetation community located within the Eufaula Lake study area is the open grassland that makes up the prairie habitat type. While several prairie communities, including short-grass and mixed-grass prairie, exist in Oklahoma, it is the tall-grass prairies that grace the dry shallow slopes and flat regions within the study area. Although the quantity and quality of tall-grass prairies has declined, it still remains a widespread habitat within the study area, especially in protected areas with little human disturbance. While most often encountered within the Osage cuestas and lower Canadian hills ecoregions, prairie habitats are also relatively common interspersed between the oak forests in the northern crosstimbers ecoregion. Two transects, one at Juniper Point Recreation Area in the southwest portion of the lake (lower Canadian hills ecoregion) and another just north of I-40 along E1060 Road (Osage cuestas ecoregion), were sampled to document plant species representative of Eufaula Lake prairie communities.

As expected, large woody species were absent and no canopy layer was observed. At the E1060 Road site, some stunted trees located on the periphery of the transect were observed; however, total sub-canopy percent cover was approximately two percent. No woody species of any height were observed within the tall-grass prairie located at Juniper Point.

The herbaceous layer of the tall-grass prairie contains similar species as those found in the same layer within savanna habitats. Within the study area, 19 herbaceous species were identified. Dominant species at Juniper Point included little bluestem, Indian grass (*Sorghastrum nutans*), Indian paintbrush (*Castillega coccinea*), wild alfalfa (*Psoralea tenuifolia*), and common goldstar (*Hypoxis hirsuta*). Indian grass was also a dominant species within the prairie located off of E1060 Road in the northern portion of the study area, with other dominants such as blackberry, western ragweed, and big bluestem also present. Due to varied growth and flowering seasons, many prairie grasses and wildflowers are difficult to identify. Since prairie habitats were assessed in the beginning of April, the list provided in Table 4-7 of Appendix B contains only those species displaying identifiable characteristics during the early spring.

In general, the tall-grass prairies located within the study area reflect a region-wide poor condition with a declining trend (ODWC 2005). Tall-grass prairies are extremely sensitive habitats that are easily overrun by competitive weedy species or encroached upon by forested habitats when human disturbance and fire suppression policies are present (Netherland 1979).

### 3.1.5 Wetlands and Aquatic Habitats

#### 3.1.5.1 Wetland Classifications

Aquatic habitats, including open water and wetlands, are integral to physical, chemical, and biological processes within lake and stream ecosystems and support a rich biodiversity by providing unique habitats for many plants and animals. Vegetated wetlands, in particular, provide a vast array of ecosystem services including water quality improvement, flood protection, erosion control, and groundwater recharge (OCC 2000). In addition, wetlands provide recreational opportunities, appealing aesthetics, and support natural resource industries including timber and fisheries.

Aquatic habitats with the Eufaula Lake study area vary from deepwater lentic systems found below the conservation pool elevation to shallow water littoral habitats consisting of emergent and scrub-shrub wetlands. All aquatic habitats were evaluated using the classification system proposed in the *Classification of Wetlands and Deep Water Habitats* (Cowardin *et al.* 1979). An evaluation of National Wetlands Inventory (NWI) maps indicated that there are six major aquatic habitat types in the Eufaula Lake study

area (some areas may be classified as a combination of these habitat types). **Figure 3.1-2** illustrates wetland classification and location in a typical lake system. The six major aquatic habitat types include:

- Palustrine Forested Broad-leaved Deciduous (PFO1)
- Palustrine Forested Dead (PFO5)
- Palustrine Scrub-Shrub Broad-leaved Deciduous (PSS1)
- Palustrine Emergent Persistent (PEM1)
- Lacustrine Littoral Unconsolidated Shore (L2USC)
- Lacustrine Limnetic Unconsolidated Bottom (L1UBH)

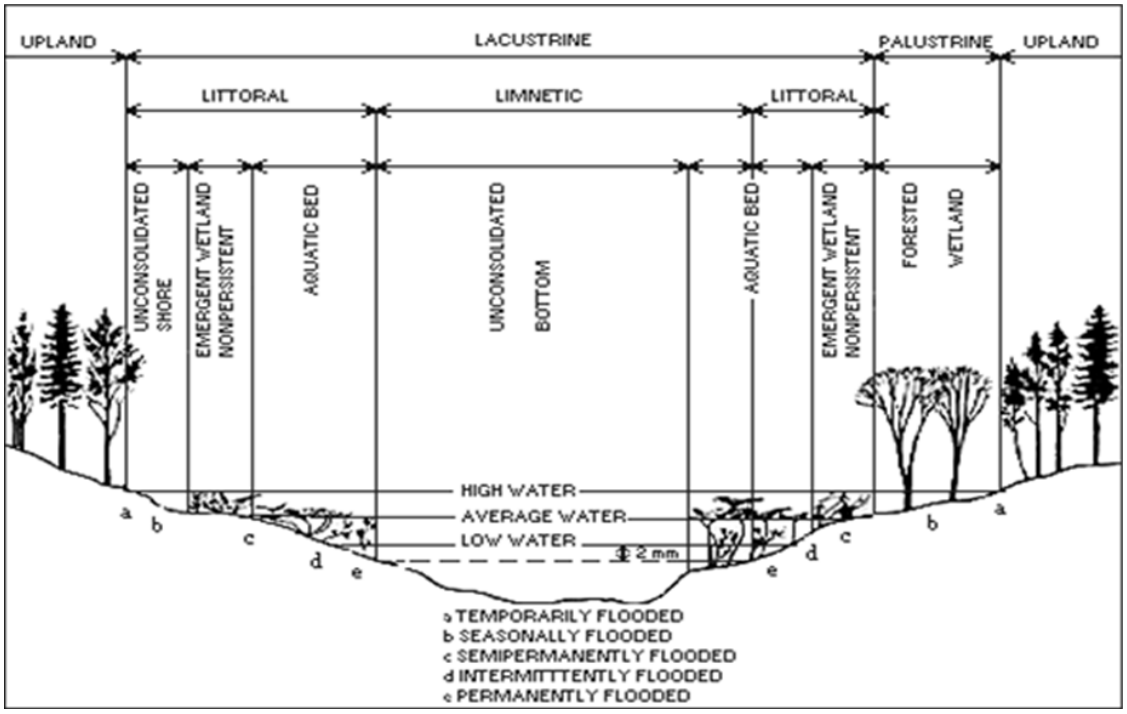



**Figure 3.1-2. Wetland Classification and Location in a Typical Lake System**

Historical and existing conditions of palustrine forested, forested dead, scrub-shrub, and emergent wetlands were assessed in detail. These wetland types were field verified with vegetation transects in April 2012, and at least two transects were conducted for each wetland type. All plant species present in the canopy, understory, and ground cover were noted, and species dominance was determined. However, the discussion of the historical and existing conditions of forested wetlands is located in the review of the synonymous bottomland hardwood forest habitat in Section 3.1.4.4 because the species composition and habitat structure of the two habitat types are so similar. Shoreline habitat assessments (SHA) were performed to characterize shoreline habitats, including several wetland types, and they are described further in Section 3.1.5.3.

Palustrine wetlands are dominated by trees, shrubs, persistent emergents, mosses, and lichens. Palustrine wetlands may also lack such vegetation but include the following characteristics: (1) area less than 20 acres; (2) active wave-formed or bedrock shoreline features are lacking; and (3) water depth in the deepest part of the basin is less than 2 meters at low water (Cowardin *et al.* 1979). Situated shoreward of the lake

and stream channels, palustrine wetlands within the Eufaula Lake study area include emergent freshwater marshes, scrub-shrub wetlands, and forested wetlands.

Lacustrine habitats include shallow and deep open-water areas with the following characteristics: (1) situated in a topographic depression or dammed river channel; (2) lacking trees, shrubs, persistent emergent, emergent mosses, or lichens with greater than 30 percent aerial coverage; and (3) total area exceeds 20 acres (Cowardin *et al.* 1979). For Eufaula Lake, the lacustrine areas are bounded by the contour approximating the normal spillway or pool elevation (585 feet above mean sea level). Therefore, many of the waters within Eufaula Lake proper are considered lacustrine open water habitats.

The lacustrine open water habitats are broken down further into limnetic and littoral zones. Lacustrine limnetic habitats include all deepwater habitats. Within the Eufaula Lake study area this includes all open water and lake bottom habitats that occur at a water depth of greater than 2 meters.

Lacustrine littoral habitats extend from the shoreward boundary of Eufaula Lake to a water depth of 2 meters or to the maximum extent of emergent vegetation (Cowardin *et al.* 1979). Substrates in littoral habitats vary widely and are influenced by shoreline substrates. Unlike in many lakes where the lacustrine littoral zone supports a wide variety of submergent and emergent vegetation, the steep slopes of most shorelines along Eufaula Lake result in unsuitable water depths and attachment points for aquatic plants. This not only eliminates cover and forage for many fish species but contributes to high erosion and turbidity rates due to wave action, especially along unforested shorelines.

In order to avoid confusion with lacustrine littoral habitats, emergent vegetation immediately adjacent to streams and the lakeshore is often referred to as the shore zone or the zone of emergent vegetation and is generally considered separately from the river or lake (Cowardin *et al.* 1979). Emergent wetlands are characterized by erect, rooted, herbaceous hydrophytes and hydrologic regimes that enable the establishment of such vegetation.

In areas where hydrology and substrate prohibit the establishment of herbaceous emergents, scrub-shrub wetlands, dominated by woody shrubs and small trees, may occur. Scrub-shrub wetlands are characterized by woody vegetation less than 20 feet tall (Cowardin *et al.* 1979).

### 3.1.5.2 Wetland Species

Scrub-shrub and emergent wetlands, in addition to forested wetlands, make up the vegetated wetland community within the study area. Each wetland type has characteristic vegetation associations named for the dominant species present. The vegetation associations observed with the greatest frequently within the Eufaula Lake study area are listed in **Table 3.1-2**.

The steep slopes of many shorelines with the Eufaula Lake study area result in unsuitable water depths and few attachment points for wetland plants; therefore, most of the emergent wetlands in the study area are within protected coves or they exist landward of the shoreline in terrestrial depressions. Several of these wetlands, including a marsh in Brooken Cove Recreation Area, are found in association with beaver activity. The beavers impound small areas of shoreline and create permanently flooded, protected habitats.

**Table 3.1-2. Wetland Communities and Respective Associations Found within the Eufaula Lake Study Area**

| Wetland Community | Dominant Plant Associations* |
|---|---|
| Palustrine Emergent Wetland | Broadleaf Cattail Herbaceous Association |
| | Softstem Bulrush—Spike Rush Herbaceous Association |
| | Common Rush Wetland Association |
| | Creeping Water Primrose—Swamp Smartweed Herbaceous Association |
| Palustrine Scrub-Shrub Wetland | Buttonbush Shrubland Association |
| | Black Willow Woodland Association |
| | Swamp Privet—Buttonbush Shrubland Association |

**Hoagland (2000)*

Emergent wetlands, while uncommon, exist within all four ecoregions and in all geographic areas of the Eufaula Lake study area. Vegetation transects were established in emergent wetlands in April 2012 in the Mill Creek Arm of the Eufaula WMA and within a public hunting area near the intersection of Blocker Road and Massey Point Road. A complete list of observed plant species is provided in **Table 3.1-3**.

**Table 3.1-3. Plant Species Found in Emergent Wetland Community Habitat Transects - April 2012**

| Common Name | Scientific Name |
|---|---|
| **Emergent Woody** | |
| Black Willow* | *Salix nigra* |
| Buttonbush* | *Cephalanthus occidentalis* |
| Eastern Swampprivet | *Forestiera acuminata* |
| Green Ash | *Fraxinus pennsylvanica* |
| Water Locust* | *Gleditsia aquatica* |
| **Emergent Herbaceous** | |
| American Water Willow | *Justicia americana* |
| Barnyard Grass | *Echinochloa* spp. |
| Broadleaf Cattail* | *Typha latifolia* |
| Common Rush* | *Juncus effusus* |
| Common Spike Rush* | *Eleocharis palustris* |
| Duckweed* | *Lemna minor* |
| Marsh Seedbox | *Ludwigia palustris* |
| Poverty Rush* | *Juncus tenuis* |
| Ravenfoot Sedge | *Carex crus-corvi* |
| Salvinia* | *Salvinia molesta* |
| Softstem Bulrush | *Scirpus tabernaemontani* |
| Spotted Water Hemlock | *Cicuta maculata* |
| Swamp Smartweed | *Polygonum hydropiperoides* |
| Valley Redstem | *Ammania coccinea* |

| Common Name | Scientific Name |
|---|---|
| **Submergent** | |
| Coontail | *Ceratophyllum demersum* |
| Watermilfoil* | *Myriophyllum pinnatum* |

**Dominant species (determined by percent composition)*

The species composition of scrub-shrub wetlands within the study area was also evaluated. Around Eufaula Lake, scrub-shrub wetlands are found along river floodplains, lake margins, and within seasonally flooded depressions. Much like emergent wetlands, scrub-shrub wetlands are found in all four ecoregions and throughout the geographic extent of the study area. Two vegetation transects were established in scrub-shrub wetlands in April 2012; one in the Duchess Creek Arm of the Eufaula WMA and another located in the Gentry Creek Recreation Area. Therefore, scrub-shrub communities were assessed in the northern and eastern regions of the study area. A complete list of observed species is found in **Table 3.1-4**.

**Table 3.1-4. Plant Species Found in Scrub-shrub Wetland Community Habitat Transects - April 2012**

| Common Name | Scientific Name |
|---|---|
| **Emergent Woody** | |
| Black Willow* | *Salix nigra* |
| Buttonbush* | *Cephalanthus occidentalis* |
| Cockspur Hawthorn | *Crataegus crux-galli* |
| Green Ash* | *Fraxinus pennsylvanica* |
| Shumard Oak | *Quercus shumardii* |
| Sugarberry | *Celtis laevigata* |
| Sycamore | *Platanus occidentalis* |
| Water Locust* | *Gleditsia aquatica* |
| **Emergent Herbaceous** | |
| American Germander* | *Teucrium canadense* |
| Barnyard Grass | *Echinochloa* spp. |
| Carolina Elephantsfoot | *Elephantopus caroliniana* |
| Common Rush* | *Juncus effuses* |
| Fox Sedge* | *Carex vulpinoidea* |
| Hop Sedge* | *Carex lupulina* |
| Pale Dock | *Rumex altissimus* |
| Ravenfoot Sedge | *Carex crus-corvi* |
| Roundleaf Greenbrier* | *Smilax rotundifolia* |
| Sweet Woodreed | *Cinna arundinacea* |
| Virginia Wildrye | *Elymus virginicus* |

**Dominant species (determined by percent composition)*

Although often overlooked in habitat analyses, palustrine forested dead wetlands exist in small, localized areas within the Eufaula Lake study area. In addition to the standing dead timber located in the shallows, the Eufaula Lake study area has significant dead timber in open water lacustrine habitats including standing timber in Longtown Arm. Most of the palustrine forested dead wetlands and lacustrine dead timber habitats resulted from the creation of the Eufaula Lake reservoir when large, incompletely cleared areas of

forest were inundated. All that remains are the emergent, gnarled trunks and treetops that periodically disrupt areas of open water. Other causes of palustrine forested dead wetland creation would include current lake water level fluctuations that may submerge forested wetlands.

While these wetlands are not as productive as their vegetated counterparts, they do provide optimal structural underwater habitat for fish species, especially crappie, and provide perches for several piscivorous bird species including bald eagle, double-crested cormorant, and osprey.

### 3.1.5.3 Shoreline Habitat Assessment

A shoreline habitat assessment (SHA) was conducted in May 2012 to determine the relative condition of the Eufaula Lake study area shoreline in comparison to that observed at lakes in the region. Assessments were conducted throughout the study area, and locations were selected based on proposed re-zoning, historical and current land use, and site access. In total 28 locations were accessed by foot and 10 were accessed by boat (**Figure 3.1-3**). Two sites, 3 and 23, are not included in **Figure 3.1-3** and were not assessed due to the presence of river, not lake, conditions at these locations. Due to the specific development proposal under consideration, the proposed Carlton Landing development, Roundtree Landing, and adjacent shorelines were sampled extensively (**Figure 3.1-4**).

Oklahoma's Water Quality Standards (WQS) are set forth under statutory authority of the Oklahoma Water Resources Board (OWRB) authorized under 82 O.S. § 1085.30 (ODEQ 2010). These standards are designed to maintain and protect the quality of waters in Oklahoma and specify numerical and narrative criteria to protect beneficial uses designated for certain waters of the state. The WQS have established five specific beneficial uses for Eufaula Lake and its major tributaries (*i.e.*, Canadian River, Gaines Creek) (OWRB 2011). The focus of the following discussion is on the Fish and Wildlife Propagation beneficial use – Warm Water Aquatic Community (WWAC).

#### *Fish and Wildlife Propagation Beneficial Use*

The Fish and Wildlife Propagation beneficial use encompasses several subcategories (Habitat Limited Aquatic Community, Warm Water Aquatic Community, Cool Water Aquatic Community, and Trout Fishery), which are capable of sustaining different climax communities of fish and shellfish. Numeric and narrative criteria used in the protection of fish and wildlife propagation include dissolved oxygen, pH, and turbidity. Eufaula Lake and its tributaries within the study area are placed in the WWAC category because biotic and abiotic habitat conditions in these waterbodies favor a climax community composed of warm water aquatic species.

**Dissolved Oxygen:** Of the 38 sites sampled not one contained dissolved oxygen levels below the established threshold. Therefore, the littoral waters of the study area would fully support the Fish and Wildlife Propagation beneficial use in terms of dissolved oxygen. Unlike many lakes in the region, Eufaula Lake does not appear to suffer from low dissolved oxygen levels.

**Hydrogen ion activity (pH):** Of the 38 sites, seven recorded pH values outside of the acceptable range. These observations suggest that waters within the Eufaula Lake study area may not always attain the Fish and Wildlife Propagation beneficial use in terms of pH.

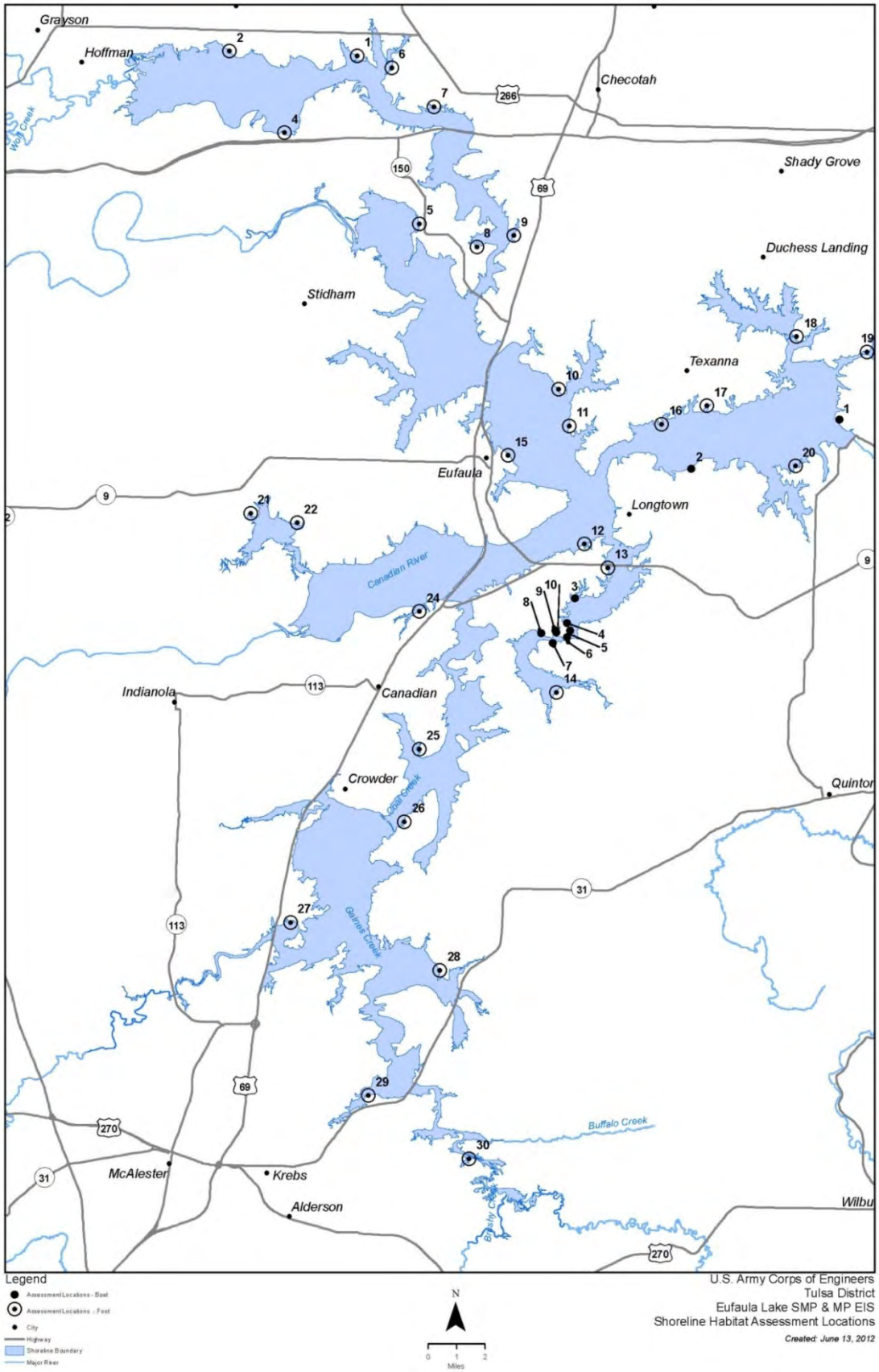



**Figure 3.1-3. Shoreline Habitat Assessment Sampling Locations**

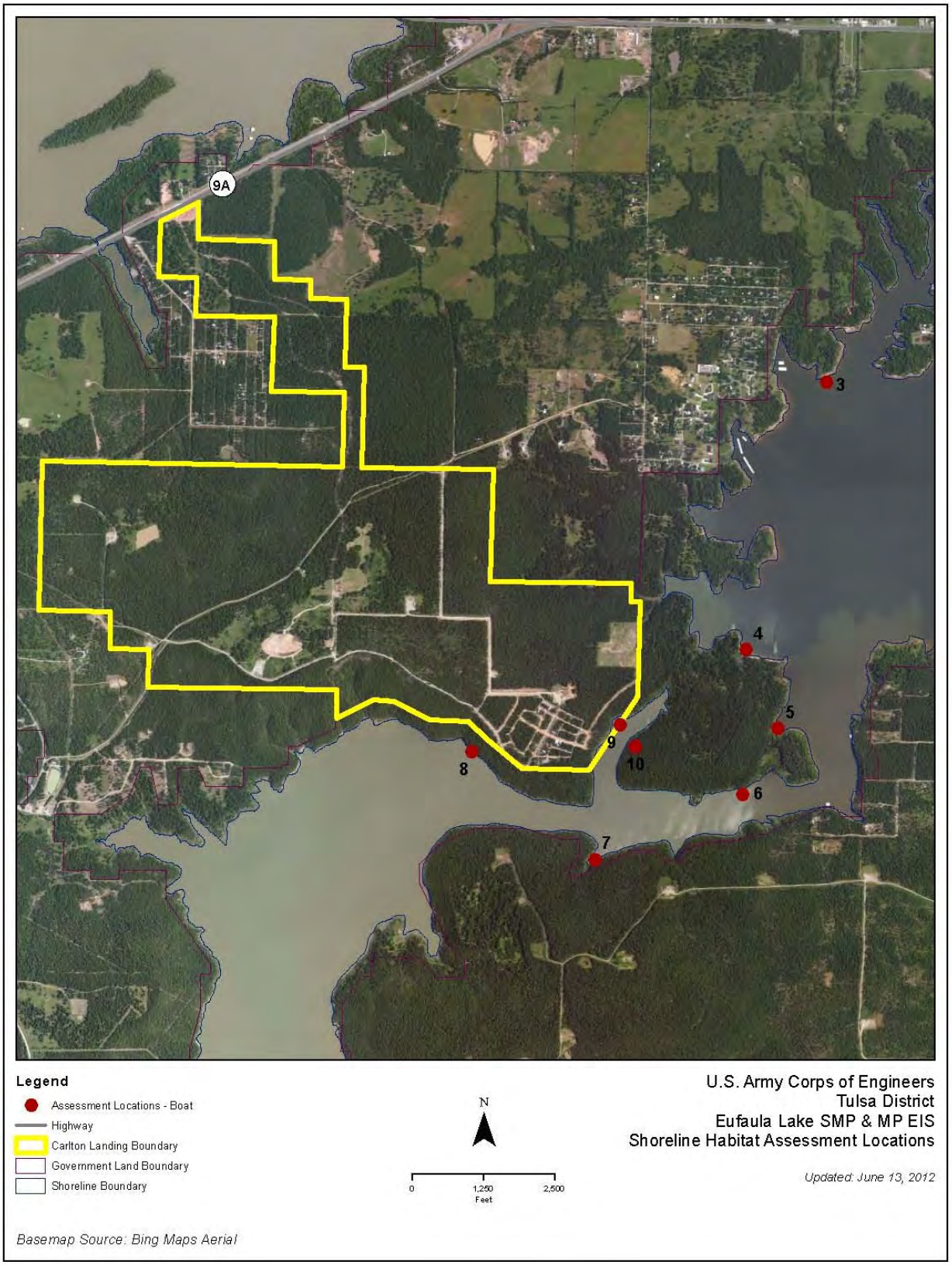



**Figure 3.1-4. Shoreline Habitat Assessment Locations – Carlton Landing Proposed Development**

**Turbidity:** The waters of the Eufaula Lake study area do not attain the Fish and Wildlife Propagation beneficial use in terms of turbidity. Within the study area, water level fluctuations, agricultural uses, and shoreline development may all contribute to excessive sedimentation. The highest turbidity values are located in the shallow waters of the Deep Fork and Gaines Creek arms of the lake. The clearest waters are found in the central portion of the lake. The SHA confirms this observation, as turbidity values for land-based sites were below or slightly above the threshold at sample sites in the central portion of the study area. However, within the central portion of the lake, shoreline development is relatively high in comparison to the rest of the study area. The increased water clarity in this area is due mostly to lake dynamics, which offsets the potential for increased sedimentation due to land disturbance. The central portion of the study area contains the deepest and slowest-moving portions of the lake, which allow sediments to drop out of the water column.

### *General Narrative Criteria*

In addition to the numeric criteria associated with the five specific beneficial uses (see Section 3.3.4.4), the Eufaula Lake study area is subject to the general narrative criteria for water quality applicable to all waterbodies in Oklahoma. Under the general narrative criteria for beneficial uses, solids, water taste and odor, and nutrients are addressed. For solids, the surface waters of Oklahoma are to be essentially free of floating debris, bottom deposits, scum, foam, and other persistent suspended substances from other than natural sources (OWRB 2011). Several assessment sites identified the presence of floating white foam, which may originate from natural sources plus wave action. The presence of foam may indicate that the Eufaula Lake study area's ability to meet the solids general narrative criterion is compromised.

The general narrative criterion for water taste and odor states that any unnatural substances that interfere with the production of a potable water supply, produce abnormalities in the flesh of fish and other edible wildlife, or result in offensive odors in the vicinity of the water are prohibited (OWRB 2011). While several assessment locations contained a natural fishy smell, no unnatural water odors were encountered.

Finally, nutrients from all sources are not to cause excessive growth of periphyton, phytoplankton, or aquatic macrophyte communities, which impairs any existing or designated beneficial use (OWRB 2011). While excessive nutrient inputs were absent in many assessment locations, the presence of green algae in the littoral zone of 18 locations and a blue-green algal bloom at Porum Landing on May 25 through 28, 2012, demonstrate that localized nutrient inputs are an issue. An examination of sites containing algae determined that these locations tend to experience high levels of human activity, including heavy recreational use and adjacent residential development.

### *Shoreline Quality and Lake Condition*

In addition to shoreline water chemistry and physical water properties, the physical habitat, including substrate, riparian zone condition, and littoral zone condition, is critically important to benthic communities, fish, and other aquatic organisms. Using protocols and indices developed for the EPA National Lakes Assessment, the SHA determined values for four integrative measures of lake condition to ascertain shoreline quality within the study area (EPA 2010). The measures include the Lakeshore Disturbance Index, Lakeshore Habitat Index, Shallow Water Habitat Index, and Physical Habitat Complexity Index. The calculation of each of these index values enables comparison between each of the 38 assessed study area sites and between Eufaula Lake and lakes region-wide.

The **Lakeshore Disturbance Index** is based on the presence and proximity of 12 types of human activities or disturbances at each SHA location (EPA 2010). The Eufaula Lake study area values indicate that medium

levels of disturbance exist. The majority of areas with low lake disturbance values consist of shorelines designated as Protected (*e.g.*, Site 19) and low-use public recreation areas (*e.g.*, Site 22). The highest lake disturbance values, indicating areas of moderate human activity, were recorded at high-use public recreation areas (*e.g.*, Site 8) and highly-modified shorelines designated as Limited Development (*e.g.,* Site 13).

The **Lakeshore Habitat Index** quantifies riparian cover and complexity based on visual estimates of vegetation cover and structure (EPA 2010). The Eufaula Lake study area values indicate that low to medium levels of riparian cover and complexity exist. The majority of areas with poor riparian conditions consist of shorelines with little or no riparian canopy cover dominated by grasses or by large expanses of barren ground (*e.g.*, Site 10). These sites are often designated Limited Development (*e.g.*, Site 15) or Public Recreation (*e.g.*, Site 25). Shorelines designated Protected tend to have the highest Lakeshore Habitat Index scores due to the presence of dense forests dominated by woody species (*e.g.*, Site 2) with little or no human activity or land disturbance. However, some of the highest riparian scores were recorded on sites designated Limited Development that contained little adjacent development or human usage (*e.g.*, Site 7).

The **Shallow Water Habitat Index** quantifies littoral cover and complexity and is based on visual estimates of the aerial cover of ten types of littoral cover features including woody snags, inundated brush, inundated live trees, inundated herbaceous vegetation, overhanging vegetation, rock ledges, boulders, and human structures, plus a separate estimation of floating, emergent, and submergent aquatic macrophytes (EPA 2010). The Eufaula Lake study area values indicate littoral cover quality ranges from absent to high. Several boat-based assessment sites, including sites 2 and 8, recorded high values due to the presence of woody snags and boulders, respectively. Land-based assessment locations with high littoral habitat values often included shorelines designated as Protected (*e.g.*, Site 2) or which were low-use public recreation areas (*e.g.*, Site 5). The majority of areas with low Shallow Water Habitat Index values were found at shorelines which have high levels of human activity (*e.g.*, Site 15), are maintained for public use (*e.g.*, Site 30), or contain high boat dock densities (*e.g.*, Site 17).

The **Physical Habitat Complexity Index** evaluates the overall quality of shoreline habitats. The majority of areas with poor overall physical habitat conditions consisted of shorelines with significant human disturbance and which are designated as Limited Development (*e.g.*, Site 15; Site 17; Site 28) or Public Recreation (*e.g.*, Site 25; Site 30). These sites are more likely to have managed shorelines, boat docks, and high levels of human activity. Shorelines designated as Protected tend to have the highest Physical Habitat Complexity Index scores due to the presence of riparian vegetation, aquatic vegetation, and underwater structures (*i.e.*, boulders, woody snags). Sites such as boat-based assessment location 2 provide no access to the shoreline from the upland; thereby, preserving the natural shoreline condition. However, some of the highest physical habitat scores were recorded on sites designated as Limited Development (*e.g.*, Site 7) or Public Recreation (*e.g.*, Site 5). These sites are characterized by wide, vegetated riparian buffers that contain little adjacent development or human usage.

In addition to comparing lake assessment index values between each of the 38 assessed study area sites, the overall mean values for Eufaula Lake can be compared to mean values for lakes region-wide.

- The Lakeshore Disturbance Index for Eufaula Lake falls under the medium disturbance condition criterion, consistent with observations that the Eufaula Lake study area is less affected by development and agricultural operations than many plains lakes, but more affected by human

disturbance than eastern highland lakes, many of which are heavily forested and located in remote areas.

- While many of the shorelines within the Eufaula Lake study area are subjected to human disturbances, the Lakeshore Habitat Index values suggest that riparian conditions are better at Eufaula Lake than in approximately half of lakes assessed regionally.
- The Shallow Water Habitat Index value for the Eufaula Lake study area is greater than the mean values for lakes in the plains, lowlands and eastern highlands regions. Therefore, the littoral habitat conditions are of a higher quality than lakes region-wide and enable Eufaula Lake and its tributaries to support diverse aquatic communities and a world-class fisheries.
- The Physical Habitat Complexity Index values recorded for Eufaula Lake suggest that habitat conditions are of moderate quality. The mean physical habitat values for the study area are slightly higher than those recorded for other lakes within the plains, lowlands, and eastern highlands regions. Therefore, Eufaula Lake exhibits shoreline littoral and riparian cover and complexity of a quality that is slightly higher than those of lakes region-wide.

### 3.1.6 Terrestrial and Aquatic Habitat Mapping

A base habitat map of the Eufaula Lake study area was developed based on maps, aerial photographs, reports, and digital resource data. Original digital data was obtained from the 1992 Oklahoma Gap Analysis Project (GAP) land cover dataset. The habitat map indicates the general locations of the major terrestrial and aquatic habitat types discussed above. Once the habitat map was completed, the habitats were field verified in April 2012 to ensure map accuracy. However, due to the size of the study area, the habitat map is shown on six separate terrestrial and aquatic habitat map sheets, which can be found in Appendix B.

The total acreage for each major terrestrial and aquatic habitat type were calculated to provide an overall characterization of the Eufaula Lake study area and allow for comparison between habitat communities (**Table 3.1-5**).

According to acreage totals derived from the final habitat map, forests and woodlands dominate the terrestrial component of the Eufaula Lake shoreline. The most prevalent terrestrial habitat is the crosstimbers followed by bottomland hardwood forest. Combined, these two habitats comprise approximately 45 percent of the total natural terrestrial habitat present. While savanna habitats, including oak savanna and cedar savanna, occupy the third-largest area among terrestrial habitats, open habitats tend to make up a relatively small percentage of the total shoreline. Combined, savanna and prairie habitats occupy approximately 26 percent of the total natural terrestrial habitat present. Prairies occupy the smallest total acreage of all natural terrestrial habitat types, which is consistent with the historical, region-wide trend of prairie loss and degradation.

**Table 3.1-5. Habitat Communities within the Eufaula Lake Study Area**

| Habitat Community | Acres within Study Area |
|---|---|
| **Terrestrial Habitats** | |
| Crosstimbers | 13,209.86 |
| Oak-Hickory Forest | 10,734.75 |
| Oak-Pine Forest | 5,704.34 |
| Bottomland Hardwood Forest* | 12,282.98 |
| Savanna | 10,786.48 |
| Prairie | 4,238.24 |
| **Aquatic Habitats** | |
| Open Water | 94,853.42 |
| Emergent Wetland | 3,208.90 |
| Scrub-Shrub Wetland | 15,371.02 |
| **Modified Habitats** | |
| Crop – Warm Season | 506.90 |
| Pasture | 6,150.78 |
| Residential/Industrial | 1,176.50 |

**Palustrine forested wetland is included within the bottomland hardwood forest habitat community*

Aquatic habitats within the Eufaula Lake study area are dominated by the open waters of Eufaula Lake and its large tributaries. Open water habitats occupy more area than all other habitats combined. This is to be expected considering the vast majority of the study area (USACE-owned lands) consists of the lake proper. Among wetland habitats, scrub-shrub wetlands are the most prevalent, as would be typical of steep-sloped shorelines with wide water-level fluctuations. These conditions often inundate emergent herbaceous species and prevent the establishment of large trees. As such, emergent wetlands are relatively rare within the Eufaula Lake study area and occupy the smallest area of all natural habitats.

While not depicted on the habitat maps, which characterize natural habitats, the Eufaula Lake study area shoreline contains habitats extensively modified and maintained by human activity. While these modified habitats, including cropland, pasture, and residential/industrial, occupy only 12 percent of total terrestrial habitat, the characterization of the Eufaula Lake shoreline is incomplete without their inclusion. Of the modified habitats, croplands make up a very small percentage with pastures occupying roughly 79 percent. In comparison, residential/industrial land uses occupy only 15 percent of developed lands. These totals support the conclusion that the Eufaula Lake study area shoreline is relatively undeveloped and the majority remains in its natural condition. Overall, these acreage numbers describe a shoreline that is mostly forested with significant areas of scrub-shrub wetland and limited quantities of human-modified habitats.

## 3.1.7 Invasive Species - Vegetation

Invasive species are widely recognized as one of the greatest threats to global biodiversity. In the United States alone, the cost of invasive species management exceeds $120 billion annually (Dorcas *et al.* 2011). As such, Oklahoma's State Wildlife Action Plan identifies invasive species as one of five priority issues that threaten conservation of the state's wildlife resources (Foster *et al.* 2009).

The Arkansas River basin has been identified as a major pathway for the introduction of invasive aquatic nuisance species (Foster *et al.* 2009). The following species are considered of special concern in Oklahoma: alligatorweed (*Alternanthera philoxeroides*), Eurasian watermilfoil (*Myriophyllum spicatum*), hydrilla (*Hydrilla verticillata*), purple loosestrife (*Lythrum salicaria*), salvinia (*Salvinia* sp.), and water hyacinth (*Eichornia crassipes*) (Foster *et al.* 2009), with hydrilla considered a high priority species throughout the state. Two invasive aquatic plants species have been documented within the study area. Habitat transects in wetland areas determined that salvinia is present within the Eufaula Lake study area. In addition, while not observed during 2012 field activities, previous studies indicate that water hyacinth has been documented in Eufaula Lake (Foster *et al.* 2009).

In addition to aquatic invasive plants, several species of terrestrial invasive species threaten the prairies, savannas, and forests of Oklahoma. The field work conducted in spring of 2012 identified several invasive species including Japanese honeysuckle (*Lonicera japonica*), Chinese lespedeza (*Lespedeza cuneata*), and Japanese climbing fern (*Lygodium japonicum*). Chinese lespedeza was dominant in both sampled savanna habitats and Japanese climbing fern was a dominant in the herbaceous layer in oak-pine forest. All three of these transects took place in undeveloped portions of public recreation areas with little human activity; therefore, the total number of terrestrial invasive species within the study area is likely underrepresented. Additional species such as tall fescue, Chinese privet, and autumn olive have been observed nearby and are known invaders of the vegetation communities present within the study area (ODWC 2005).

While not an exotic, the rapid westward spread of eastern red-cedar into previously uninhabited ecosystems has raised concerns with habitat managers in the state. This encroachment is evident within the Eufaula Lake study area as red-cedar was observed within crosstimbers, oak-hickory forest, oak-pine forest, and prairie habitat transects, with it being dominant in oak-pine and crosstimbers habitats.

### 3.1.8 Rare, Unique, and Imperiled Vegetation

There are no threatened or endangered plant species known to occur or likely to occur within the Eufaula Lake study area; however, the Oklahoma Natural Heritage Inventory (ONHI) has identified several plant species and plant associations of state conservation concern (ONHI 2012). Several of these plant communities are relatively common within the Eufaula Lake study area but may be uncommon regionally. These communities, including pin oak-pecan-deciduous holly and shortleaf pine-white oak-black oak forest associations, were documented by the habitat transects and are discussed within the bottomland hardwood forest and oak-pine forest sections, respectively. This also applies to the listed wetland (*e.g.*, cattail-herbaceous association) and prairie shrubland (*e.g.*, big bluestem-little bluestem-Indian grass herbaceous association) communities. **Table 3.1-6** includes those plant species confirmed as located within or adjacent to the Eufaula Lake study area that are ranked as imperiled or critically imperiled in Oklahoma by ONHI.

All six of the rare and imperiled plant species have been given an OHNI rarity ranking of state critically imperiled. This designation means that these species are critically imperiled in Oklahoma because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because some factor of their biology makes them especially vulnerable to extinction (ONHI 2012). While none of the six species were observed during any of the spring 2012 field activities, and their presence is unlikely, all have the potential to be within the Eufaula Lake study area. A discussion on current status and natural history of each is included in Appendix B.

**Table 3.1-6. Plant Species of State Conservation Concern Documented to Occur within or Adjacent to the Eufaula Lake Study Area**

| Common Name | Scientific Name | ONHI Rarity Ranking* |
|---|---|---|
| Blackfoot Quillwort | *Isoetes melanopoda* | State Critically Imperiled |
| Bradley's Spleenwort | *Asplenium bradleyi* | State Critically Imperiled |
| Indian-Pipe | *Monotropa uniflora* | State Critically Imperiled |
| Kentucky Wisteria | *Wisteria macrostachya* | State Critically Imperiled |
| Lobed Spleenwort | *Asplenium pinnatifidum* | State Critically Imperiled |
| Small-Headed Pipewort | *Eriocaulon koernickianum* | State Critically Imperiled |

**Obtained from ONHI occurrence database (2012)*

## 3.1.9 Vegetation Change Over Time

Vegetation cover types on USACE-owned lands and on adjacent private lands within 0.5 mile of the government land boundary were characterized using 1999, 2006, and 2011 multispectral satellite imagery. The purpose of the vegetation change analysis was to evaluate changes in vegetation and land features at Eufaula Lake over the past decade since the last SMP revision. Specific vegetation classes were established based on the spectral signatures of the imagery throughout the study area. The methodology for this analysis is described in Appendix C.

**Table 3.1-7** compares the total area of public and private lands around the lake within the study area and **Table 3.1-8** focuses only on government lands adjacent to shorelines designated as Limited Development and their adjacent private lands within 0.5 mile. The hypothesis is that Limited Development shorelines would be more attractive to residential development because of the ability for lakeshore landowners to install private docks while private lands adjacent to other shoreline designations would be less attractive to residential development. The analysis also evaluates the idea that the predominant agent of vegetation change over the past decade may have been residential development.

Between 1999 and 2011, the residential/built environment land classification changed the most during the second half of the decade regardless of whether it occurs on government lands or on private lands with the greatest degree of change observed on lands adjacent to Limited Development shorelines. The bare land category changed the most during the first half of the past decade, with the biggest changes seen on private lands. Adjacent shoreline zoning does not appear to be a significant factor in the changes in this category. Often bare land is a precursor to residential development, so it would be logical that the bigger changes would precede changes in urban classifications; however, in the Eufaula Lake area, bare land may also be a result of oil and gas exploration in areas that are not otherwise converting to residential development.

Forest land declined across all categories, but it declined at nearly twice the rate on private lands over government lands. On private lands, the amount in pasture/grazing vegetation categories stayed about the same across the decade; but mowed grass increased without respect to adjacent shoreline zoning. On government lands adjacent to Limited Development shorelines, mowed grass increased while pasture grass declined. **Table 3.1-9** summarizes the percent change observed between 1999 and 2011 for each vegetation cover type and compares the percent change between the entire study area and only those areas adjacent to Limited Development allocated shorelines.

**Table 3.1-7. Vegetation Change over Time for Entire Study Area**

| Vegetation Cover Type | USACE-owned Land (percent) | | | Adjacent Private Land[2] (percent) | | |
|---|---|---|---|---|---|---|
| | 1999 | 2006 | 2011 | 1999 | 2006 | 2011 |
| Bare Land/Fallow Land | 6.4 | 11.4 | 12.6 | 4.0 | 19.2 | 17.9 |
| Residential/Built | 0.7 | 0.5 | 1.4 | 0.4 | 0.7 | 1.5 |
| Emergent Wetlands | 0.6 | 1.2 | 3.4 | 0.3 | 0.7 | 1.3 |
| Bottom Land Forest | 27.1 | 26.1 | 23.4 | 12.5 | 11.0 | 10.7 |
| Mowed Grass | 0.06 | 0.8 | 2.1 | 0.3 | 1.5 | 2.0 |
| Pasture/Grazing | 10.2 | 7.9 | 9.9 | 33.5 | 25.8 | 30.2 |
| Forest | 55.0 | 52.2 | 47.0 | 49.1 | 41.2 | 36.4 |
| Cloud Cover[1] | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 |

*1- Cloud cover was only present in a small portion of the 2011 imagery.*

*2- Includes private lands within 0.5 miles of the government land boundary*

**Table 3.1-8. Vegetation Change Associated with Limited Development Shorelines**

| Vegetation Cover Type | USACE Land Adjacent to Limited Development Shorelines (percent) | | | Private Land Adjacent[2] to Limited Development Shorelines (percent) | | |
|---|---|---|---|---|---|---|
| | 1999 | 2006 | 2011 | 1999 | 2006 | 2011 |
| Bare Land/Fallow Land | 7.7 | 13.3 | 16.4 | 4.2 | 18.8 | 17.6 |
| Residential/Built | 1.2 | 1.1 | 2.7 | 0.6 | 1.1 | 2.3 |
| Emergent Wetlands | 0.7 | 0.4 | 2.9 | 0.01 | 0.1 | 0.2 |
| Bottom Land Forest | 14.4 | 13.9 | 9.8 | 2.2 | 2.0 | 1.9 |
| Mowed Grass | 0.1 | 0.3 | 1.7 | 0.5 | 1.1 | 2.1 |
| Pasture/Grazing | 10.2 | 6.6 | 6.8 | 34.0 | 26.6 | 31.4 |
| Forest | 65.7 | 64.4 | 59.7 | 58.5 | 50.3 | 44.4 |
| Cloud Cover[1] | 0 | 0 | 0.03 | 0 | 0 | 0.1 |

*1- Cloud cover was only present in a small portion of the 2011 imagery.*

*2- Includes private lands within 0.5 miles of the government land boundary*

**Table 3.1-9. Percent Change in Vegetation Cover Types from 1999 to 2011**

| Vegetation Cover Type | Entire Study Area (percent change) | | Adjacent to Limited Development Shoreline Only (percent change) | |
|---|---|---|---|---|
| | USACE – owned Land | Adjacent Private Land[2] | USACE – owned Land | Adjacent Private Land[2] O |
| Bare Land/Fallow Land | 96 | 348 | 113 | 319 |
| Residential/Built | 100 | 275 | 125 | 283 |
| Emergent Wetlands | 467 | 333 | 314 | 1900 |
| Bottom Land Forest | -14 | -14 | -32 | -14 |
| Mowed Grass | 3400 | 567 | 1600 | 320 |
| Pasture/Grazing | -3 | -10 | -34 | -8 |
| Forest | -14 | -26 | -9 | -24 |

*1- Cloud cover was only present in a small portion of the 2011 imagery.*

*2- Includes private lands within 0.5 miles of the government land boundary*

### *Vegetation Change Associated with Residential Developments*

Fourteen subdivision areas that have been developed over the last decade were selected and the vegetation classes for each image year were measured on both the private lands and the USACE-owned lake front at each selected area (**Table 3.1-10**). This sample looks closely at how the vegetation/land cover classes change over time in areas where development pressure has been high. At the start of the period, in 1999, there was a much higher percentage of area in pasture/grazing on private lands than on USACE-owned lands. USACE-owned lands had a higher percentage of forest cover than was found on adjacent private lands.

Based on this sample of residential developments that have been constructed over the past decade, it appears that the biggest impact on vegetation on government lands is to grasslands. The "pasture/grazing" vegetation class would include any type of non-irrigated, non-mowed grassland. On government shorelines these areas are more likely to be grasslands rather than active pastures. Grasslands on shorelines adjacent to residential developments were converted to bare earth or mowed grass at a much higher rate than similar grassland vegetation classes on adjacent private lands.

Conversely, USACE-managed shorelines are much more protective of forest cover than adjacent private ownership where residential developments are constructed. Forest cover on government lands decreased less than 10 percent within these sample areas where development pressure has been high, while on private lands, forest cover decreased by almost 40 percent. It should also be recognized that some effects on vegetation cover may take longer to become apparent. This analysis focused on residential developments that have been constructed only over the past decade. For example, bare earth may convert back to grass cover or forest cover may continue to decline with more time.

**Table 3.1-10. Vegetation Change Associated with Recent Residential Development**

| | USACE-owned Land (percent) | | | Adjacent Private Land[1] (percent) | | |
|---|---|---|---|---|---|---|
| **Vegetation Cover Type** | **1999** | **2006** | **2011** | **1999** | **2006** | **2011** |
| Bare Earth/Fallow land | 7.7 | 13.8 | 17.4 | 5.6 | 23.4 | 30.1 |
| Residential/Built | 0.7 | 0.7 | 1.6 | 1.1 | 2.0 | 3.9 |
| Emergent Wetlands | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bottom Land Forest | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 |
| Mowed Grass | 0.03 | 0.2 | 1.3 | 1.0 | 2.2 | 4.7 |
| Pasture/Grazing | 10.9 | 6.4 | 5.6 | 28.0 | 23.0 | 21.0 |
| Forest | 80.7 | 78.8 | 74.0 | 64.4 | 49.4 | 40.2 |

*1- Includes private lands within the selected areas as shown in Appendix C.*

### *Vegetation Change Compared by Adjacent Residential Density*

Five representative areas around the lake were selected where residential developments of medium and high densities were located in close proximity to each other and to areas of low or no residential development on the lake shore. The locations were also selected for similarity in apparent dock suitability and approximate size. All of the high and medium density developments included existing docks. Some of the low density developments also have constructed docks, albeit in lower numbers than their more dense neighbors. These locations were used to evaluate the effect of adjacent residential density on vegetation change.

The trends in vegetation change over time are similar regardless of residential density, but the magnitude of the change is greater with increasing residential density (**Tables 3.1-11**, **3.1-12**, and **3.1-13**). For example, forest cover on USACE-owned lands adjacent to residential development declined under all scenarios, but it only declined by approximately 12 percent adjacent to low density developments while forest cover declined almost 23 percent when adjacent to high density developments. While these numbers are higher than reported in the previous sections, this analysis did not consider the age of the development and there may be continued loss of forest cover over time that was not detected in the analysis of recent developments.

Similar to the results for all lands, grasslands experienced the greatest amount of change, declining up to 77 percent on government lands adjacent to high density development when compared across the decade. Private ownership appeared to be much less protective of forest cover compared to USACE-owned lands, but did not result in as much change in grasslands.

**Table 3.1-11. Vegetation Change Associated with Low Density Development**

| Vegetation Cover Type | USACE-owned Land (percent) | | | Adjacent Private Land[2] (percent) | | |
|---|---|---|---|---|---|---|
| | 1999 | 2006 | 2011 | 1999 | 2006 | 2011 |
| Bare Earth/Fallow land | 4.3 | 10.2 | 12.5 | 2.1 | 13.2 | 14.2 |
| Residential/Built | 0.2 | 0.3 | 0.7 | 0.3 | 0.6 | 1.2 |
| Emergent Wetlands | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bottom Land Forest | 0.0 | 0.0 | 0.0 | 0.02 | 0.02 | 0.02 |
| Mowed Grass | 0.07 | 0.07 | 0.7 | 0.2 | 0.3 | 1.1 |
| Pasture/Grazing | 10.9 | 6.8 | 8.3 | 23.3 | 21.0 | 23.7 |
| Forest | 84.5 | 82.5 | 74.0 | 74.0 | 64.9 | 53.6 |
| Cloud Cover[1] | N/A | NA | 3.8 | N/A | N/A | 6.3 |

*1- Cloud cover was only present in a small portion of the 2011 imagery.*
*2- Includes private lands within the selected areas as shown in Appendix C.*

**Table 3.1-12. Vegetation Change Associated with Medium Density Development**

| Vegetation Cover Type | USACE-owned Land (percent) | | | Adjacent Private Land[2] (percent) | | |
|---|---|---|---|---|---|---|
| | 1999 | 2006 | 2011 | 1999 | 2006 | 2011 |
| Bare Earth/Fallow land | 6.3 | 17.2 | 18.0 | 7.0 | 27.3 | 33.7 |
| Residential/Built | 0.4 | 0.8 | 1.4 | 1.0 | 4.3 | 7.3 |
| Emergent Wetlands | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bottom Land Forest | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Mowed Grass | 0.1 | 0.2 | 4.1 | 1.9 | 4.9 | 7.5 |
| Pasture/Grazing | 13.1 | 3.6 | 2.6 | 46.6 | 33.5 | 28.5 |
| Forest | 80.2 | 78.2 | 74.0 | 43.4 | 30.1 | 22.9 |
| Cloud Cover[1] | N/A | N/A | 0.0 | N/A | N/A | 0.0 |

*1- Cloud cover was only present in a small portion of the 2011 imagery.*
*2- Includes private lands within the selected areas as shown in Appendix C.*

**Table 3.1-13. Vegetation Change Associated with High Density Development**

| Vegetation Cover Type | USACE-owned Land (percent) | | | Adjacent Private Land[2] (percent) | | |
|---|---|---|---|---|---|---|
| | 1999 | 2006 | 2011 | 1999 | 2006 | 2011 |
| Bare Earth/Fallow land | 8.8 | 22.8 | 22.9 | 12.8 | 37.6 | 44.6 |
| Residential/Built | 3.7 | 4.5 | 7.9 | 5.3 | 10.7 | 14.2 |
| Emergent Wetlands | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bottom Land Forest | 0.0 | 0.0 | 0.0 | 0.02 | 0.02 | 0.02 |
| Mowed Grass | 0.7 | 2.5 | 13.5 | 3.0 | 7.0 | 12.1 |
| Pasture/Grazing | 22.4 | 10.1 | 5.2 | 55.5 | 28.0 | 17.0 |
| Forest | 64.4 | 60.1 | 49.8 | 23.3 | 16.8 | 12.0 |
| Cloud Cover[1] | N/A | N/A | 0.6 | N/A | N/A | 0.002 |

*1- Cloud cover was only present in a small portion of the 2011 imagery.*
*2- Includes private lands within the selected areas as shown in Appendix C.*

**Table 3.1-14** summarizes the percent change observed between 1999 and 2011 for each vegetation cover type and compares the percent change associated with the three development intensity levels.

**Table 3.1-14. Percent Change in Vegetation Cover Types Associated with Residential Development from 1999 to 2011**

| Vegetation Cover Type | USACE-Owned Land[1] (percent change) | | | Adjacent Private Land[2] (percent change) | | |
|---|---|---|---|---|---|---|
| | Low Density | Medium Density | High Density | Low Density | Medium Density | High Density |
| Bare Land/Fallow Land | 190 | 186 | 160 | 576 | 381 | 248 |
| Residential/Built | 250 | 250 | 114 | 300 | 630 | 168 |
| Emergent Wetlands | 0 | 0 | 0 | 0 | 0 | 0 |
| Bottom Land Forest | 0 | 0 | 0 | 0 | 0 | 0 |
| Mowed Grass | 900 | 4000 | 1829 | 450 | 295 | 303 |
| Pasture/Grazing | -240 | -80 | -77 | 2 | -39 | -69 |
| Forest | -12 | -8 | -23 | -28 | -47 | -48 |

*1- Includes USACE-owned lands between the lakeshore and private lands developed at the respective densities.*
*2- Includes private lands within the selected areas as shown in Appendix C.*

# 3.2 Fish and Wildlife

## 3.2.1 Area of Analysis (Fish and Wildlife)

The study area boundaries for the fish and wildlife analysis are the USACE-owned lands around Eufaula Lake, which include the lake and a narrow band of uplands of varying widths around the lake above elevation 585 feet above mean sea level. General descriptions of habitats may refer to broader areas beyond the study area.

### 3.2.2 Regulatory Setting (Fish and Wildlife)

Section 1502.25 of the NEPA regulations require that EISs be prepared concurrently and integrated with environmental analyses and related surveys and studies required by other federal statutes (40CFR 1502.25). With respect to fish and wildlife, those statutes include those mentioned under Section 3.1.2, as well as the Endangered Species Act of 1973, the Migratory Bird Treaty Act, the Fish and Wildlife Coordination Act, the Bald and Golden Eagle Protection Act, and the North American Waterfowl Management Plan. These regulations are described in Section 1.6.

### 3.2.3 Data Collection and Analysis Methodology

In preparation for data collection, existing relevant documents were reviewed that pertain to the ecology of Eufaula Lake and associated habitats, mammals, birds, reptiles, amphibians, fish, and federal threatened and endangered species, as well as other state listed species that may be of concern within the study area.

Pedestrian surveys to evaluate the natural resources were done in conjunction with field verification of habitats described in Section 3.1. In support of the inventory of natural resources, the field verification included documenting all observations of listed species and their habitats. Specific sampling methods for listed species were implemented pursuant to USFWS guidelines.

A limited faunal survey was conducted on two days within the Eufaula Lake EIS study area including the proposed Carlton Landing development shoreline areas. Access to survey points was obtained by foot, vehicle, and boat, as necessary. Species were identified through both visual observation and identification of faunal indicators including tracks, nests, droppings, calls, and vocalizations. Observation sites were selected to capture a representative sample of the aquatic and terrestrial habitats in the Eufaula Lake EIS study area.

A survey for the American burying beetle was conducted on the shoreline areas of the proposed Carlton Landing development. The beetle surveys were performed by a qualified biologist approved by USFWS and followed the protocols approved by USFWS (USFWS 2011b).

### 3.2.4 Protected Species

Within the study area, there are six animal species listed by the USFWS as federally endangered, threatened, or candidate for listing. There are two additional species that are federally protected or are a species of federal concern. Oklahoma lists ten animal species as state imperiled, critically imperiled, or of state conservation concern that have the potential to occur within the study area (Howery 2011a; Howery 2011b; Stubbs 2012). There are no plant species listed by either Oklahoma or USFWS potentially in the study area. These species are listed in **Table 3.2-1**.

Through coordination with state and federal agencies, it was determined that only the American burying beetle (*Nicrophorus americanus*), interior least tern (*Sterna antillarum*), bald eagle (*Haliaeetus leucocephalus*), and Arkansas River shiner (*Notropis girardi*) have the potential to occur in habitats within the Eufaula Lake study area and to be affected by the proposed alternatives (Howery 2011a; Howery 2011b). These listed species are described in more detail below and potential impacts under each alternative are described in Chapter 4. Although some of the other listed species may be occasionally found in the study area, only those species that may be potentially impacted by the alternatives under consideration are evaluated.

The Oklahoma Natural Heritage Inventory (ONHI) maintains a statewide database of all federally and state listed species and species of concern. This database was consulted to provide known occurrence locations of animal species within the Eufaula Lake study area. A total of 41 occurrences of 11 listed species and species of concern were located within or immediately adjacent to the study area. A summary of each of these species occurs within their respective sub-section in this chapter.

Federally listed species are discussed below. Other state protected species are discussed under the following sections that deal with each family of animals (*e.g.* state protected fish are discussed under Fish, Section 3.2.5; state protected reptiles are discussed under Reptiles, Section 3.2.6, etc.)

**Table 3.2-1. Federally-listed Species and Oklahoma State Species of Concern Potentially Found within the Eufaula Lake Study Area**

| Common Name | Scientific Name | Regulatory Status* |
|---|---|---|
| Alligator snapping turtle** | *Macrochelys temminckii* | State Imperiled |
| American burying beetle | *Nicrophorus americanus* | Federal Endangered |
| Arkansas River shiner | *Notropis girardi* | Federal Threatened |
| Bachman's sparrow | *Aimophila aestivalis* | State Imperiled |
| Bald eagle** | *Haliaeetus leucocephalus* | Federally Protected; State Critically Imperiled |
| Bell's vireo | *Vireo bellii* | State Conservation Concern |
| Interior least tern | *Sterna antillarum* | Federal Endangered |
| Long-tailed weasel | *Mustela frenata* | State Critically Imperiled |
| Mississippi map turtle | *Graptemys kohnii* | State Imperiled |
| Paddlefish | *Polyodon spathula* | State Critically Imperiled |
| Peregrine Falcon | *Falco peregrinus* | Federal Conservation Concern |
| Piping plover | *Charadrius melodus* | Federal Threatened |
| Prairie mole cricket | *Gryllotalpa major* | State Imperiled |
| Prothonotary warbler | *Protonotaria critea* | State Conservation Concern |
| River otter | *Lontra canadensis* | State Imperiled |
| Sprague's pipit | *Anthus spragueii* | Federal Candidate Species (ESA) |
| Whooping crane | *Grus americana* | Federal Endangered |

**Obtained from ODWC website (2012), USFWS and ODWC email correspondence (2012), and ONHI occurrence database (2012)*

***Observed during Spring 2012 Eufaula Lake surveys (includes visual ID, sign, or tracks)*

### 3.2.4.1 Federally-listed Fish Species

#### *Arkansas River Shiner*

The Arkansas River shiner (*Notropis girardi*) is a freshwater minnow that inhabits the main channels of wide, shallow, sand-bottomed rivers and larger streams of the Arkansas River basin.

On November 23, 1998, the Arkansas River shiner was listed as a threatened species under the ESA, and USFWS designated critical habitat for this species throughout its range on April 4, 2001 (USFWS 1998, USFWS 2001). Although critical habitat has not been designated within the Eufaula Lake study area, there is a critical habitat unit on the Canadian River that extends downstream to the Indian Nation Turnpike Bridge northwest of McAlester in Pittsburg County, Oklahoma. This is within 15 river miles of the

confluence of the Canadian River and Eufaula Lake. Therefore, any revisions to the Eufaula Lake SMP or to the MP could potentially affect the Arkansas River shiner.

Within the last 35 years, the Arkansas River shiner has lost over 80 percent of its historical habitat, due largely to human-caused alteration of natural stream-flow patterns, drought, and introduced fishes. Within the Eufaula Lake study area, it is believed to be extirpated in Haskell, Muskogee, and Okmulgee Counties, with extant populations located in McIntosh and Pittsburg Counties (NatureServe 2011a). No historical or current evidence exists of populations within Latimer County.

Eufaula Lake represents the downstream extent of the current range of the Arkansas River shiner in the Canadian River. Within the study area, ONHI occurrence records indicate this species is most often found along the old channels of the North Canadian and Canadian Rivers (ONHI 2012). Current threats include habitat destruction, water quality degradation, reduced stream flow due to the diversion of surface water, groundwater pumping, and construction of impoundments. Competition, accidental capture, drought, and other natural causes may also be contributing to the decline in populations (Bestgen *et al*. 1989).

### 3.2.4.2 Federally-listed Mammals

Two mammalian species, the Indiana bat (*Myotis sodalis*) and the gray bat (*Myotis grisescens*), are federally-listed as endangered, and the Ozark big-eared bat (*Corynorhinus townsendii ingens*) is a federally-listed endangered subspecies. These bats have declined as a result of disturbances to cave habitats, loss of bottomland forests, pesticide use, and disease. The three listed species of bats and are rare in the Eufaula Lake study area and USFWS has determined that a detailed discussion of these species and of potential effects is unwarranted (Stubbs 2012).

### 3.2.4.3 Federally-listed Birds

Coordination with USFWS identified the federally-listed species that could be affected by changes in the SMP and MP. In accordance with discussions with USFWS, this EIS addresses the existing condition of the bald eagle and interior least tern within the Eufaula Lake study area (Stubbs 2012). The bald eagle is protected at the federal and state levels, but is not listed as threatened or endangered. Therefore, the bald eagle is discussed in Section 3.2.9.1. All other listed bird species and species of concern are migrants that are rarely encountered within the study area and are addressed briefly within the larger context of migratory bird protection (Stubbs 2012) (Section 3.2.9.2). The current status and life history requirements of species other than bald eagle and least tern and reasons why potential significant impacts are unlikely are discussed in Appendix B.

#### *Interior Least Tern*

On May 28, 1985, the interior population of the least tern was listed as an endangered species under the ESA. No critical habitat rules have been published for the interior least tern. In Oklahoma, least terns may be found on portions of the Arkansas, Cimarron, Canadian, and Red Rivers. Although critical habitat has not been designated within the Eufaula Lake study area, interior least terns have been documented using tributaries of Eufaula Lake in Pittsburg, Muskogee, Haskell, and McIntosh Counties (ODWC 2011b). Terns may also use shallow areas along the Eufaula Lake shoreline to feed.

Terns live along large rivers and may sometimes be found hunting fish in shallow wetlands and along the margins of ponds and lakes. In Oklahoma, the interior least tern can be found during the late spring and summer breeding season (mid-May through late August). The peak of the nesting season occurs from mid-

June to mid-July (Downing 1980). They require bare sand and gravel for nesting and typically nest in small colonies consisting of two to 20 pairs along large rivers on sand bars and scoured bends (Burger 1984).

The interior least tern is migratory and historically bred along the Mississippi, Missouri, Red, and Rio Grande River systems. Widespread loss and alteration of its riverine nesting habitat has eliminated the interior least tern from many locations within its former breeding range in the interior United States. The construction of dams, large reservoirs, and river channelization has permanently submerged some nesting areas and has altered the seasonal flooding dynamics that are required to build and sustain the sandbars that terns need for nesting (Leslie *et al.* 2000). In comparison to warmer, shallower riverine habitats, reservoirs often increase the amount of deep, cold water, which decreases the availability of preferred small forage fish (USFWS 2011b). Additionally, recreational vehicle use and other disturbances around nesting colonies have reduced nesting success and reproduction (ODWC 2011b).

However, with protection under the law and restorative efforts the population has begun to rebound. At Sam's Point on Eufaula Lake, a 1992 survey found 25 to 30 adult least terns. Annual surveys on the Canadian River from 1987 to 1992 from the Burlington Northern Railroad to the river mouth found an average of 55 adult birds (Hill 1993). More recently, USFWS has indicated terns forage at Eufaula Lake and nest on the Canadian River upstream and downstream of the lake (Stubbs 2012). The OHNI occurrence database also records three least tern observations from along the Canadian River (OHNI 2012). Habitat and faunal surveys conducted in the spring of 2012 by CDM Smith biologists failed to document the presence of least terns, but did record several, undisturbed sand beaches that could serve as potential nest sites including the north shore of Roundtree Landing (see Appendix B).

USFWS continues to work with state agencies and conservation organizations to ensure the long-term viability of a sustainable least tern population in Oklahoma. This has resulted in the development of a memorandum of understanding between the Nature Conservancy, USACE, ODWC, USFWS, Tulsa Audubon Society, City of Tulsa River Parks Authority, and riverbed landowners for protection and management of essential habitat within the Arkansas River basin (USFWS 1990).

### 3.2.4.4 Federally-listed Invertebrates

#### *American Burying Beetle*

The American burying beetle, formerly distributed throughout temperate eastern North America, now persists in only low-density, widespread, and disjunct populations. In 1983, based on the drastic decline and extirpation of the species over nearly its entire range, the American burying beetle was included as an endangered species in the Invertebrate Red Book published by the International Union for the Conservation of Nature (IUCN) (Ratcliffe 1997). The species was granted federal and state endangered species status in July 1989 (*Federal Register* Vol. 54 (133): 29652-5) (USFWS 1991).

The American burying beetle is the largest member of the carrion beetle family Silphidae and feeds on the carcasses of dead mammals, birds, and reptiles (ODWC 2011c). Carrion beetles are an important component of a vast host of scavengers that are responsible for recycling nutrients from decaying organic matter. American burying beetles reproduce only once or twice a year in the spring and summer (early May through August) (ODWC 1995).

Specific habitat requirements for the American burying beetle are unknown (Ratcliffe 1997). Considering the broad geographic range once inhabited by the species, it is unlikely that a specific soil or vegetation type was a limiting factor. Currently, the American burying beetle is largely restricted to areas undisturbed

by human influence. This includes a wide range of habitat types including tall-grass prairie, open woodlands, and forests (ODWC 2011c).

Most agree that the population decline of the American burying beetle is most likely the result of the interplay between several complex factors that may include (1) artificial lighting that decreases populations of nocturnal insects, (2) changing sources of carrion because of habitat alteration and extinctions, (3) isolation of preferred habitat due to land use changes, (4) increased edge effects that benefit more predators and competitors for carrion, and (5) the possibility of reduced reproductive ability due to genetic impairments caused by small population sizes (Ratcliffe 1997).

Species specific surveys were conducted in May 2012 to determine the presence of American burying beetles within the Eufaula Lake study area. Selected survey sites include Carlton Landing and the shoreline immediately west along the Longtown Creek. All surveys followed procedures outlined in the USFWS Rangewide Survey Guidance, and survey personnel who hold a USFWS Section 10 Recovery Permit for the handling of the American burying beetle conducted the field work (USFWS 2011a, USFWS 2009).

The field survey confirmed the presence of American burying beetle along the shorelines at Carlton Landing; and therefore, consultation with USFWS on potential effects has been conducted as described in Section 7.4.3. The results also indicate that the shoreline habitat within and adjacent to Carlton Landing contains suitable carrion beetle habitat that supports a high species diversity. The final American burying beetle survey report composed by Blackbird Environmental that documents the survey methodology and results in detail can be found in Appendix D of Appendix B.

Although the adjacent private lands at Carlton Landing were not included in the survey, the habitats appear similar to those along the shoreline and may also support American burying beetle. While the beetles appear to use a wide variety of habitat types, they are not commonly found in areas with human disturbances. The private lands at Carlton Landing are in the process of becoming more fragmented. Over the past several years, the developer has constructed an access road to the shoreline and has begun clearing and construction on the first phase of the development. These changes may have reduced the suitability of the adjacent private lands for the American burying beetle.

## 3.2.5 Fish

As the largest lake in Oklahoma with approximately 808 miles of shoreline and over 105,000 acres of surface water, Eufaula Lake and its tributaries provide habitat for over 70 species of fish. Natural fish habitat consists of large expanses of open water, areas of submerged standing timber, sandstone rock and coarse gravel, and mud or sand flats (Bowen 2008).

A list of all common fish species likely found within the Eufaula Lake study area is included in Table 4-17 in Appendix B.

### 3.2.5.1 State Protected Fish Species

*Paddlefish*

Growing to over six feet long and weighing over 100 pounds, paddlefish (*Polyodon spathula*) are a prehistoric species that gather algae and zooplankton from the water by swimming slowly with their mouths open. Their habitat includes slow or quiet waters of large rivers or impoundments. Paddlefish tolerate, or even seek out, turbid aquatic systems.

In Oklahoma, paddlefish begin staging at the upper end of reservoirs in early spring in anticipation of the spawning run. As water temperatures rise and river flows increase, paddlefish move upstream to spawn. Preferred spawning habitat consists of gravel bars in large rivers that are inundated during spring high water. Tagging studies indicate that a given female only spawns every three years, and a given male about every two years. This low reproductive potential has contributed to paddlefish population declines.

Paddlefish are considered critically imperiled in Oklahoma and are found mainly in the Grand, Neosho, and Arkansas River systems. However, dams on several of these rivers and their tributaries have blocked annual paddlefish movements associated with spawning. In addition to dam construction, reasons for paddlefish decline include habitat alteration, specifically the destruction of spawning areas, pollution, and harvesting for caviar. Since 2007, USFWS and ODWC have stocked Eufaula Lake with juvenile paddlefish in an effort to restore the species throughout its historical range. The 2011 ODWC public stocking report documents the release of 9,206 juvenile paddlefish measuring 12 to 24 inches in length (ODWC 2011a). Management of this species also includes a small rod and reel snagging fishery that requires a free paddlefish permit. All banded paddlefish must be reported as part of on-going research at the Paddlefish Research and Processing Center.

### 3.2.5.2 Fisheries

Eufaula Lake has established populations of several game fishes that are actively managed to provide anglers with quality fisheries. Major sport fish species present in Eufaula Lake include largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieu*), crappie (*Pomoxis* spp.), blue catfish (*Ictalurus furcatus*), white bass (*Morone chrysops*), channel catfish (*I. punctatus*), and sunfish (*Lepomis* spp.). Walleye (*Stizostedion vitreum*), spotted bass (*Micropterus punctulatus*), and flathead catfish (*Pylodictis olivaris*) can also be caught, and striped bass (*Morone saxatilis*) are present in significant numbers below the dam. Bow fishermen are able to target gar and other rough fish like carp (*Cyprinus carpio*) and buffalo (*Ictiobus* sp.).

The black bass fishery, which includes largemouth and smallmouth bass, is among the most popular in Eufaula Lake. White bass and spotted bass can also be found in healthy numbers in Eufaula Lake. White bass is Oklahoma's state fish and the current state record was caught on Eufaula Lake in 1984. The number of spotted bass in the lake has also been increasing in recent surveys, and there is concern that their numbers will increase further because changes in the reservoir environment as it ages may favor the reproduction and recruitment of this species (Bowen 2008).

The Arkansas River system supports one of the few inland populations of naturally reproducing striped bass in the southeastern United States. For striped bass to successfully reproduce, a long reach of free-flowing river is needed for proper development of eggs and fry. The tailwaters of Eufaula Lake provide these conditions and support a popular fishery.

Eufaula Lake has a national reputation for great crappie fishing. Crappie thrive in areas of dense cover and prefer to spawn on sand and clay beds such as those found throughout the lake. Some of the more popular crappie areas are near bridges, riprap shorelines, brush piles, and standing timber.

Three catfish species are present in Eufaula Lake: blue, channel, and flathead. Catfish tend to prefer the deeper creek channels and rocky areas. They often use boat ramps, submerged roadways, and abandoned underwater culverts as nesting areas. Blue catfish are the most abundant in the lake with recent surveys indicating the presence of a quality fishery.

Threats to both the fisheries of Eufaula Lake and the overall fish community include siltation, stratification, turbidity, aquatic nuisance species, competing water uses, declining water quality, and disease. Erosion and sedimentation directly affect water quality and can eliminate optimal fish habitat and spawning conditions. Turbidity and true color values can also indicate a decline in water quality. As of 2008, the Fish and Wildlife Propagation (FWP) beneficial use based on these values was not supported (Bowen 2008). By not meeting this standard, Eufaula Lake's elevated turbidity and true color values adversely impact aquatic wildlife.

Aquatic invasive and nuisance species also threaten the fish community of Eufaula Lake. Zebra mussels (*Dreissena polymorpha*) and Quagga mussels (*Dreissena rostiformis bugensis*) pose a threat as they can be transported on boats and trailers moving from infested waters. Asian carp species, including silver carp (*Hypophthalmichthys molitrix*), bighead carp (*Aristichthys nobilis*), and grass carp (*Ctenopharyngodon idella*) also present potential problems. These species are voracious feeders and prolific breeders that often displace and outcompete native species where introduced. Grass carp have been collected during ODWC sampling in Eufaula Lake. Although reproduction has not been documented, they are known to have reproduced in Lake Texoma (Bowen 2008). No widespread aquatic nuisance plant species have been widely documented in the lake; however, localized populations of both salvinia and water hyacinth have been observed. In addition, alligatorweed (*Alternanthera philoxeroides*) and curlyleaf pondweed (*Potamogeton crispus*) are both established in the Arkansas River Navigation System and have expanded their range in recent years (Bowen 2008).

Invasive species can also include bacteria and viruses that cause fish disease. Largemouth Bass Virus (LMBV) was found in the bass population in 2001. The presence of fish diseases is often attributed to declines in water quality and efforts to improve water quality conditions often reduce the occurrence of fish disease.

### 3.2.6 Reptiles

According to the Distribution of Oklahoma Amphibian and Reptiles by Recorded Sightings (DOKARRS) database maintained by the Oklahoma Biological Survey (OBS), over 55 species of reptiles have been observed in the five counties that are included within the Eufaula Lake study area (see Table 4-18 in Appendix B). This includes 12 species of turtle, 8 species of lizard, and 35 species of snake. None of these species are federally or state listed as endangered or threatened.

Among reptiles known to occur within or adjacent to the Eufaula Lake study area, alligator snapping turtle (*Macrochelys temminckii*) and Mississippi map turtle (*Graptemys kohnii*) populations are declining. These two species are listed as state species of concern, with both species considered imperiled. Collection or possession of individuals is banned.

The Mississippi map turtle, while secure throughout much of its range, is declining in Oklahoma due primarily to habitat loss and collecting from the wild for the pet trade. This diurnal, freshwater turtle prefers rivers, lakes, and sloughs with soft bottom substrates and abundant aquatic vegetation. Eggs are laid in a shallow nest on land near water. ONHI occurrence data records two observations within or adjacent to the Eufaula Lake study area. The first is located near the mouth of the Deep Fork River, and the second is located in Grove Creek just east of Checotah (ONHI 2012).

Alligator snapping turtles are large, highly aquatic turtles emerging from the water only for nesting or, rarely, for basking. Preferred habitat consists of the slow-moving, deep water of rivers, sloughs, oxbows,

and canals or lakes associated with rivers (*e.g.*, large impoundments). Ongoing threats include habitat alteration and fragmentation, water pollution, deliberate harvest for human consumption, and incidental catch by commercial fishers. Protection requires the preservation of adequate nesting habitat and water quality (Riedle *et al*. 2005). ONHI occurrence data records an observation at the mouth of the Deep Fork River, and February 2012 field surveys recorded tracks moving from the lake to an adjacent pond near Sycamore Bay. In addition, Oklahoma State University used the area around Eufaula Lake as a capture site for a study on the genetic variation of alligator snapping turtles in Oklahoma (ODWC 2009). USFWS currently reintroduces approximately 150 alligator snapping turtles a year into state waters in an attempt to establish stable populations throughout its historic range.

## 3.2.7 Amphibians

Oklahoma has 51 species of amphibians native to the state. This includes 24 species of salamanders, representing six families and ten genera and 27 species of frogs and toads, representing five families and seven genera (ODWC 1996). Of these, DOKARRS identifies 20 that have been documented to exist within counties surrounding the Eufaula Lake study area. None of the amphibians likely to be found within the study area are listed as threatened, endangered, or as a species of conservation concern at the federal or state levels.

While most amphibians often do not use the open water habitats at Eufaula Lake, they do find optimal habitat in shallow backwaters and in emergent and forested wetlands along the shoreline. Open freshwater wetland habitats are favored by larger anuran species like the bullfrog (*Rana catesbeiana*) and southern leopard frog (*Rana utricularia*), whereas large numbers of small, vocal frogs, like the spring peeper (*Hyla crucifer*) and striped chorus frog (*Pseudacris triseriata feriarum*), prefer dense forested wetlands. Both habitats contain specific hydrologic parameters that facilitate amphibian reproduction. In addition, wetlands and adjacent uplands provide shelter and food resources. These two cover types need to be in optimal proximity to one another and not separated by impassible barriers such as busy roads. Amphibians are often exceptional indicators of ecosystem health and water quality; therefore, they often are the most sensitive to anthropogenic impacts.

## 3.2.8 Mammals

According to the OBS database and observations during field surveys, over 40 native mammal species are known to exist within or adjacent to the Eufaula Lake study area (see Table 4-20 in Appendix B). Four species of rodents (house mouse, Norway rat, black rat, nutria) have been introduced and populations or individuals of several domestic mammals (especially dogs, cats, and pigs) also now occur in the wild.

### 3.2.8.1 State Protected Mammal Species

OHNI species occurrence data has identified the long-tailed weasel (*Mustela frenata*), river otter (*Lontra canadensis*), and mountain lion (*Puma concolor*) as state species of concern with recorded observations within the Eufaula Lake study area. While the river otter and long-tailed weasel have been documented recently, the mountain lion occurrence was from a single observation in 1968 outside of Eufaula (OHNI 2012). This was most likely a transient individual as eastern Oklahoma does not have current evidence of a resident breeding population. Therefore, the long-tailed weasel and river otter, which have documented recent occurrences within, or adjacent to, the Eufaula Lake study area are considered further in this document.

The long-tailed weasel, while fairly common in northeast Oklahoma, is a rare inhabitant in the Eufaula Lake study area and is considered critically imperiled within the state (ONHI 2012). This is primarily due to the secretive nature of the weasel, as population estimates are hard to obtain, and the fact that local populations can fluctuate wildly in conjunction with prey availability. While no long-tailed weasels have been documented within the Eufaula Lake study area, observations have been recorded in areas to the south and east of Eufaula Lake near the towns of Kinta and Lutie (ONHI 2012).

Habitat destruction, human settlement, unregulated harvest, and water pollution severely depleted or extirpated rivers otters in much of their historic range by the early 1900s. As a result, river otters have been protected by Oklahoma state law since 1917. In 1984 and 1985, ODWC reintroduced river otters in eastern Oklahoma and they have since reclaimed much of their former range (ODWC 2008a). During studies in 2007 and 2008, one otter carcass and otter sign was documented above Eufaula Lake along the North Canadian River in McIntosh County. River otter sign was also collected along the Canadian River above and below Eufaula Lake (ODWC 2008a). This data is supplemented by an ONHI documented occurrence within Eufaula Lake near Mill Creek (ONHI 2012). Therefore, it is likely that river otters exist in low densities within the study area.

Even though both the river otter and long-tailed weasel are considered state imperiled and state critically imperiled, respectively, both are not exempt from legal trapping within the study area.

### 3.2.8.2 Game Species

Both economically and culturally, hunting and trapping have been frequent recreational and subsistence activities. Hunting and trapping is allowed in publically managed areas, such as WMAs, and on private lands within the Eufaula Lake study area. Common game mammals include white-tailed deer, feral hog, eastern cottontail, swamp rabbit, gray squirrel, and fox squirrel (ODWC 2011d). While rare in areas around the lake, black bear and elk are present in portions of adjacent Latimer and Muskogee Counties, respectively. Furbearers include muskrat, nutria, raccoon, mink, Virginia opossum, striped skunk, river otter, bobcat, beaver, gray fox, red fox, and coyote (ODWC 2011d).

### 3.2.8.3 Invasive Mammal Species

Several mammal species have been introduced into Oklahoma and have established populations. These invasive species include the house mouse, Norway rat, black rat, nutria, and feral hog. The house mouse and the two Old World rat species prefer areas of extensive human development, which provide ample food sources and nesting sites. The nutria and feral hog are more suited to the habitats surrounding Eufaula Lake, and they have the ability to do significant ecological damage within the study area.

Feral hogs are a genetic crossing between purebred wild boars, purebred domestic livestock, and hybrids of these species. Wild feral hogs can cause extensive damage to natural wildlife habitat, managed food plots for deer and waterfowl, agricultural areas, farm ponds, and watering holes for livestock (Stevens 1996). According to the Samuel Roberts Noble Foundation, feral hogs are present in 74 of Oklahoma's 77 counties, including all counties within the study area (Noble Foundation 2012). Feral hogs were first observed in the east and southeast portions of the study area prior to the 1970s. Observations of hogs in the west and southwest portions of the study area began in the 1980s, with feral hogs only recently being sighted in the northern portions of the study area. In 2007, the estimated feral hog density within the study area was 13-58 hogs per square mile (Noble Foundation 2012).

## 3.2.9 Birds

Within Oklahoma, declines in bird populations are often attributed to habitat degradation and loss, hunting, predation, and pesticide use. As compared to the historical condition, Oklahoma has experienced a significant loss of prairie and wetland habitats. On the other hand, several habitats currently located within the Eufaula Lake study area, while not present in large tracts historically, provide resting, nesting, and forage areas for a variety of bird species. For example, the open water habitats of Eufaula Lake have benefited certain waterfowl and waterbird species and the encroachment of dense forests into savanna and prairie habitats have benefited certain forest-dwelling songbirds.

### 3.2.9.1 Protected Bird Species

Coordination with USFWS and ODWC identified the federal and state protected species as well as species of conservation concern that could be affected by changes in the SMP and MP. In accordance with discussions with these regulatory authorities, this EIS addresses the existing condition of the bald eagle and interior least tern within the Eufaula Lake study area (Stubbs 2012). The interior least tern is discussed in Section 3.2.4.3. All other listed bird species and species of concern are migrants that are rarely encountered within the study area and are addressed briefly within the larger context of migratory bird protection (Stubbs 2012). The current status and life history requirements of species other than bald eagle and least tern and reasons why potential significant impacts are unlikely are discussed in Appendix B.

*Bald Eagle*

The bald eagle was first listed as a federally endangered species in 1967 and was declared endangered by the State of Oklahoma in 1978 (Tulsa Audubon Society 2008). However, conservation successes have led to a rebound in eagle populations both nationally and statewide. Except for the distinct Sonoran Desert population segment in Arizona, the bald eagle was removed throughout its range from the federal list of threatened and endangered species on August 9, 2007 (USFWS 2010a). Even though they are currently delisted, the bald eagle is still protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act (USFWS 2010a). These laws require measures to prevent human activities from resulting in the harassment and take of bald eagles.

All of Oklahoma's major rivers and reservoirs, including Eufaula Lake, support wintering eagles. Major reservoirs provide areas of flooded timber that make ideal perches, and open water for fishing usually can be found below dams even when other areas freeze. In contrast to their territorial behavior during the breeding season, bald eagles become sociable in winter and roost communally at night in trees near reliable food sources.

According to ODWC, dozens of bald eagles migrate to the Eufaula Lake study area during the winter months (November-March) and approximately six pairs of resident, non-migratory eagles remain year-round (Howery2011b). According to the ONHI occurrence database, 11 bald eagle observances have been recorded along the old Canadian River channel (ONHI 2012). Records of 2010 eagle nest locations are currently unavailable (Barstow 2011a). The field surveys conducted for this EIS did not confirm any new nests or roosts but did record observations of individual bald eagles flying along the shoreline in Brooken Cove on February 6, 2012, over the Mill Creek portion of the lake on May 28, 2012, and across a cove near Roberts Ridge on May 29, 2012.

USFWS provides management guidelines and conservation measures to protect the bald eagle when they are most sensitive to human disturbance, which occurs during the breeding season and wintering periods.

Eagles are most sensitive to human disturbance during the courtship and nest building phase of the breeding season. It is during this period that eagles are most likely to abandon nest sites if disturbed. In Oklahoma, this phase generally occurs between December and February (USFWS 2010b). Even if human disturbance is avoided during the critical first phase, eagles continue to be extremely sensitive until the young have fledged in July.

### 3.2.9.2 Migratory Birds

Migratory birds are afforded protection under several regulations including the Migratory Bird Treaty Act. While these regulations protect migratory birds at the federal level, the responsibility for managing waterfowl and other migratory species in Oklahoma falls primarily on the Central Flyway Council. The Central Flyway generally follows the Great Plains from central Canada in the north to the Texas Gulf Coast in the south. Eufaula Lake sits on the easternmost edge of the Central Flyway and provides ample food, water, and cover for migrating birds.

USFWS instructed that several listed species should be addressed in this EIS within the general discussion on all migratory birds (Stubbs 2012). This is justified because these species are rare to the Eufaula Lake study area and would only be present, if at all, during brief stopovers in spring and fall. Therefore, brief discussions on the status and habitat requirements of the piping plover (*Charadrius melodus*) and whooping crane (*Grus americana*) are included in this section.

The **piping plover** is listed as federally threatened in Oklahoma. Major threats are related primarily to human activity; nesting disturbance, predation, development pressure, and inappropriate water management. It has been known to nest sporadically in Oklahoma, but no known nesting has occurred within the Eufaula Lake study area. Birds are most likely to be encountered at low densities within the study area during spring (April-May) and fall (August-September) migrations (Howery 2011b). Preferred nonbreeding habitats include sand and algal flats in protected bays where they feed on invertebrates.

The **whooping crane** was listed as endangered throughout its range in 1967. Whooping cranes are extremely sensitive to human disturbance and declined due to conversion of pothole and prairie habitats to hay and grain production. Whooping cranes use a variety of habitats during migration, including croplands for feeding and palustrine wetlands and submerged sandbars in wide channels for roosting. While the study area contains these habitats, OHNI has no reports of whooping cranes in the vicinity of Eufaula Lake (OHNI 2012). If cranes use the study area, it would most likely be during spring (April-May) or fall (September-October) migration.

#### *Bird Species of Conservation Concern*

Species of conservation concern are species that, while not listed, are monitored by state or federal wildlife officials. Federal and state species of conservation concern are not afforded the same protections as listed species under the ESA; however, because these species are protected under laws designed to protect all migratory birds, including the Migratory Bird Treaty Act brief discussions on the status and habitat requirements are included. The species of conservation concern that may occur within the study area include the peregrine falcon (*Falco peregrinus*), Sprague's pipit (*Anthus spragueii*), Bell's vireo (*Vireo bellii*), Bachman's sparrow (*Aimophila aestivalis*), and prothonotary warbler (*Protonotaria citrea*). These species are also discussed in more detail in Appendix B. Potential impacts to these species, some of which are seasonal residents within the Eufaula Lake study area, and to all migratory birds, are included in Section 4.2.

**Peregrine falcons** are most frequently seen hunting birds near rivers and lakes, and they may be found within the study area at low densities during migration periods (Howery 2011b). However, OHNI does not have any documented occurrences within the Eufaula Lake study area (OHNI 2012).

**Sprague's pipit** would most likely occur in the study area in September and October and again in March and April with an outside possibility of some birds residing there through the winter months. Habitats used by this species during migration and in winter consist of pastures and weedy fields, including grasslands with dense herbaceous vegetation or grassy agricultural fields (NatureServe 2011b). Sprague's pipit is intolerant of grazing and low densities are reported in mowed areas.

**Bell's vireo** is a summer resident that may occur in the Eufaula Lake study area from early April through late September. ODWC has documented populations in all six study area counties, particularly within sandbar willow thickets along the North Canadian and Canadian Rivers (Howery 2011b).

**Bachman's sparrow** is a summer resident of southeastern Oklahoma. The OHNI occurrence database lists one documented sighting of Bachman's sparrow occurring in Okmulgee County near Dewar, just to the northwest of the Eufaula Lake study area (OHNI 2012).

The **prothonotary warbler** is also a summer-resident songbird in Oklahoma where it is listed as a species of conservation concern by ODWC. This species is most likely to be observed in the study area from mid-April to mid-September (Howery 2011b). These warblers have a very specialized habitat, mainly occurring in forested wetlands, bottomland forests, and other forested riparian habitats. These habitats occur in pockets throughout the study area and are often located where tributaries drain into Eufaula Lake. An active nest was located on May 28, 2012 in a cavity along the Carlton Landing shoreline to the east of the proposed Town Center during the field surveys.

### *Birds of Prey*

Birds of prey, or raptors, are one of the most visible groups of migratory birds found within the study area. Many species of hawks, falcons, owls, and vultures can be seen soaring and hunting along the lakeshore in habitats ranging from open prairie to dense oak-hickory forest. While the conversion from a lotic to a lentic system that occurred with the creation of Eufaula Lake would have had little effect on the populations of birds of prey in comparison to waterbirds and waterfowl, the development of shoreline areas and terrestrial habitat alteration greatly impacts these species. Human-associated disturbance is the primary threat to raptor populations. Raptors are especially sensitive during courtship and nesting, and disturbance has been shown to lead to decreased hunting success (Richardson and Miller 1997). This is of note because the majority of raptor species are likely to be found within the study area during the breeding season. Thus, as compared to the historical condition, the current Eufaula Lake study area conditions favor species that are habitat generalists that can tolerate limited human disturbance. Field surveys in 2012 documented several observations of species well suited to the variable habitats located in the study area such as the red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), Cooper's hawk (*Accipiter cooperii*), American kestrel (*Falco sparverius*), barred owl (*Strix varia*), and black vulture (*Coragyps atratus*).

### *Songbirds*

In addition to birds of prey, the study area supports many species of resident and migratory passerine birds. The Eufaula Lake study area, with its diverse habitats likely supports over 70 species of migrant and resident songbirds. During the spring 2012 habitat and faunal surveys, visual and auditory identification

techniques documented 30 species at the sample points. Many of these species are year-round residents as several of the surveys were conducted in February before the spring migration. Observed songbird species composition also depended on habitat type, with habitat generalists seen more often than habitat specialists. The most commonly observed species included the tufted titmouse (*Baeolophus bicolor*), blue jay (*Cyanocitta cristata*), brown thrasher (*Toxostoma rufum*), Carolina wren (*Thryothorus ludovicianus*), Carolina chickadee (*Poecile carolinensis*), hermit thrush (*Catharus guttatus*), northern cardinal (*Cardinalis cardinalis*), northern mockingbird (*Mimus polyglottos*), swamp sparrow (*Melospiza georgiana*), and white-breasted nuthatch (*Sitta carolinensis*). Also, present were other species of wrens, cuckoos, sparrows, swifts, hummingbirds, vireos, and warblers.

### *Ground Birds*

Historically, the prairies, savanna, and crosstimbers were regulated by frequent fires, which kept the understory free of weeds and shrubs. These open habitats supported several species of ground birds such as the greater roadrunner (*Geococcyx californianus*) and northern bobwhite (*Colinus virginianus*). However, policies restricting natural fires and a lack of controlled burns have resulted in a loss of much of this habitat. Additionally, conversion of native prairie to introduced grasses has deprived ground birds of food and cover. While many of these species can still be found in the Eufaula Lake study area, as evidenced by the observation of a greater roadrunner at Carlton Landing during 2012 field surveys, populations of several species are in decline.

Ground birds are of particular concern because several, including the mourning dove (*Zenaida macroura*), wild turkey (*Meleagris gallopavo*), and northern bobwhite are recreationally-important game species. Bobwhite can be found in protected areas of the study area, such as in the Eufaula WMA, but occurs in very low numbers (Ridge 2011).

Both Rio Grande (*M. g. intermedia*) and Eastern (*M. g. silvestris*) wild turkey inhabit the Eufaula Lake study area but they are not considered abundant and are present in only a few localized areas (Ridge 2011). While only the Rio Grande subspecies is native, the eastern subspecies was introduced for recreational hunting purposes. As birds of open woodlands, turkeys thrive in savanna and crosstimbers habitats. CDM Smith field surveys in 2011 observed wild turkeys in Arrowhead State Park and additional 2012 surveys observed wild turkeys in the Mill Creek arm of the Eufaula WMA.

### *Woodpeckers and Other Common Bird Species*

Woodpeckers are mentioned separately due to their very specific habitat requirements and role in maintaining forest health. Their preference for standing dead timber and territoriality make them especially vulnerable to human development and disturbance. Six species of woodpecker, including five confirmed during 2012 field surveys, are likely to inhabit the study area. This includes the downy woodpecker (*Picoides pubescens*), hairy woodpecker (*Picoides villosus*), northern flicker (*Colaptes auratus*), pileated woodpecker (*Dryocopus pileatus*), red-bellied woodpecker (*Melanerpes carolinus*), and red-headed woodpecker (*Melanerpes erythrocephalus*). All are year-round residents and improve forest health by consuming pests such as wood-boring beetles, ants, and grasshoppers. They differ in their ability to adjust to human disturbance with downy, red-bellied, and northern flicker adapting well to areas of modest development and pileated, hairy, and red-headed woodpeckers preferring undisturbed forests and open woodland (Bull and Farrand Jr. 1993).

Both bank and barn swallows can be seen nesting under the many bridges within the study area, while tree swallows utilize standing dead timber. The American crow is a common visitor to the many parks and

recreation areas and its smaller, rarer relative, the fish crow, and the belted kingfisher can be seen frequenting the marshes and riverine habitats within the study area (National Geographic 2002). These birds tend to adapt well to some degree of human disturbance and can occupy a variety of altered habitats.

### *Waterfowl*

Waterfowl are among the most highly valued natural resources in North America. These birds embark twice each year on long-distance journeys between their breeding areas and wintering grounds. The Eufaula Lake study area is located along the eastern edge of the Central Flyway and is just to the west of the Mississippi Flyway (Krause 2005). Therefore, a great variety of waterfowl utilize aquatic habitats in the area.

The creation of Eufaula Lake between 1956 and 1964 turned the former riverine and wetland system into a lake system dominated by steep banks with little aquatic vegetation. Most reservoirs lack natural water fluctuations and shallow littoral zones that maintain the biological productivity of natural wetlands. Shoreline development has also reduced the amount of habitat available to waterfowl. However, some species such as mallard and Canada goose adapt well to open water habitats and human disturbance and can still be found in significant numbers. In addition, the 2005 Central Flyway Harvest and Population Survey indicates that populations of gadwall (*Anas strepera*), American wigeon (*Anas americana*), green-winged teal (*Anas crecca*), ring-necked duck (*Aythya collaris*), and common goldeneye (*Bucephala clangula*) in the area are rebounding from historic lows (Krause 2005). Field surveys conducted in spring 2012 documented frequent sightings of mallard, Canada goose, wood duck, and gadwall.

Waterfowl management in the study area is most evident on public lands protected for wildlife management. The Eufaula WMA covers over 48,000 acres and contains the largest tracts of protected wildlife habitat within the study area (Ridge 2011). The Eufaula WMA consists of six protected areas spread throughout the geographic extent of the lake. The majority of the area is located on the upper reaches of river and creek arms of Eufaula Lake, including the Deep Fork, North Canadian, and Canadian Rivers, and Mill and Gaines Creeks. Available habitat consists mainly of floodplain and river bottoms and adjacent natural wetlands and uplands. In addition to maintaining the Eufaula WMA, ODWC actively manages two wetland development units (WDUs) totaling approximately 780 acres at Deep Fork and Mill Creek to provide important habitat and refuge resources to waterfowl and other migratory birds (Ridge 2011). This often includes the establishment of emergent wetland areas and the planting of quality food species.

### *Waterbirds*

In addition to the variety of waterfowl species, several waterbird and gull species make up a significant proportion of the avian community likely to be found within the Eufaula Lake study area. Waterbirds, in this case, refer to birds that live in or around water and are differentiated from waterfowl in that they are not actively managed game species. This group ranges from duck-like birds such as the American coot (*Fulica americana*) to gulls and large wading birds such as the great egret (*Ardea alba*). All waterbirds have adaptations that enable a semi-aquatic lifestyle and depend on aquatic systems for food and nesting sites. While some, such as the great blue heron (*Ardea herodias*) and double-crested cormorant (*Phalacrocorax auritus*) are year-round residents, most are seasonal visitors to Eufaula Lake.

Historically, the riverine systems in the study area would have favored waterbirds adapted to floodplain wetlands and bottomland forests such as the least bittern (*Ixobrychus exilis*), green heron (*Butorides virescens*), and both species of night-heron. The creation of Eufaula Lake increased open water habitats

and relegated shoreline specialists to remnant riverine areas. It is very likely that lake creation increased the individual abundance of some species, but decreased the overall number of species present. While some wetland habitats exist in backwater coves and river mouths, much of the lake shoreline has lost the aquatic vegetation and shallow littoral zones that many waterbird species utilize to find food. This is due both to inundation and limited shoreline development. These same processes have favored species adapted to open water habitats such as gulls (*Larus spp*.), white pelicans (*Pelecanus erythrorhynchos*), and double-crested cormorants, which can now be frequently seen within the Eufaula Lake study area. Habitat generalists that can tolerate human disturbance in foraging areas such as the great blue heron and American coot have also adapted to the conversion of habitat and are often seen feeding along Eufaula Lake's shorelines.

## 3.2.10 Invertebrates

Invertebrates constitute the largest and most diverse group of organisms found within the Eufaula Lake study area. Arthropods, insects, crustaceans, annelids, mollusks, and aquatic macroinvertebrates all fall under this umbrella. There is little detailed study on the historical and current condition of populations of invertebrates located within the Eufaula Lake study area and within Oklahoma as a whole. It is reasonable to expect that the historical condition would have favored invertebrate species suited to the riverine and prairie systems that were prevalent before impoundment. Today, species that inhabit lentic aquatic systems and oak-pine and crosstimbers forests make up the majority of the invertebrate community.

Areas adjacent to and within the Eufaula Lake study area may provide habitat for the federally-endangered American burying beetle (*Nicrophorus americanus*) and the prairie mole cricket (*Gryllotalpa major*), a state species of conservation concern. The results of a presence/absence study for the American burying beetle on government lands adjacent to the proposed Carlton Landing development are presented in Section 3.2.4.4 and in Appendix B.

### 3.2.10.1 Terrestrial Arthropods

The terrestrial invertebrate community is dominated by arthropods, specifically insects and arachnids. Arthropods serve important roles in decomposition, pollination, and as food sources for other organisms. The 2012 Eufaula Lake study area field surveys document that butterflies and grasshoppers are most common in open habitats, with beetles, wasps, and flies common in forest habitats.

Currently listed as state imperiled in Oklahoma, the prairie mole cricket has been documented within Lake Eufaula State Park in the northern portion of the study area (ONHI 2012). Historically, this large cricket was found throughout tall-grass ecosystems. However, due to habitat conversion for agricultural use, the prairie mole cricket was thought to be extinct by 1984 (Layher *et al.* 2005). Several populations have since been found in Kansas, Arkansas, Missouri, and Oklahoma. It is theorized that soil type plays a large role in determining habitat suitability (Layher *et al.* 2005). Large-scale grazing operations and urbanization, both of which compact soils, are thought to contribute to the prairie mole cricket's decline. While prairies supporting a high diversity of native grasses produce larger prairie mole cricket populations, the species has also been found in hayfields, mowed lawns, and second growth fields (Layher *et al.* 2005).

### 3.2.10.2 Aquatic Invertebrates

Aquatic invertebrates are important indicators of water quality and comprise the base of the aquatic food web. Aquatic macroinvertebrate communities often vary widely depending on substrate and hydrologic gradient. Before impoundment, the Canadian River within the Eufaula study area would likely have had a

community consisting largely of species of mayflies and caddisflies common in the low-gradient rivers of the region.

The creation of Eufaula Lake would have eliminated the habitat of more lotic species and selected for aquatic macroinvertebrates that thrive in lake systems with fine sediments. Current macroinvertebrate communities within the study area are likely dominated by tolerant species including true flies (Diptera), mollusks (Gastropoda), worms (Oligochaeta), and several groups of crustaceans including cladocerans (Brachiopoda) and copepods (Wagner 1996). Crayfish are also abundant along lake margins and in wetland areas. During 2012 surveys, several crayfish burrows were observed in wet meadows near the mouth of the North Canadian River.

Plankton is made up of both plants (phytoplankton) and animals (zooplankton). They comprise a large portion of the living matter in lake systems and are acutely affected by pollutants, transferring pollutants to sediments and other organisms (Walsh 1978). In 1973, an Oklahoma State University study characterized the zooplankton of the open water portions of Eufaula Lake (Bowles 1973). Since the lake was completely filled at that time, it is expected that the current open water zooplankton community shares similarities with the community observed in 1973. A total of 23 species were found. While not characterized in the 1973 study, the phytoplankton community in the study area likely reflects that of other reservoir systems and would include mainly green and blue-green algae (*i.e.* cyanobacteria) (Walsh 1978).

Riverine systems and their associated wetlands would also have contained a different freshwater mussel community in comparison to the lentic system present today. Oklahoma has approximately 57 species of native Unionid mussels, with species richness declining along a continuum from east to west across the state (Mather 2005). A relatively large proportion of these species have been identified as Species of Greatest Conservation Need, a list that was developed as part of the Oklahoma Comprehensive Wildlife Conservation Plan. Freshwater mussels would have been placed on this list due primarily to habitat conversion and destruction and invasive species (Mather 2005). After impoundment of the lake, mollusks that require faster-moving water over rocky substrates would have given way to species that can handle the low flows and fine substrates of Eufaula Lake. Eufaula Lake and its surrounding riverine and wetland habitats are estimated to possess at least 15 species of freshwater mussels.

Three species of mussels have been confirmed within the waters of Eufaula Lake. The pink papershell (*Potamilus ohiensis*) was documented in Eufaula Cove (Mather 2005). The giant floater (*Pyganodon grandis*), which has been introduced in many reservoirs and is becoming widespread throughout Oklahoma, was observed at Brooken Cove Recreation Area during 2012 field surveys. Records also indicate that this species has been observed at Elm Point south of Blocker (Mather 2005). Additionally, a fragile papershell mussel (*Leptodea fragilis*) was observed at Arrowhead State Park. The fragile papershell is particularly suited for Eufaula Lake in that it is one of the few mussel species that often inhabits unconsolidated and unstable substrates. Extremely weathered shells of several species were found in upland areas at several locations in the study area, indicating the presence of at least historical populations. At Carlton Landing, weathered yellow sandshell (*Lampsilis teres*), pondmussel (*Ligumia subrostrata*), and pimpleback mussel (*Quadrula pustulosa*) shells were observed.

Oklahoma's State Wildlife Action Plan identifies exotic and invasive species as one of five priority issues that threaten the conservation of state wildlife resources and two of the most prolific invaders are the freshwater zebra mussel (*Dreissena polymorpha*) and Asian clam (*Corbicula fluminea*). In January 2010,

zebra mussels were found in Eufaula Lake and monitoring is ongoing to determine the extent of infestation (Laney 2010). The zebra mussel is a prolific fouling organism, causing billions of dollars in damage to water control structures. It consumes large quantities of plankton from the water column, thus competing with native mollusks and fish. Zebra mussels also impact water quality, food availability, and fish spawning areas (Benson *et al.* 2012). Signs at public boat ramps within the project area warn visitors of the potential impacts of the zebra mussel and provide preventative measures meant to stop dispersal.

The Asian clam, while not recorded within the Eufaula Lake study area, has invaded freshwater ecosystems throughout Oklahoma including the Arkansas River from Cherokee to Wagoner Counties, Little River, Lake Texoma, Lake Overholser, and Lake Thunderbird (Foster *et al.* 2012). Several of these locations share similar habitat conditions with Eufaula Lake and are located nearby; therefore, increasing the likelihood of invasion. Much like the zebra mussel, the Asian clam is a prolific fouling organism, alters benthic substrates, and competes with native species for limited resources. Unlike the zebra mussel, several native species, including catfish, crayfish, and raccoons, have been known to feed on the Asian clam (Foster *et al.* 2012). Any changes within the study area that alter littoral zone and benthic conditions have the potential to influence the risk of establishment and spread of both invasive freshwater mussel species.

## 3.3 Water Quality

This section describes existing water quality conditions in the Eufaula Lake study area. Information in this section is based on the Water Quality Technical Report (see Appendix D).

### 3.3.1 Area of Analysis (Water Quality)

Eufaula Lake is located in the upper Arkansas River basin and is generally defined as the area below an elevation of 585 feet above mean sea level, which defines the conservation pool. The conservation pool elevation is the level at which the lake is generally maintained to optimize various water resource and recreational uses of the lake. The study area includes USACE-owned land and adjacent private lands that may be affected by changes in shoreline designations and policies.

All activities that occur in Eufaula Lake, such as boating, swimming, and fishing, are dependent upon good water quality. In addition, other uses, including drinking water supplies, may be impacted by water quality of Eufaula Lake. Eufaula Lake is a critical water resource for recreation, aquatic life, and the communities that benefit from the flood control and drinking water supplies provided by the lake.

### 3.3.2 Regulatory Setting (Water Quality)

Section 1502.25 of NEPA regulations require that EISs be prepared concurrently with environmental analyses and related surveys and studies required by other federal statutes (40 CFR 1502.25). NEPA, in combination with the Clean Water Act (CWA) and Executive Order (EO) 11990, establishes a national policy regarding the management of water resources. Where the quality of a water resource supports a diverse, productive, and ecologically sound habitat, it is a national policy that those waters be maintained and protected unless there is compelling evidence that to do so will cause significant national economic and social harm. This national policy is founded on the overall objective established in the CWA to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The purpose of this policy is to protect existing and future uses including assimilative capacity, aquatic life, drinking water supply,

recreation, industrial use, and hydropower. Where water resource uses are degraded, it is the national goal to restore those degraded waters to more productive conditions.

Regulations that protect water quality offer a basis for comparison in which water quality impacts can be understood relative to the minimum standards for water quality. An impact on water quality may be considered significant if it compromises the ability for Eufaula Lake to meet established water uses or degrades water quality as described in the national policy.

Regulations relevant to the evaluation of water quality include the Clean Water Act, Executive Order 11990: Protection of Wetlands, Engineer Regulation (ER) 1110-2-1462, ER 1110-2-8154, and Oklahoma's Water Quality Standards - Oklahoma Administrative Code, Title 785, Chapter 45. These regulations are described in Section 1.6.

### 3.3.3 Methodology (Water Quality)

The purpose of this section is to describe information on hydrologic features and water quality in Eufaula Lake and the surrounding study area, including the area described in the Carlton Landing development proposal. Water body and drainage features identified include, but are not limited to, streams, swales, wetlands, depressions, ponds, and selected outfalls. This forms the basis for assessing potential environmental impacts of the alternatives to shoreline management and potential cumulative impacts of the alternatives. Each of the alternatives is evaluated for potential effects on water quality in Section 4.3.

Baseline hydrology and water quality conditions were described for the lake with a focus on the lake shoreline. Similar information from areas upstream of the lake that flow to the lake was also evaluated. Water quality data were collected from the following sources:

- U.S. Fish and Wildlife Service (USFWS) including the National Wetland Inventory
- EPA including 303(d) Impaired Waters report
- U.S. Geological Survey (USGS) including quadrangle maps
- Oklahoma Water Resources Board (OWRB) 2000-2009 (17 sample sites)
- USACE, Tulsa District 2009 (9 stations)
- Other relevant state and federal agencies.
- Local agencies that may monitor construction activities

Habitat maps were used for the base maps to indicate the location of hydrologic features, selected outfalls, and selected water quality sampling stations. The water quality sampling stations are shown on **Figure 3.3-1**. Water quality data were analyzed to determine trends in the data and to evaluate how water quality may affect the alternatives, as well as to understand if the alternatives may have the potential to affect water quality.

Site visits were used to verify hydrologic features and aquatic resources, as needed, as well as to document activities that may impact water quality such as outfalls, areas with significant sedimentation and erosion, and areas with extremely high boat usage.

In addition, a shoreline habitat assessment (SHA) was conducted in May 2012 to determine the relative condition of the Eufaula Lake study area shoreline in comparison to that observed at lakes in the region.

Assessments were conducted throughout the study area, and locations were selected based on proposed re-zoning, historical and current land use, and site access. In total 28 locations were assessed by foot and 10 were assessed by boat (see Section 3.1.5.3 for a discussion of the survey results).

## 3.3.4 Existing Conditions (Water Quality)

The existing water quality at Eufaula Lake serves as a baseline against which to compare potential water quality impacts that may result from the action alternatives and to identify mitigation measures that may be necessary to meet Oklahoma Water Quality Standards. This section provides an inventory of the existing water quality in Eufaula Lake in the context of the lake's watershed.

### 3.3.4.1 Location and Description

Eufaula Lake dam is located on the Canadian River in McIntosh County, Oklahoma. The reservoir area lies in Haskell, McIntosh, Okmulgee, and Pittsburg Counties. With over 800 miles of shoreline and 105,500 surface acres, Eufaula Lake offers a variety of recreational opportunities and is environmentally significant to the region. The watershed's terrain ranges from hills and ridges of the northern crosstimbers in the north and transitions southward to the diverse plains, terraces, and wooded hills of the Arkansas Valley and finally to the Fourche Mountains at the far southern border.

Mud Creek, Deep Fork of Canadian River, North Canadian River, Canadian River, Coal Creek, Brushy Creek, Gaines Creek, Ash Creek, and Longtown Creek are the major streams that contribute to Eufaula Lake. Both the Canadian River and North Canadian River may have periods of low to no flow due to seasonal and long-term dry spells and droughts.

Eufaula Lake dam and reservoir were completed in 1964 for flood control, water supply, navigation, and hydropower purposes, and recreation has since been added. Eufaula Lake has a conservation pool elevation of 585.0 feet above mean sea level (MSL), a mean depth of 20.3 feet, and cumulative a storage capacity of 2,141,422 acre feet at the conservation pool elevation. Eufaula Lake has a dependable water supply yield of 56,000 acre feet per year and is an important water supply resource for the State of Oklahoma.

According to the USACE study *2001 Eufaula Lake Water Quality Report*, "the lake inflow carries a large amount of sediment that comes mostly from the Canadian, North Canadian, and Deep Fork Rivers. Based on a 1977 sediment survey, the amount of storage lost to sediment accumulation below elevation 597 feet NGVD is 125,524 acre feet [AF]."

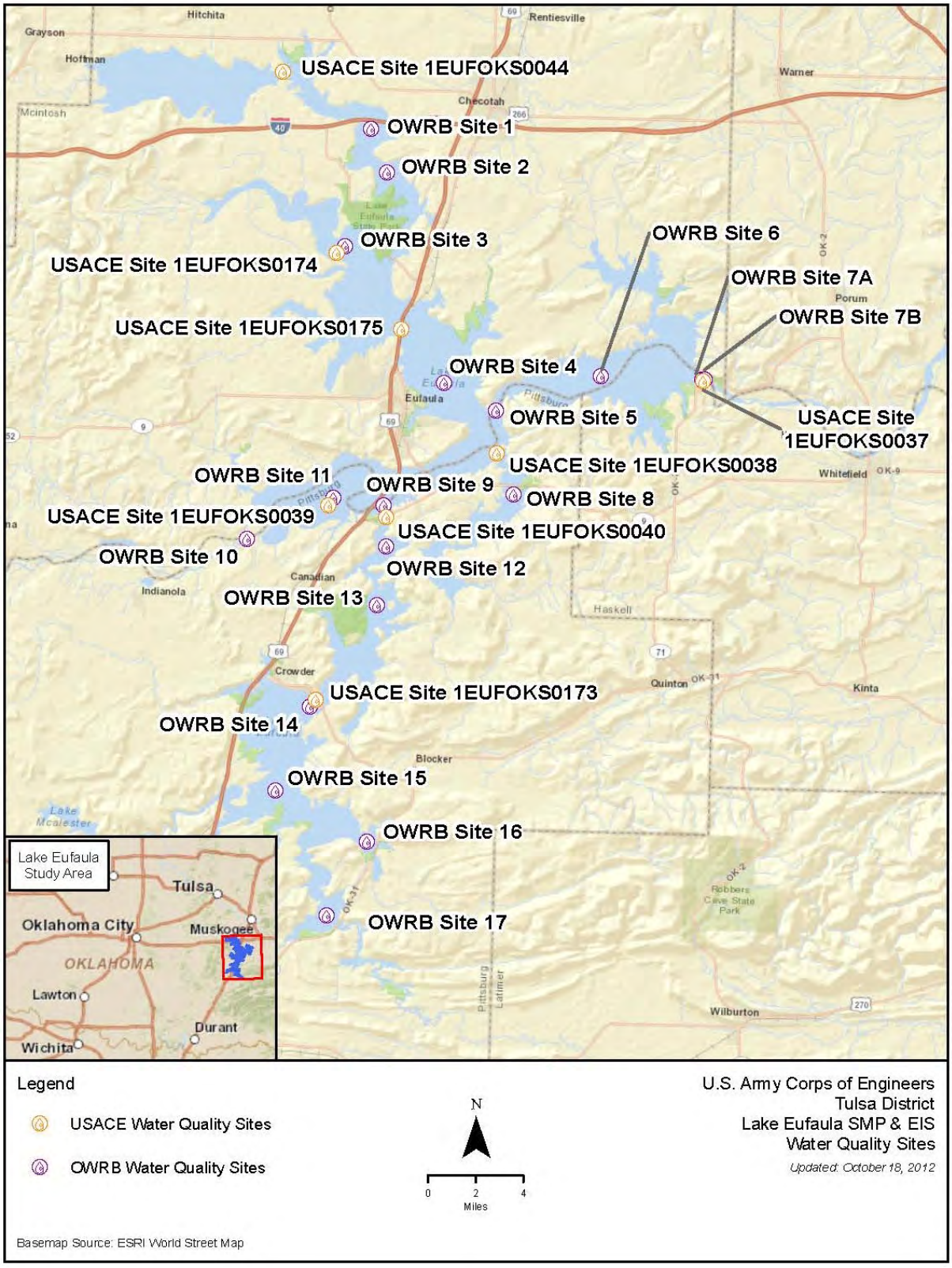



**Figure 3.3-1. Water Quality Sampling Stations**

### 3.3.4.2 Hydrogeology/Groundwater

Within the Eufaula Lake watershed there are eight identified aquifers: the Canadian River and North Canadian River major alluvial aquifers, the Ashland Isolated Terrace minor alluvial aquifer, the Garber-Wellington and Vamoosa-Ada major bedrock aquifers, and the East-Central Oklahoma, Kiamichi, and Pennsylvania minor bedrock aquifers.

The following represent general water quantity yields from aquifers within the Eufaula Lake EIS study area:

- Canadian River – from 100 to 400 gallons per minute (gpm) in the alluvium and from 50 to 100 gpm in the terrace
- North Canadian River – from 300 to 600 gpm in the alluvium and from 100 to 300 gpm in the terrace
- Ashland Isolated Terrace – less than 50 gpm
- Garber-Wellington – from 200 to 400 gpm
- Vamoosa-Ada – from 25 to 150 gpm

Alluvial groundwater in the Eufaula Lake watershed is predominantly of a calcium magnesium bicarbonate type, is variable in dissolved solids content, and is generally suitable for most purposes.

The Garber-Wellington bedrock groundwater in the Eufaula Lake watershed is predominately of a calcium magnesium bicarbonate type and ranges from hard to very hard. Water from this aquifer is generally suitable for public water supply, but local concentrations of nitrates, sulfate, chloride, fluoride, arsenic, chromium, and selenium may exceed drinking water standards.

The Vamoosa-Ada water quality is generally good but is impacted by iron infiltration and hardness. Except for areas of local contamination resulting from past oil and gas activities, chloride and sulfate concentrations are low and water quality is generally suitable for public water supply.

### 3.3.4.3 Recreation

Eufaula Lake is shallow, with a mean depth of 20.3 feet and a maximum depth of 87 feet. Water clarity across the lake varies from muddy areas located generally to the west of Highway 69 with very muddy areas in Gaines Creek and Deep Fork Arms, and clear areas near Longtown Creek and eastern lake areas towards Duchess Creek (Lake Area 4 as shown on **Figure 3.7-1**). This varying water clarity drives recreational use across the lake where muddy areas may be preferable for certain types of fishing and clearer areas are preferable for boating, swimming, and water skiing. The Highway 69 causeways bisect the lake and have the potential to create settling basins allowing the eastern areas of the lake to be clearer and for muddier conditions to be contained in the western portion of the lake. The increased water clarity in the central portion of the lake is due mostly to lake dynamics, this portion of the lake contains the deepest and slowest-moving waters, which allow sediments to drop out of the water column.

### 3.3.4.4 Beneficial Uses

The OWRB has established the following specific beneficial uses for Eufaula Lake and its major tributaries (*i.e.*, Canadian River, Gaines Creek):

- Public and Private Water Supply (PPWS) beneficial use
- Fish and Wildlife Propagation beneficial use – Warm Water Aquatic Community (WWAC) subcategory
- Agriculture beneficial use
- Primary Body Contact Recreation (PBCR) beneficial use
- Aesthetics beneficial use

### 3.3.4.5 Water Quality

Water quality conditions in the study area were based on data from three sources:

- Oklahoma Water Resources Board (OWRB) provided water quality data for 17 sample sites at Eufaula Lake collected between 2000 and 2009.
- USACE, Tulsa District provided water quality data for nine sites collected in 2001
- Oklahoma Conservation Commission (OCC) provided water quality data for 15 sites collected between 1999 and 2010.

Data from these stations over the past decade were collected and analyzed. For each station, the full list of the mean, median, minimum, maximum, and number of observations for each of the OWRB, USACE, and OCC sample sites, as well as the applicable Oklahoma water quality standards and designated beneficial use are found in Appendix D. The existing conditions for sampled parameters are summarized below.

A basic model was used to quantitatively estimate existing runoff and pollutant loads into Eufaula Lake. The EPA Spreadsheet Tool for Estimating Pollutant Load (STEPL) Model employs simple algorithms to estimate annual runoff volume, and total nitrogen (N), phosphorus (P), biochemical oxygen demand (BOD), and sediment load from location and land use input information. For the purposes of the STEPL analysis, two scenarios were explored: pollutant loads contributed from USACE-owned lands only, and pollutant loads contributed from USACE-owned lands and adjacent private lands. The contributing watershed was assumed to be the USACE-owned lands around the lake, and USACE-owned lands plus 0.5 miles of adjacent private lands around the lake. Resulting runoff and pollutant loads are presented in **Table 3.3-1**.

The total pollutant loads presented in **Table 3.3-1** only accounts for inputs around the lakeshore and do not include pollutant loadings from the rivers that contribute to Eufaula Lake. According to ODWC (2008), Eufaula Lake receives an annual sediment inflow of 7,249 acre feet (AF) from contributing rivers. Under current conditions, the average phosphorus concentration in the lake is 0.070 ppm, and the average nitrogen concentration is 0.410 ppm. More detail on the model results are provided in **Appendix D**.

**Table 3.3-1. Pollutant Loading into Eufaula Lake**

| | USACE-Owned Land | USACE-Owned Land and Adjacent Private Land |
|---|---|---|
| **Land Use Inputs (acres)** | | |
| Urban | 2,302 | 8,544 |
| Pasture | 14,531 | 101,797 |
| Forest | 45,838 | 131,242 |
| Wetlands | 2,291 | 4,616 |
| Total Area | 64,962 | 246,199 |
| **Total Pollutant Loadings (Model Outputs)** | | |
| Runoff (AF) | 38,832 | 155,011 |
| P (lb/yr) | 22,661 | 106,200 |
| N (lb/yr) | 158,163 | 942,021 |
| BOD (lb/yr) | 481,656 | 2,950,824 |
| Sediment (tons/yr) | 3,921 | 14,384 |

### *Chlorophyll-a*

Chlorophyll-*a* measures productive algae biomass in the water column. Algal blooms can deplete the dissolved oxygen in the water as they decompose which may harm fish. Algal blooms can also release toxins into the water, which can affect people engaged in water contact sports such as swimming or water skiing.

Chlorophyll-*a* concentrations in Eufaula Lake ranged from a minimum of 0.7 ug/L to a maximum of 92.7 ug/L, with a lake wide mean of 10.47 ug/L. USACE staff reported an algal bloom in summer 2011, although no water quality data were collected during the event. There is no applicable chlorophyll-*a* WQS for Eufaula Lake.

In May, June, August, and September 2012, the USACE Tulsa District collected samples from six sites to evaluate blue-green algae (the term blue-green algae will be used in this document to refer to cyanobacteria). In May, blue-green algae presence was detected at Porum Landing in excess of 100,000 cells/mL. In June, blue-green algae presence had declined at Porum landing but remained above 100,000 cells/mL. In August, blue-green algae were present at Brooken Cove, Highway 9 Landing, Porum Landing, and Belle Starr Park in excess of 100,000 cells/mL and blue-green algae were present at Elm Point and Gentry Creek at levels below the 100,000 cells/mL threshold. Blue-green algae in excess of 100,000 cells/mL were detected at Porum Landing, Brooken Cove, and Highway 9 Landing in September (**Figure 3.3-2**). Recreational surveys during the summer of 2012 noted the presence of blue-green algae in Deep Fork Arm, and helicopter surveys identified algae on Gaines Creek Arm; these observations suggest the problem is more widespread than sampling may indicate. Overall, levels climbed at all sample sites as the summer progressed. The presence of algae is widespread throughout Eufaula Lake and given the limited sampling locations, algae could be occurring anywhere on the lake.

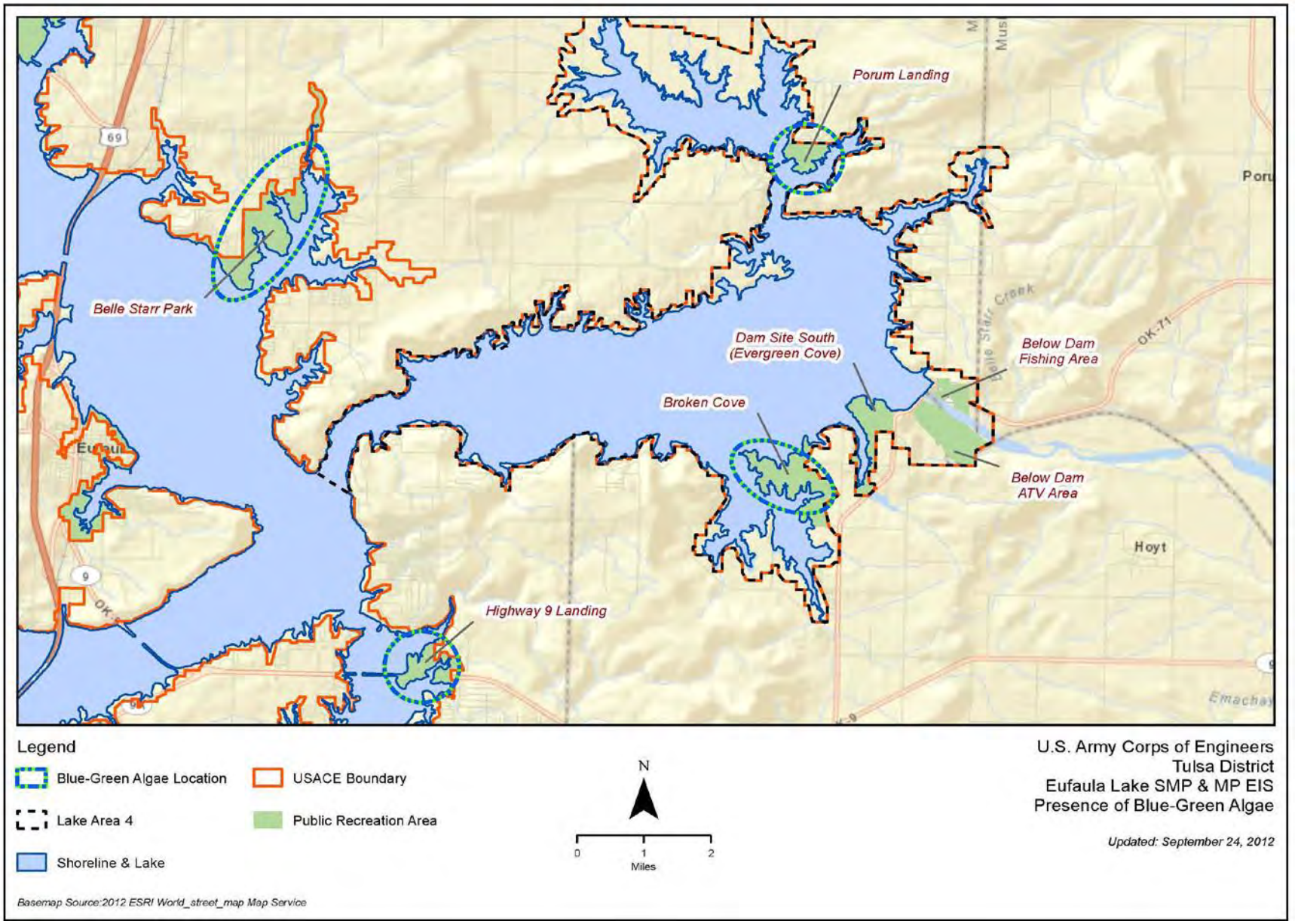



**Figure 3.3-2. Areas Impacted by Blue-Green Algae**

### *Specific Conductance*

Conductivity is useful as a general measure of stream water quality. Each stream tends to have a relatively constant range of conductivity that, once established, can be used as a baseline for comparison with regular conductivity measurements. Significant changes in conductivity could then be an indicator that a discharge or some other source of pollution has entered a stream.

Only one measurement of specific conductance was taken by OWRB (1,468 µS/cm was recorded at Site 4 in November 2006). From the 2001 USACE data, specific conductance ranged from a minimum of 114 µS/cm to a maximum of 872 µS/cm, with a lake-wide mean of 416 µS/cm. Based on the OCC data, conductivity in area streams varied from a minimum of 46.00 µS/cm to a maximum of 5,099 µS/cm.

### *Total Nitrogen and Total Phosphorus*

Total nitrogen and phosphorus are measures of the level of nutrients in the water. High levels of nutrients may support algal blooms.

All of the total nitrogen samples were collected between 2001 and 2009. Generally only one or two samples were collected at the OWRB sites, while more samples at various depths were collected at each of the USACE sites. Total nitrogen concentrations in Eufaula Lake ranged from a minimum of <0.02 mg/L to a maximum of 2.58 mg/L, with a lake-wide mean of 0.77 mg/L. The *OCWP Eufaula Regional Report* noted an upward trend for total nitrogen at Eufaula Lake between 1995 and 2009. There is no applicable WQS for Eufaula Lake; however, the WQS for nitrates of 10 mg/L would apply to Eufaula Lake under its public water supply designation. From the OCC data, nitrates in streams varied from a minimum of <0.02 mg/L to a maximum of 5.55 mg/L, with a mean of 0.22 mg/L.

Total phosphorus concentrations in Eufaula Lake ranged from a minimum of 0.011 mg/L to a maximum of 0.460 mg/L, with a lake-wide mean of 0.06 mg/L. There is no applicable total phosphorus WQS for Eufaula Lake. From the OCC data, total phosphorus concentrations in streams varied from a minimum of 0.007 mg/L to a maximum of 3.278 mg/L, with a mean of 0.165 mg/L.

### *Turbidity*

Turbidity is a measure of water clarity how much the material suspended in water decreases the passage of light through the water. Higher turbidity increases water temperatures because suspended particles absorb more heat. This, in turn, reduces the concentration of dissolved oxygen (DO) because warm water holds less DO than cold water does. Higher turbidity also reduces the amount of light penetrating the water, which reduces photosynthesis and the production of DO. Suspended materials can clog fish gills, reducing resistance to disease in fish, lowering growth rates, and affecting egg and larval development. As the particles settle, they can blanket the stream bottom, especially in slower waters, and smother fish eggs and benthic macroinvertebrates. Turbidity is measured in nephelometric turbidity units or NTUs.

According to the USACE data, turbidity concentrations in Eufaula Lake ranged from a minimum of 0.20 NTU to a maximum of 745.40 NTU with a lake-wide mean of 32.60 NTU. The State of Oklahoma lake water quality standard for turbidity is 25 NTU.

For turbidity, a minimum of ten samples must be collected under seasonal base flow conditions to make an attainment determination. According to Oklahoma Water Quality Standards (Oklahoma Administrative Code Title 785, Chapter 45), the Fish and Wildlife Propagation beneficial use is considered attained if ten percent or fewer of the samples collected exceed the screening level of 25 NTUs. Of the 38 assessment

sites sampled in conjunction with the SHA, 23 contained turbidity values greater than the 25 NTU threshold. Based on the water quality data collected, 40 percent of samples exceeded the 25 NTU threshold.

### *Alkalinity*

Alkalinity is a measure of the capacity of water to neutralize acids. Measuring alkalinity is important in determining a stream's ability to neutralize acidic pollution from rainfall, wastewater, or acid mine drainage. Alkalinity is one of the best measures of the sensitivity of the waterbody to acid inputs.

Alkalinity (as CaCO3) concentrations from Eufaula Lake ranged from a minimum of <5.0 mg/L to a maximum of 161.0 mg/L with a lake-wide mean of 90 mg/L. There is no applicable alkalinity WQS for Eufaula Lake. The lowest recorded values of alkalinity were observed in the Gaines Creek Arm (OWRB Sites 16 and 17), which is consistent with observations by the USACE. The 2001 Eufaula Lake Water Quality Report by USACE reported that "alkalinity levels in the lake were moderate implying most of the lake is reasonably well buffered; an exception may be portions of the Gaines Creek Arm where the lowest alkalinities were observed" (USACE 2012). In addition, acid mine drainage is located in the Gaines Creek Arm. Acid mine drainage is characterized by elevated acidity, and may be affecting the buffering capacity of the Eufaula Lake in this area.

### *Metals*

Water samples were tested for arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc. No measurable concentrations were found for barium, copper, selenium and silver. No measurable cadmium, chromium, lead or mercury levels were found at the OWRB sites. However, three USACE sites found cadmium samples above the chronic criterion.

All seven observations of lead were below Oklahoma's criteria for public and private water supply, but above the chronic criteria for fish and wildlife propagation, and equal to or above the criteria for fish consumption and water.

Several of the observations of mercury were at or above the Oklahoma criterion for fish consumption and water.

Zinc was measurable in both of the OWRB site samples but at levels lower than the Oklahoma WQS of 5.0 mg/L for public and private water supply.

### *Dissolved Oxygen, Temperature, and pH*

Oxygen is measured in its dissolved form as dissolved oxygen (DO). If more oxygen is consumed than is produced, dissolved oxygen levels decline and some sensitive animals may move away, weaken, or die. The rates of biological and chemical processes depend on temperature. Aquatic organisms from microbes to fish are dependent on certain temperature ranges for their optimal health. Optimal temperatures for fish depend on the species. In addition, warmer waters hold less dissolved oxygen which can limit the ability of aquatic organisms to live in certain locations. pH affects many chemical and biological processes in the water. For example, different organisms flourish within different ranges of pH. The largest variety of aquatic animals prefers pH values within a range from 6.5 to 8.0.

At OWRB site 4, measurements for dissolved oxygen, pH, and water temperature were collected in November 2006. According to the OCC data, dissolved oxygen concentrations in streams varied from a

minimum of 2.79 mg/L to a maximum of 15.44 mg/L, with a mean of 8.67 mg/L. Surface concentrations of dissolved oxygen ranged from 4.99 mg/L to 11.63 mg/L, with a mean of 7.9 mg/L. Dissolved oxygen concentrations near the bottom ranged from 0.07 mg/L to 8.85 mg/L, with a mean of 4.41 mg/L.

The numerical limits to protect the beneficial use of Fish and Wildlife Propagation for the single parameter of dissolved oxygen depends on several factors, including the pertinent subcategory or fishery class, the time of year, and the seasonal temperature. For dissolved oxygen, the WWAC subcategory of the Fish and Wildlife Propagation beneficial use designated for a stream or the surface water of a lake is deemed to be attained if ten percent or fewer of collected samples are less than 5.0 mg/L from April 1 through June 15 and less than 4.0 mg/L from June 16 through October 15. Testing in conjunction with the SHA indicated that none of the 38 sites contained dissolved oxygen levels below the 5.0 mg/L threshold.

Water temperature ranged from 12.2 degrees Celsius to 32.3 degrees Celsius, with a lake-wide mean of 24.77 degrees Celsius.

The pH ranged from 6.75 to 9.12 with a lake-wide mean of 7.86. According to OCC data, the pH in streams tributary to Eufaula Lake had a mean of 7.67. The beneficial use is considered attained if pH values in ten percent of samples or fewer fall outside the screening range of 6.5 and 9.0. Of the 38 sites tested in conjunction with the SHA, seven (18 percent) recorded pH values were outside of the acceptable range.

### *General Narrative Criteria*

Water taste and odor, and nutrients are addressed under the general narrative criteria for beneficial uses.

For solids, the surface waters are to be essentially free of floating debris, bottom deposits, scum, foam, and other persistent suspended substances. Several assessment sites identified the presence of floating white foam, which may originate from natural sources plus wave action. The presence of foam may indicate that the study area's ability to meet the solids general narrative criterion is compromised.

The criteria for beneficial use regarding water taste and odor states that any unnatural substances that interfere with the production of a potable water supply, produce abnormalities in the flesh of fish and other edible wildlife, or result in offensive odors in the vicinity of the water are prohibited. While several assessment locations contained a natural fishy smell, no unnatural water odors were encountered.

Finally, nutrients from all sources are not to cause excessive growth of periphyton, phytoplankton, or aquatic macrophyte communities, which impairs any existing or designated beneficial use. While excessive nutrient inputs were absent in many assessment locations, the presence of green algae in the littoral zone at 18 of the SHA sample locations and blue-green algae blooms at several recreation areas over the summer (Belle Starr, Brooken Cove, Highway 9 Landing, and Porum Landing) demonstrate that localized nutrient inputs are an issue.

### *Shoreline Quality*

Using protocols and indices developed for the U.S. EPA National Lakes Assessment, the SHA determined values for four integrative measures of lake condition to ascertain shoreline quality within the study area: Lakeshore Disturbance Index, Lakeshore Habitat Index, Shallow Water Habitat Index, and Physical Habitat Complexity Index.

The Lakeshore Disturbance Index is based on the presence and proximity of 12 types of human activities or disturbances at each SHA location. The index is scaled from 0 to 1, with 0 indicating no human disturbance,

and 1 indicates high disturbance. The Eufaula Lake study area values ranged from 0.25 to 0.65, indicating medium levels of disturbance.

The Lakeshore Habitat Index quantifies riparian cover and complexity based on visual estimates of vegetation cover and structure. This index also varies from 0 to 1, where 0 indicates the absence of cover and complexity and 1 indicates riparian vegetation conditions of the highest quality. The Eufaula Lake study area values ranged from 0 to 0.61; therefore, low to medium levels of disturbance exist.

The Shallow Water Habitat Index quantifies littoral cover and complexity and is based on visual estimates of the aerial cover of ten types of littoral cover features including woody snags, inundated brush, inundated live trees, inundated herbaceous vegetation, overhanging vegetation, rock ledges, boulders, and human structures. This index varies from 0 to 1, where 0 indicates the absence of littoral cover and complexity and 1 indicates the presence of a diverse array of littoral cover types. The Eufaula Lake area values ranged from 0 to 0.79; therefore, the littoral cover quality ranges from absent to high.

The Physical Habitat Complexity Index is the mean of the values for the three indexes listed above. The Eufaula Lake area values ranged from 0 to 0.61, indicating low to medium levels of riparian and littoral cover and complexity.

### 3.3.4.6 Potential Sources of Nonpoint Source Pollution

#### *Septic Systems*

Septic systems are responsible for treating large quantities of waste and many residential developments in rural areas depend on septic systems for waste management. These systems, if improperly managed and/or maintained, may contribute to surface water pollution and result in elevated nutrient or bacteria loads to Eufaula Lake. According to EPA, 10 to 20 percent of all septic systems fail at some point (EPA 2003). Common causes of failure include aging, inappropriate design, overloading with too much wastewater in too short a period of time, and poor maintenance.

Many homes within the Eufaula Lake watershed and along the shoreline are served by septic systems. Over 5,000 septic systems are located in the counties around Eufaula Lake. Septic system data were obtained for the entire counties of Pittsburg, McIntosh, Muskogee, Haskell, and Okmulgee counties. The data set includes 1,176 permitted septic systems in Pittsburg County; 1,012 in McIntosh County; 1,221 in Muskogee County, 387 in Haskell County; and 1,356 in Okmulgee County. The septic system data set is limited to recently installed systems and is missing significant location information that would be necessary for a geographically-specific analysis. With the current data set, it is not possible to conduct a detailed analysis of septic system locations and potential impacts on water quality.

#### *Acid Mine Drainage*

Acid mine drainage (AMD) is a major nonpoint source pollution concern in many former mining regions. AMD is formed by the oxidizing action of air and water on exposed sulfidic strata and is characterized by elevated concentrations of metals (especially iron and aluminum), acidity, and sulfate. In Eufaula Lake, AMD impacts from abandoned coal mining activities are only present in Gaines Creek, which flows into the Gaines Creek arm in Lake Area 6 (Lake Areas are shown on **Figure 3.7-1**). The AMD source is located in the Gaines Creek watershed upstream of the government lands around the reservoir (Nairn 2000).

*Lawn Fertilization*

Many residences adjacent to the Limited Development shorelines apply fertilizers to their lawns and other landscaped areas. Excess amounts of fertilizer may enter streams causing nonpoint source pollution. Fertilizers most commonly enter water sources from surface runoff and leaching from agricultural lands. Increased amounts of nutrients can have negative impacts on public health and aquatic ecosystems. Over application of fertilizer can lead to nutrients entering the lake through stormwater runoff.

The impact of fertilization on water quality depends in part on the distance between the point of fertilizer application and the lake shore. Areas of natural vegetation where fertilizer is not applied can act as a buffer by filtering nutrients out of the stormwater runoff and reducing the amount of nutrients that enter the surface waters (Mayer *et al.*, 2007).

### 3.3.4.7 Impaired Waterbodies

Several streams in the Eufaula Lake watershed are impaired for their designated uses, as shown on **Table 3.3-2**. Total Maximum Daily Loads (TMDLs) are developed to address water quality concerns in impaired waterbodies. A TMDL is a tool for ensuring water quality meets applicable WQS. TMDLs are developed by ODEQ based on available funding. ODEQ has developed TMDLs for portions of the watersheds of the Canadian River and the Deep Fork River upstream of Eufaula Lake. Currently, no TMDLs have been developed for Eufaula Lake.

**Table 3.3-2. List of Impaired Waterbodies in Eufaula Lake Watershed**

| Waterbody Name | Cause of Impairment | Impaired Use |
|---|---|---|
| Eufaula Lake | Dissolved Oxygen | FWP – Warm Water Aquatic Community |
| | Turbidity | FWP – Warm Water Aquatic Community |
| | Color | Aesthetic |
| Mud Creek | Fish Bioassessments | FWP – Warm Water Aquatic Community |
| | Lead | Fish Consumption |
| | Sedimentation/Siltation | Aesthetic |
| | Turbidity | FWP – Warm Water Aquatic Community |
| | Dissolved Oxygen | FWP – Warm Water Aquatic Community |
| | Zinc | FWP – Warm Water Aquatic Community |
| Longtown Creek | Dissolved Oxygen | FWP – Warm Water Aquatic Community |
| Mill Creek | Dissolved Oxygen | FWP – Warm Water Aquatic Community |
| Canadian River | Enterrococcus | Primary Body Contact Recreation |
| | Sedimentation/Siltation | FWP – Warm Water Aquatic Community |
| | Turbidity | FWP – Warm Water Aquatic Community |
| | Thallium | Fish Consumption |
| | Sulfates | Agriculture |
| | Lead | Aesthetic |
| | Fish Bioassessments | Fish Consumption |
| Canadian River, Deep Fork | Enterococcus | Primary Body Contact Recreation |
| | Fecal Coliform | Primary Body Contact Recreation |
| | Lead | Fish Consumption |
| | Sedimentation/Siltation | Aesthetic |
| | Turbidity | FWP – Warm Water Aquatic Community |

| Waterbody Name | Cause of Impairment | Impaired Use |
|---|---|---|
| Hay Creek | Chloride | Agriculture |
| | Oil and Grease | Aesthetic |
| | Total Dissolved Solids | FWP – Warm Water Aquatic Community |
| Big Creek | Chloride | Agriculture |
| | Total Dissolved Solids | Agriculture |
| Brushy Creek | Turbidity | FWP – Warm Water Aquatic Community |
| | Lead | Fish Consumption |
| | Oil and Grease | Aesthetic |
| | Dissolved Oxygen | FWP – Warm Water Aquatic Community |
| Peaceable Creek | Sulfates | Agriculture |
| | Dissolved Oxygen | FWP – Warm Water Aquatic Community |
| Bull Creek | Copper | FWP – Warm Water Aquatic Community |
| | Lead | FWP – Warm Water Aquatic Community |
| | Zinc | FWP – Warm Water Aquatic Community |
| Gaines Creek | Oil and Grease | Aesthetic |
| | Dissolved Oxygen | FWP – Warm Water Aquatic Community |
| | pH | FWP – Warm Water Aquatic Community |
| Beaver Creek | Oil and Grease | Aesthetic |
| | Turbidity | FWP – Warm Water Aquatic Community |
| | pH | FWP – Warm Water Aquatic Community |
| | Dissolved Oxygen | FWP – Warm Water Aquatic Community |
| Pit Creek | Dissolved Oxygen | FWP – Warm Water Aquatic Community |
| | pH | FWP – Warm Water Aquatic Community |
| | Sulfates | Agriculture |
| | Total Dissolved Solids | Agriculture |
| Tiger Creek | Chloride | Agriculture |
| Carter Creek | Chloride | Agriculture |
| | Total Dissolved Solids | Agriculture |
| Wewoka Creek | Cadmium | FWP – Warm Water Aquatic Community |
| | Chloride | Agriculture |
| | Nitrates | Public and Private Water Supply |
| | Sulfates | Agriculture |
| | Total Dissolved Solids | Agriculture |
| Magnolia Creek | Chloride | Agriculture |
| | Total Dissolved Solids | Agriculture |
| Salt Cedar Creek | Chloride | Agriculture |
| | Total Dissolved Solids | Agriculture |
| Wewoka Creek, Tributary A | Chloride | Agriculture |
| | Total Dissolved Solids | Agriculture |
| Oakwood Cemetery Creek | Chloride | Agriculture |
| | Total Dissolved Solids | Agriculture |
| Gentry Creek | Enterococcus | Primary Body Contact Recreation |
| | Escherichia coli | Primary Body Contact Recreation |
| | Dissolved Oxygen | FWP – Warm Water Aquatic Community |

| Waterbody Name | Cause of Impairment | Impaired Use |
|---|---|---|
| Grave Creek | Chloride | Agriculture |
| Coal Creek | Turbidity | FWP – Warm Water Aquatic Community |
| Wolf Creek | Fish Bioassessments | FWP – Warm Water Aquatic Community |

# 3.4 Geology, Soils, and Mineral Resources

This section provides information on the geology, soils, and mineral resources at Eufaula Lake.

## 3.4.1 Area of Analysis (Geology, Soils, and Mineral Resources)

The area of analysis for this section includes the lake and the adjacent USACE-owned lands surrounding the lakeshore. The area of analysis also includes adjacent lands that may be affected by federal management actions at the lake. The Carlton Landing study area includes the government-owned lakeshore, the adjacent private lands proposed for development, and any associated areas that might be affected by the development.

## 3.4.2 Regulatory Setting (Geology, Soils, and Mineral Resources)

### 3.4.2.1 Federal

*Mining and Minerals Policy Act of 1970 (30 U.S.C. § 21 et seq.)*

An amendment to the Mineral Leasing Act, this statute encompasses both hard rock mining and oil and gas development and established modern federal policy regarding mineral resources in the United States. The Act articulated a national interest to foster and encourage private enterprise while mitigating adverse environmental impacts.

*Army Regulation 405-30 Mineral Exploration and Extraction*

Under this regulation, it is the policy of the Department of the Army that all lands under its control will be made available for oil and gas leasing, except at installations or at civil works projects specifically excluded from such leasing upon the recommendation of USACE and approval by the Assistant Secretary of the Army for Installations and Environment. Lease requests are first submitted to the Bureau of Land Management (BLM) which determines whether the offer is sufficient. For mineral and gas lease requests at Eufaula Lake, BLM would then forward the offer to the Tulsa District. As the federal land manager for Eufaula Lake, the Tulsa District would work with the local BLM office to ensure that the proposed mineral or gas extraction is consistent with the Eufaula Lake Project purposes before granting consent to lease.

*Federal Land Policy and Management Act of 1976 (43 U.S.C. §1701 et seq.)*

The Federal Land Policy and Management Act (FLPMA) consolidated and articulated the Bureau of Land Management (BLM) responsibilities and delegated many management responsibilities pertaining to federal land from the Secretary of the Interior to the Director of the BLM, including oversight of oil and gas leases. FLPMA provides an express congressional policy aimed at retaining federal control and possession over valuable lands and mineral resources. FLPMA established multiple use, sustained yield, and environmental protection as the guiding principles for public land management. Specifically, BLM must take any action necessary to prevent unnecessary or undue degradation of the lands. These policies would be considered

by BLM in determining the sufficiency of a request for a lease for extraction of minerals, oil, or gas and before BLM forwards such requests to USACE.

#### 3.4.2.2 State

*Oklahoma Administrative Code, Title 165, Chapter 10: Oil and Gas Conservation*

Part of the Oklahoma Corporation Commission , Oil and Gas Division rules, this Chapter defines requirements to prevent the waste of oil and gas, to assure the greatest ultimate recovery from the state's reservoirs, to protect the correlative rights of all interest owners, and to prevent pollution. The Oklahoma Corporation Commission is a regulatory agency of the State of Oklahoma, with an emphasis on the fuel, oil and gas, public utilities, and transportation industries.

### 3.4.3 Existing Conditions (Geology, Soils, and Mineral Resources)

#### 3.4.3.1 Regional Geology

Eufaula Lake is located within the Arkoma geologic province at an elevation of approximately 585 feet. The broad rolling hills surrounding the prairie plains in which the lake is situated rise to elevations of just over 800 feet. The ridge and plain topography is due to unequal resistance to erosion, with hills capped with resistant sandstone and plains formed by shales (USACE 2010).

The primary geological formations within the boundaries of Eufaula Lake belong to the Krebs group of the Des Moines series and consist primarily of shales, sandstones, and a few minor limestones of Pennsylvanian age. Unique rock outcroppings are found along the high plateaus and hilly areas and contribute to the scenic quality of the region.

#### 3.4.3.2 Soils

The Eufaula Lake MP identifies a series of 25 types of soils that occur in the Eufaula Lake region (USACE 2010), and additional soil types present in the area of analysis are identified in the *Eufaula Lake Shoreline Management Permit Guidance for Shoreline and Wildlife Habitat Protection* (USACE 2012). Many soil types found near the shoreline are susceptible to erosion (**Figure 3.4-1**). The soil type, the slope of the land near the shoreline, and the type and amount of vegetation cover are all important criteria in determining the potential for soil erosion in shoreline areas.

Vegetation stabilizes the soil and slows the movement of water over the land surface toward the lake, thus reducing the loss of soil and subsequent sedimentation in the lake. The current Eufaula Lake SMP regulates vegetation management activities on the government-owned shorelands (USACE 1998). Any modification of vegetation along the shoreline must be approved through a shoreline use permit from the Lake Manager. When issued, this permit may allow mowing of an area from the private property line to the shoreline within the width of the private property as extended onto the public land. Mowing of vegetation is restricted to no more than a 30-foot strip of public property adjacent to the private property when there is significant wildlife habitat or scenic/aesthetic quality to the area proposed for mowing. In addition, current regulations restrict the removal of any flowering trees, shrubs, or redbud, regardless of the size, as well as trees or shrubs larger than 4 inches in diameter (USACE 1998).

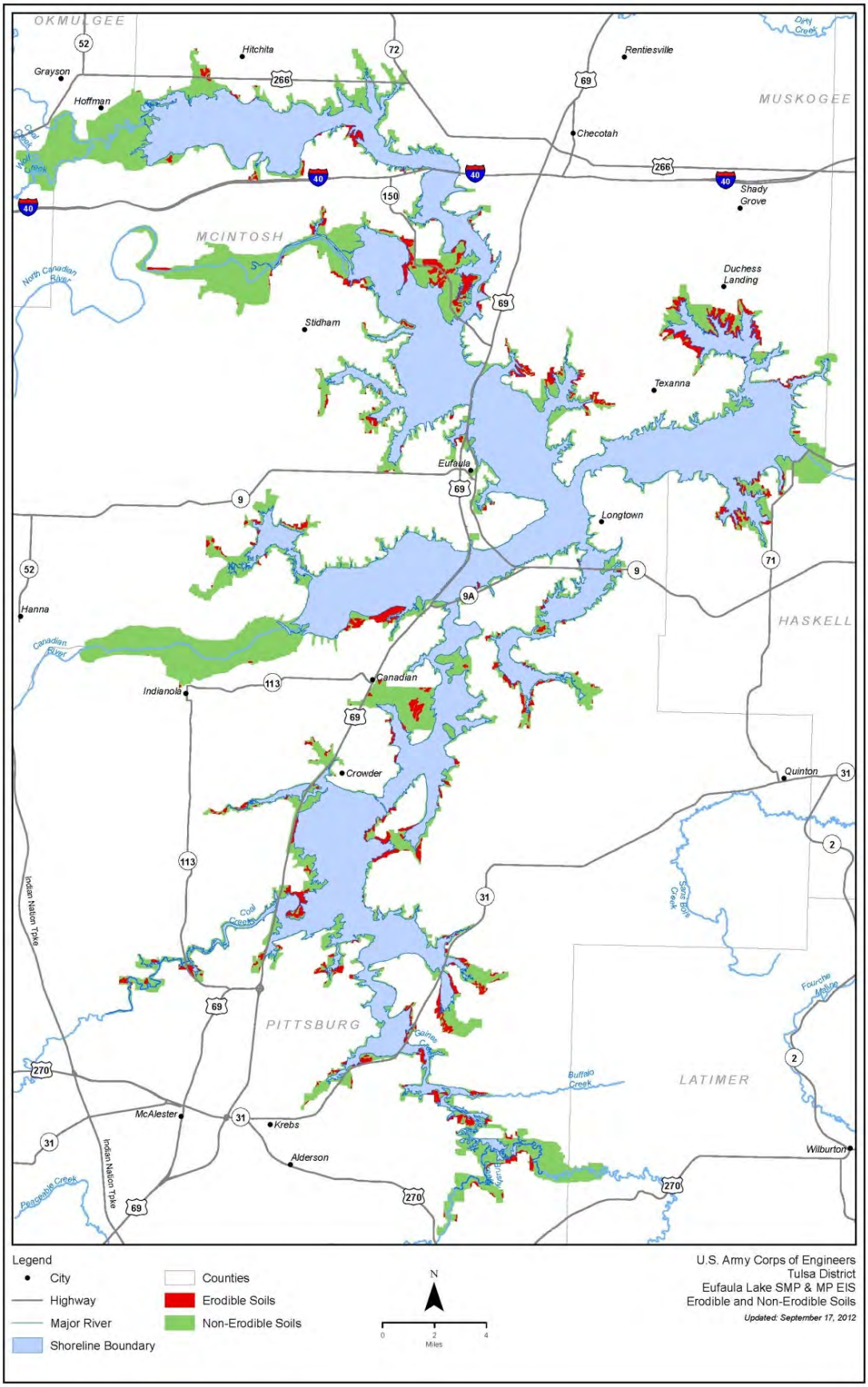



**Figure 3.4-1. Erodible Soils around Eufaula Lake**

The SMP also describes the erosion control policies in place for Eufaula Lake. Prior to conducting erosion control activities, a landowner must obtain a permit from the Lake Manager, and all work must meet the specifications of Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act. The SMP includes requirements on the size, materials, and methods to be used for erosion control, and the Lake Manager must approve the type of rock and species of plants to be used along the shoreline. Structures such as retaining walls must be designed by a state licensed civil or structural engineer experienced in retaining wall construction and the design reviewed by USACE. If soil erosion is occurring on a trail, the trail may be closed unless improvements are approved through the permitting process (USACE 1998).

### 3.4.3.3 Mineral Resources

Mineral resources in the Eufaula Lake region include natural gas and coal. Petroleum production began in 1912 with the completion of the first natural gas well. Landowners with mineral rights can apply to drill a well to extract mineral resources, following an environmental review and approval by USACE (Schrodt 2012) as described in Army Regulation 405-30. All new wells are required to be located above the flood pool elevation of the lake; however, some existing wells are located below the flood pool elevation. The Oklahoma Corporation Commission regulates the drilling and operation of oil and gas extraction wells in Oklahoma and oversees regular inspection and monitoring requirements. **Figure 3.4-2** depicts a gas well located on USACE lands near Eufaula Lake. Many natural gas wells are located on USACE lands within the area of analysis, as shown in **Figure 3.4-3**.

Coal mining began in the region in the 1870s, first with underground shaft mining and later, beginning in the 1970s, strip-mining (Sewell 2007). The largest commercial coal mining area near Eufaula Lake is known as the Secor vein, located in northern McIntosh County. Coal mining also occurred south of Eufaula Lake in the Gaines Creek watershed where the Hartshorne coal outcrop is located. The last of the underground mines in this area ceased operation in the 1920s or early 1930s (Cobbs 1979). There is currently no active coal, sand, or rock mining around Eufaula Lake within the area of analysis (Schrodt 2012).

**Figure 3.4-2. Natural Gas Well at Eufaula Lake**

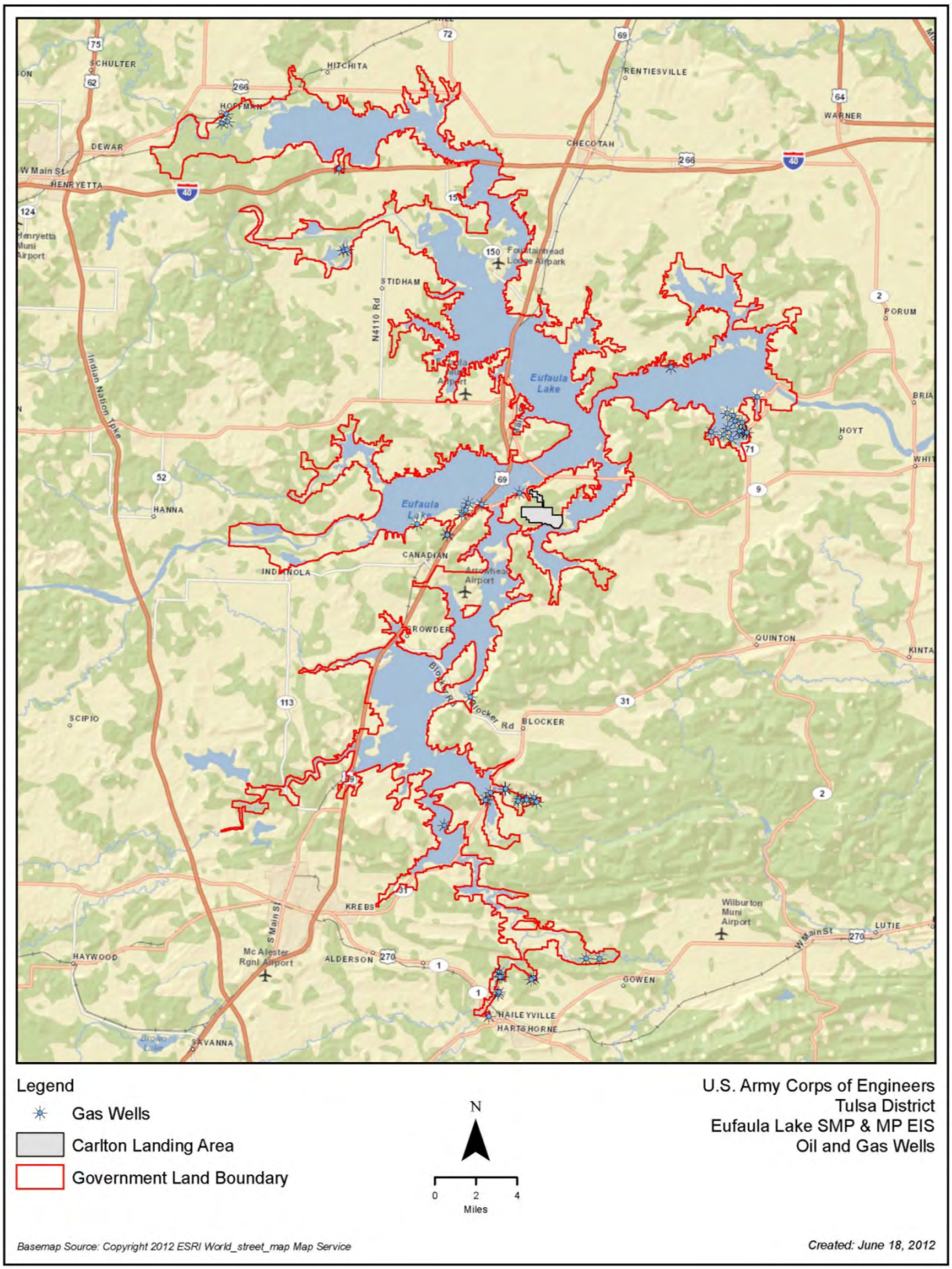



**Figure 3.4-3. Oil and Gas Wells on USACE-owned Lands at Eufaula Lake**

# 3.5 Aesthetics and Visual Resources

## 3.5.1 Area of Analysis (Aesthetics and Visual Resources)

The study area for the visual resources assessment includes Eufaula Lake below the normal pool elevation of 585 feet above MSL, and all land within 3,000 feet from that shoreline. This distance was selected to attempt to include most land that is visible from the lake. Although government-owned property around Eufaula Lake exceeds this distance in some locations, such as in WMAs, this report focuses on the areas that might be affected visually by changes in the SMP. Land within the study area was evaluated to determine its basic visual character and develop a framework for assessing specific viewpoints. In forecasting future conditions, the primary focus areas were those that are visible from the lake, shoreline, and bridges. Representative locations were selected to predict the likely overall impact of the different shoreline management alternatives under consideration for the SMP revision.

## 3.5.2 Regulatory Setting (Aesthetics and Visual Resources)

Several laws, regulations, and policies provide guidance to and serve as the regulatory framework for the visual resources assessment including the Rivers and Harbors Act of 1894, the Clean Water Act, the Flood Control Act of 1944, the Federal Water Project Recreation Act of 1965, and Rules and Regulations Governing Public Use of Water Resources Development Projects Administered by the Chief of Engineers. These regulations are described in Section 1.6.

Local counties and cities enact zoning regulations to guide development within their jurisdictional areas. These development rules can considerably affect the aesthetic quality of the landscape. Local land use is described in Section 2.8 of Appendix H. The counties surrounding Eufaula Lake and the City of Crowder have not enacted zoning ordinances although most of the land uses immediately adjacent to the lake are residential. The City of Eufaula has established land use zones adjacent to the lake, which include residential and commercial zones.

## 3.5.3 Data Collection (Aesthetics and Visual Resources)

The visual analysis was conducted using the methodology in the Visual Resources Assessment Procedure (VRAP) for USACE as developed by Smardon *et al.* (1988). The procedure uses the Visual Management Classification System (MCS) to identify Landscape Similarity Zones (LSZ), inventory visual resources, and establish an assessment framework based on local aesthetic values.

Visual or scenic resources are the natural and built features of the landscape that contribute to the public's experience and appreciation of the environment. The principal steps required to identify visual resources are as follows:

- Management Classification System: The Regional Landscape (visual setting and character of Eufaula Lake in general) was defined, and LSZs and visual resources of the study area were identified. Each LSZ was assigned to a Management Class.
- Visual Sensitivity and Key Views: Key viewpoints for visual assessment were identified where potential land use changes resulting from the SMP revision would be most visible to viewers.

The Regional Landscape provides a frame of reference for the inventory and evaluation of visual resources. Within the Regional Landscape, landforms, water resources, vegetation, and climate tend to exhibit common characteristics (Smardon *et al.* 1988). The Regional Landscape was described based on

physiographic and ecoregion characteristics as described by Woods *et al.* (2005), as well as field observations at Eufaula Lake in February and April, 2012.

Within the Regional Landscape, Landscape Similarity Zones (LSZs) were identified that represent areas of land that share common characteristics of landform, water resources, vegetation/ecosystems, land use, and land use intensity.

Ten LSZs were established within the study area: Forest, Grassland/Prairie/Pasture, Farmland, Wetland, Recreation Area, Residential - Medium Density, Urban-Commercial/Industrial, Transportation, Marinas, and High Density Docks. GIS data from the USGS 2006 National Land Cover Dataset (USGS 2011) and aerial photography were used to identify and map the similarity zones within the study area. The LSZs and their component land use and/or cover type are summarized in **Table 3.5-1**. A map of the Eufaula Lake study area and the LSZs is presented in Figures 3-1 through 3-6 in Appendix F.

**Table 3.5-1. Landscape Similarity Zones Established for Eufaula Lake**

| Landscape Similarity Zone | | Acres | Component Land Cover or Use | Data Source |
|---|---|---|---|---|
| 1 | Forest | 91,712 | Deciduous forest, evergreen forest, mixed forest | USGS 2011 |
| 2 | Grassland/ Pasture/ Prairie | 60,777 | Grasslands/herbaceous, pasture/hay, shrubland, urban/recreational grasses | USGS 2011 |
| 3 | Farmland | 726 | Orchards/Vineyards, row crops, small grains, fallow | USGS 2011 |
| 4 | Wetland | 4,080 | Emergent herbaceous wetlands, woody wetlands | USGS 2011 |
| 5 | Recreation Area | 12,128 | Parkland areas | USACE 2011 |
| 6 | Residential - medium density | 14,218 | developed, open space; developed, low intensity | USGS 2011 |
| 7 | Urban - Commercial/ Industrial | 281 | developed, high intensity; railroad corridors | USGS 2011; USACE 2012 |
| 8 | Transportation | 1,150 | highways and bridges | ESRI, Inc. 2005 |
| 9 | Marinas | 194 | marinas | Aerial photography |
| 10 | High Density Docks | 2,111 | high density docks | Aerial photography |
| **Total Acres** | | **187,378** | | |

To create an assessment framework, judgments are made about the existing visual quality of each zone by identifying examples of resource categories that exhibit each of three levels of visual quality: Distinct, Average, and Minimal (Smardon *et al.* 1988). These levels are defined by Smardon *et al.* (1988) as follows:

- Distinct – something that is considered unique and is an asset to the area. It is typically recognized as a visual/aesthetic asset and may have many positive attributes. Diversity and variety are characteristics in such a resource.
- Average – something that is common in the area and not known for its uniqueness, but rather is representative of the typical landscape of the area.

- Minimal – something that may be looked upon as a liability in the area. It is basically lacking any positive aesthetic attributes and may actually diminish the visual quality of surrounding areas.

The assessment framework is then used as a basis for evaluating the visual impacts of the different alternatives.

## 3.5.4 Existing Conditions (Aesthetics and Visual Resources)

### 3.5.4.1 Regional Landscape

The upland vegetation and terrestrial habitats present within the Eufaula Lake study area are described below as presented in Ecoregions of Oklahoma (Woods *et al.* 2005).

The Eufaula Lake study area falls within four different ecoregions: the Northern Crosstimbers, the Osage Cuestas of the Central Irregular Plains, Scattered High Ridges and Mountains of the Arkansas River Valley, and the Lower Canadian Hills of the Arkansas River Valley (Woods *et al.* 2005). These ecoregions give the study area a varying aesthetic of steep, rocky slopes, sandy lowlands, tall hills with dry forest, and scattered grasslands.

The Northern Crosstimbers are located on the northern and western portions of the Eufaula Lake study area, to the north of the main channel of the Canadian River. The Northern Crosstimbers consist of hills, cuestas, and ridges that are naturally covered by a mosaic of oak savanna, scrubby oak forest, eastern redcedar (*Juniperus virginiana*), and tall grass prairie. Today, livestock farming and large oilfields are the main land uses of this ecoregion; however, they are not highly visible from within the study area (Woods *et al.* 2005).

The Osage Cuestas ecoregion is located on the very northern section of the study area. This ecoregion is an irregular to undulating plain that is underlain by interbedded, westward-dipping sandstone, shale, and limestone. East-facing cuestas and low hills occur. Topography and vegetation are distinct from nearby ecoregions. Natural vegetation is mostly tall grass prairie, but a mix of tall grass prairie and oak–hickory forest occurs in eastern areas. Today, rangeland, cropland, riparian forests, and on rocky hills, oak woodland or oak forest occur (Woods *et al.* 2005).

The Lower Canadian Hills ecoregion covers the majority of the study area south of the Northern Crosstimbers. This ecoregion is underlain by Pennsylvanian-age shale, sandstone, and coal. It acts as a transition between the drier Crosstimbers to the west and moister parts of the Arkansas Valley to the east. Native vegetation is a mixture of oak woodland, tall grass prairie, oak–hickory forest, and oak–hickory–pine forest. Today, steep slopes are wooded and used for timber, woodland grazing, or recreation. Gently sloping uplands are used as pastureland or hayland. Cropland or pastureland occurs on bottomlands. Other main land uses include poultry farming, coal mining, and natural gas production.

The Scattered High Ridges and Mountains ecoregion represents a small southeastern portion of the study area just south of the community of Blocker. This ecoregion is more rugged and wooded than the surrounding ecoregions. This ecoregion is largely underlain by Pennsylvanian sandstone and shale. Land uses are similar to those in the Lower Canadian Hills.

### 3.5.4.2 Landscape Similarity Zones

*LSZ 1 – Forest*

The Forest LSZ largely consists of oak-dominated woodlands. The different ecoregions exhibit slightly different dominant species assemblages due to differences in water availability, soils, geology, and topography. The understory of most upland forested areas is somewhat thin and can be seen through, especially in the winter. The understory of forested wetlands may be denser.

The Forest LSZ is most visible on hillsides and ridges, and is a very dominating part of the overall aesthetic of Eufaula Lake. The forests appear rugged and rocky, with large boulders and small escarpments often visible, especially near the shore. The ridges of the many forested hills create a sense of mystery in the lake, hiding large portions of it from view at one point. As a result, the lake appears much smaller to the viewer than it actually is.

From within the Forest LSZ, the view of the lake depends on the exact topography and vegetation of a location. In some locations, the lake is hidden behind hills and ridges. Where the lake is not screened by hills, however, it is only partially screened by trees. Since the understory in the forest is most often rather thin, the lake and opposite shoreline are very visible, especially in winter.

This zone includes scattered residential homes on wooded or partially cleared lots. Many homes are situated to view a panorama of the lake and forestlands. The forested areas also include many wildlife management areas and are used extensively for hunting and fishing. Lake users queried during the February and April visual resources surveys noted that undeveloped wetlands and forested areas are of particular value to them.

Some of the forested areas are quite littered. Remote areas with access roads have been reported to attract illegal activity. During the visual surveys, it was noted that some remote areas are littered with bottles and cans, food containers, shotgun shells, and miscellaneous refuse. In general, however, this litter can only be seen when the user is within the littered area, and is not seen from the lake or nearby shorelines.

*LSZ 2 - Grassland/Pasture/Prairie*

The Grassland/Prairie/Pasture LSZ consists of areas with short herbaceous vegetation. These areas include native grasslands and prairie, rangeland for cattle, abandoned farmland, and maintained grasses in urban/recreational areas that do not fall under other LSZs (such as Park/Recreational, Residential, and Commercial/Industrial). The majority of these areas are away from the lakeshore, in the more gently sloping or flat inland areas. This type of land use covers extensive areas in the region; however, it covers only about half the land use in the study area due to the topography surrounding the lake. It should be noted that the study area only includes lands that are within 3,000 feet of the lakeshore and that this characterization does not necessarily apply to other areas away from the lake.

LSZ 2, especially areas that are pastured, can offer wide, sweeping views of the landscape, but only occasional views of Lake Eufaula, since it is generally at a much lower elevation. Views of the lake sometimes occur near the top of gentle slopes, where a portion of the lower slope is also kept as short vegetation such that trees do not block the view. However, in most locations, the surrounding topography and lakeside forested areas screen views of the lake. Views of streams are not common in this LSZ, as their surrounding hill slopes are generally wooded.

Native prairie openings can be found in undisturbed, protected areas and areas with a higher frequency of fire. Where they do occur, they are typically small and surrounded by forested areas.

Grasslands and grazed pasture can have a dry, somewhat barren aesthetic; however, many areas exhibit a wide diversity of colorful wildflowers during part of the year.

Much of this area is dotted with natural gas and oil extraction wells, which can sometimes detract from the overall aesthetic. Where they are present, their industrial appearance is incongruous with the surrounding rangeland landscape. However, the oil wells do contribute to a sense of place and may be a somewhat nostalgic reminder of American history and culture.

### *LSZ 3 - Farmland*

The Farmland LSZ represents a very small portion of the study area. Cropland occurs in stream valleys and bottomlands in the Lower Canadian Hills, Scattered High Ridges and Mountains, and Northern Crosstimbers ecoregions; whereas it occurs on nearly level plains in the Osage Cuestas ecoregion (Woods 2005).

Cropland was identified in McIntosh and Pittsburg Counties. A good portion of the farmland in the study area is located on government-owned property. Although information regarding the type of crops grown at specific locations was not available, general information about crop types grown in these counties was obtained from the 2007 Census of Agriculture (USDA 2009).

Views of cropland from Eufaula Lake are most often screened by trees along the lake fringe; however, some cropland is visible from the lake, especially in winter. The view of cropland has a pastoral aesthetic, in keeping with and complimentary to the tranquil feeling of other areas surrounding the lake, such as forest and grasslands.

### *LSZ 4 - Wetland*

The Wetlands LSZ is located in large areas adjacent to Eufaula Lake, as well as fringing shallows adjacent to other LSZs. Wetland types include forested broad-leaved deciduous, scrub-shrub broad-leaved deciduous, and herbaceous emergent (as classified by Cowardin *et al.* 1979).

Most wetland areas are located inside coves where low-lying land and shallowly inundated areas are protected from wave action. Large areas of wetlands occur in some of the WMAs. Wetland areas are largely either hidden from view or unnoticeable from the interior of the lake, but are seen up-close by boaters and those fishing near the shore and within coves, as well as people hunting in WMAs.

Wildlife is particularly evident in all wetland areas, not just in the WMAs. Wildlife that is particularly visible within the study area includes waterfowl, wading birds, songbirds, birds of prey, beaver, muskrat, and deer.

### *LSZ 5 - Recreation Area*

Recreation areas surrounding Eufaula Lake include campgrounds, picnic areas, beaches, and swimming areas, and opportunities for fishing, hiking, and nature watching. Marinas located within public recreation areas are considered separately as they have a character distinct from other recreational areas. Many parks are developed with campsites, restrooms, showers, boat ramps, group shelters, playgrounds, and ball fields.

Most recreation areas have some undeveloped forest, but only a few have official hiking trails. Recreation area users most often drive through forested areas on their way to more developed park areas. Opportunities for viewing wildlife, meadows, and woodlands are still abundant in the developed parks, since the more developed areas are usually bordered by forest, wetland, or Eufaula Lake. Some recreation areas have very developed facilities, with playgrounds and group shelters, and these facilities can experience very high use rates. As a result, the overall aesthetic the user experiences ranges from active play area to tamed nature to back country. Some litter can be present, especially during high use periods, but in general the recreational areas are kept free of significant litter.

### *LSZ 6 - Residential – Medium Density*

The Residential - Medium Density LSZ includes area subdivisions and residential neighborhoods, ranging from high-end to modest. A few areas have neglected homes. Many of the neighborhoods are subdivisions of relatively recent construction. This zone includes homes with medium to large size lots, and most lots have a lawn. Neighborhoods have developed in areas that have lake access for docks, are near lake access points, or have lake views. In general, neighborhoods tend to be more developed and cleared on the north side of the lake and more wooded on the south side.

### *LSZ 7 - Urban – Commercial/Industrial*

The Urban and Industrial/Commercial similarity zone occupies very little area in the study area. It consists of downtown areas, shopping centers, small industrial businesses, and self-storage facilities. It is mostly concentrated around Eufaula and includes the downtown area of Eufaula and small commercial/industrial operations northwest of Eufaula near the intersection of US 69 and Highway 9. Other areas include those near the intersection of US 69 and Highway 150, and small areas in Crowder and north of Porum Landing. The areas in this similarity zone are not adjacent to Eufaula Lake; rather, they are set back from the shoreline and are typically not visible from the lake nor have a view of it.

These areas are largely paved with little vegetation and some are unpaved. Downtown Eufaula is well-maintained and attractive for tourism. Shopping areas outside of downtown Eufaula vary from well-maintained to somewhat neglected. Industrial areas are generally unattractive to passers-by.

### *LSZ 8 - Transportation*

This zone consists of highway and primary road corridors that are most frequently traveled. These corridors include the following: US 69, I-40, Highways 9, 9A, 31, 72, 113, and 150, Old Highway 69. The zone also includes railways.

US 69 and I-40 are both divided limited-access highways with wide, cleared edges. State highways are two-lanes with cleared shoulders. Where these roads cross the study area, they offer wide, panoramic views of Eufaula Lake, partially screened views of secluded coves and wetlands, and often dramatic views of the surrounding topography. This is especially the case on bridges and causeways.

### *LSZ 9 - Marinas*

The Marinas LSZ includes the following:

- Eufaula Lake Marina at Eufaula Lake State Park
- Belle Starr Marina at Belle Starr Park
- Eufaula Cove Marina in Eufaula

- Duchess Creek Marina at Porum Landing
- Cole's Evergreen Marina near Brooken Cove
- Highway 9 Marina at Highway 9 Landing
- Area 51 Marina at Arrowhead State Park

This zone includes the land occupied by the marinas as well as docks, no-wake zones, and adjacent water where the users' views are dominated by marina activities.

The marinas have a somewhat industrial quality due to the materials the docks are constructed of (sheet metal, metal poles, plastic floats, etc.) as well as the general upkeep of the landscape. Marinas are kept as functional places where users are not generally expected to linger. Rather, the marinas are simply an embarkation point for recreational activities.

Marina users experience unpleasant noise and odor more often than in the other similarity zones. Revving boat motors and exhaust are commonplace. Spilled fuel and oil is common in marinas and can create a sheen on the water.

While the overall aesthetic of marinas is not particularly attractive, they do allow users to keep and access their boats so that they can enjoy many other unique scenic qualities and recreational opportunities of Eufaula Lake.

*LSZ 10 - High Density Docks*

The High-Density Docks LSZ consists of areas within the lake itself where there are dense concentrations of docks.

High-density dock areas are generally in protected coves near residential areas. When in small coves, these areas are not very visible to lake users as the surrounding landscape and vegetation screens their view; however, larger coves are more easily seen by people boating on the lake and on opposite shores.

High-density dock areas can be unattractive in the landscape, especially when they block views of the shore and the surrounding topography does not offer views of the unique landscape and geology of the Eufaula Lake area. However, many public comments submitted during scoping complained about the moratorium on new dock construction, and many requested that their particular properties be allowed to have docks. It is clear that many adjacent landowners want to construct a dock so they can have a boat close to their property.

### 3.5.4.3 LSZ Management Class Assignment

The visual qualities of the Regional Landscape and each LSZ were assessed, and examples of each resource category were identified within each of the visual quality levels (Distinct, Average, and Minimal). These examples were tabulated on VRAP Form 3 for each LSZ and are included in Appendix F. Each resource category of the Regional Landscape and the LSZs was assigned an overall rating of Distinct, Average, or Minimal based on the dominant characteristics of the category within that zone. The individual ratings of each resource category were then weighted according to the VRAP and used to calculate a numerical total assessment value for the LSZ. The total assessment value for each LSZ was then used to assign it to one of five management classes (MCS classification): preservation, retention, partial retention, modification, or

rehabilitation. These classifications are used to provide guidelines for different aspects of visual change. The resource category ratings are tabulated on Form 4 for each LSZ and summarized on Form 5 (included in Appendix F). The Management Classes assigned for the Regional Landscape and each LSZ are presented in **Table 3.5-2**.

**Table 3.5-2. Management Classifications for LSZs and the Regional Landscape at Eufaula Lake**

| Landscape Similarity Zone | | MCS Assessment Score | Classification |
|---|---|---|---|
| 1 | Forest | 18 | Preservation |
| 2 | Grassland/Pasture/Prairie | 12 | Partial Retention |
| 3 | Farmland | 14 | Retention |
| 4 | Wetland | 17 | Preservation |
| 5 | Recreation Area | 17 | Preservation |
| 6 | Residential - medium density | 12 | Partial Retention |
| 7 | Urban - Commercial/Industrial | 10 | Modification |
| 8 | Transportation | 15 | Retention |
| 9 | Marinas | 7 | Rehabilitation |
| 10 | High Density Docks | 9 | Modification |
| **Regional Landscape** | | **15** | **Retention** |

### 3.5.4.4 Viewpoint Inventory

Inventory sheets and photos for each viewpoint are included in Appendix F. Viewpoint 3, Roundtree Landing is included here as an example (**Figure 3.5-1**).

#### *Viewpoint 1 – Near Duchess Creek Island*

Viewpoint 1 is from the water of the shoreline and uplands east of Duchess Creek Island, facing east. The landform consists of rolling hills with plains behind. The view consists of a mix of forested land, large maintained lawns with mature trees, and residences. This viewscape is typical of moderately developed shores on this lake in the Northern Crosstimbers ecoregion, with a mix of oak forest and grassland on a terrain of low hills and plains. The residences and lawns are most visible in the winter season, when there is less screening provided by vegetation. When trees are in leaf, they screen the residences and yards such that they are not very noticeable, giving the view a rural aesthetic. The shoreline itself has an undeveloped aesthetic; one dock with what appears to be two slips is present.

The water of Lake Eufaula and the sky are dominant features in this viewscape. During the winter visit, migratory waterfowl were present. No user activity was noted during any of the visits, but user activity is known to be high in the summer months and consists of boating recreation.

#### *Viewpoint 2 – Standing Rock Cut – East*

This view is from the water of the shoreline and uplands at Standing Rock Cut, facing southwest through the cut. The landform consists of the rolling hills on the north and south sides of Standing Rock Cut. The right side of the view (the north side of the cut) consists of forested land and a shoreline with an undeveloped aesthetic. The left side of the view (the south side of the cut) consists of medium-density residences with large maintained lawns, lots cleared to the shoreline, and scattered trees. As a result, the shoreline on the south side has a highly developed aesthetic.

The water of Lake Eufaula and the sky are also dominant features in this viewscape. During the winter visit, migratory waterfowl were present. No user activity was noted during any of the visits, but user activity is known to be high in the summer months and consists of boating recreation.

### *Viewpoint 3 – Roundtree Landing*

This view is from the water of the shoreline on the north side of Roundtree Landing, facing west (**Figure 3.5-1**). The view consists of undeveloped forested land and wetlands surrounding a small cove. The landform gently slopes towards the shore, such that only the land near the shoreline is visible.

The water of Lake Eufaula and the sky are dominant features in this viewscape. During the winter visit, migratory waterfowl were present. No user activity was noted during any of the visits, however, USACE staff noted that this location is popular for fishing.

### *Viewpoint 4 – Carlton Landing*

This view is from the water of the cove and shoreline at Carlton Landing, facing northwest. The landform on both sides of the cove is of rolling hills, so the land adjacent to the shoreline is most dominant. The left-hand view (the west side of the cove) consists of natural forest (on government-owned property).

The shoreline in the middle (north side of the cove) and right-hand sides (east side of the cove), consists of natural forest and wetland. The east side of the cove is the west bank of Roundtree Landing.

The natural undisturbed portions of the view are serene and offer excellent opportunities for viewing wildlife. The construction activity at Carlton Landing detracts from the scenic quality considerably, but this activity is temporary.

The enclosure of the cove makes the land and shoreline dominant features in this viewscape. During the winter visit, migratory waterfowl were present. One small boat with fishermen was observed during the late February and April visits.

### *Viewpoint 5 – Daisy Hallum Cove, Near Gaines Creek Park*

The view is from the water of Daisy Hallum Cove, about 0.8 mile northeast of Gaines Creek Park, facing east. The surrounding land consists of deciduous forest. In winter, this forest appears thin, exposing the craggy hill slope. In the growing season, the boulders and rocks that occur on the steep slope are screened by the leaves of the trees.

The viewscape has an enclosed feeling due to the surrounding tall hills, which are a dominant part of the viewscape. The rocks and boulders on the hill slopes are examples of the interesting geological features present in the Eufaula Lake area. No user activity was noted during any of the visits, but user activity is likely high in the summer months and would consist of boating recreation and fishing.

LEAF-ON

LEAF-OFF

**Figure 3.5-1. Viewpoint 3: Roundtree Landing – Existing Conditions**

### *Viewpoint 6 – I-40 Bridge and Causeway*

The view is from the east causeway of the I-40 bridge over Deep Fork Arm, facing north. The view consists of a wide panorama of Eufaula Lake, the opposite north and northeast shorelines, and the side of the highway. The land on the opposite shore consists of deciduous forest on a hill slope that in places rises somewhat steeply from the lake.

A small densely developed residential neighborhood is present on the north shore, in the left side of the viewscape. Mature forested hillsides and small coves are seen between the residential areas. The ruggedness of the terrain and the nearly full screening of residential neighborhoods from view during the growing season give an unspoiled and untamed aesthetic to the general landscape.

The highway corridor is highly littered and loud with traffic. However, the dramatic landscape is so prominent that the viewer's gaze is pulled across the lake to the opposite shore. Regular clearing of vegetation is apparent so that this view is maintained. No user activity was noted on the lake during any of the visits, but user activity is known to be high in the summer months and consists of boating recreation.

This view is particularly interesting as a feature along I-40 as it stands in sharp contrast to the open dry plains or forested bottomlands that are seen along nearby stretches of the highway. The boulder-strewn shoreline and rocky, rugged bluffs are examples of the interesting geological features present in the Eufaula Lake area. These draw the viewer's eye and are particularly dramatic. The bridge affords a sudden, open view of the water and bluffs that provides visual cues to passing travelers that they have come upon a special feature in the landscape.

### *Viewpoint 7 – US 69 Bridge at Bridgeport*

This view is from the north causeway of the US 69 bridge at Bridgeport, facing north. The view consists of a wide panorama of Eufaula Lake, the shoreline at Bridgeport, and the side of the highway. The land on the shore is gently sloping and a protected sandy beach is present. In many areas, scrubby willows flank the shoreline.

Beyond the shoreline, the land is relatively flat. A relatively dense neighborhood sits back from the shore, but it is rather well-hidden due to dense woodland and the flat terrain.

The highway corridor is highly littered and loud with traffic. The wide vista of the lake draws the viewer's attention, but the bridge and causeway are still prominent features in the viewshed. Some deciduous trees and shrubs have grown along the causeway but are easily seen through in winter.

The very left side of the viewshed offers an extended viewing distance over the water, which gives a sense of enormity to the Lake. The flatness of the land in the center and right of the viewshed are accentuated by this view. The leaves on the trees during the growing season screen the nearby community almost completely from view. Overall, the effect is of relatively unspoiled sandy shore.

### *Viewpoint 8 – Arrowhead State Park*

This view is from a picnic area and water access on the west side of Arrowhead State Park, facing west. The view consists of the lake, the opposite shoreline, and some of the picnic area. The land on the opposite shore is hilly with deciduous forest. A few cleared areas are present on the hillside, as is a utility easement. A few homes on the opposite shore are slightly visible through the trees in the winter, but mostly hidden by foliage during the growing season.

The overall effect of this viewscape is of a large but relatively quiet cove and the opposite shore. It is peaceful and has the aesthetic of domesticated nature within the park. People driving and parking on the dirt road next to the shore decrease the overall tranquility of the location somewhat. The opposite shore and hill slope appear undeveloped and natural. Opportunities for viewing wildlife are excellent.

*Viewpoint 9 – Highway 31 Bridge North of Elm Point Park*

This view is from the bridge on Highway 31 north of Elm Point Park, facing west. The view consists of the lake, forested tall hills and Elm Point Park on the opposite shoreline, and the Highway 31 causeway. The forested land on the opposite shore is steep and appears undeveloped. Elm Point Park is on the left side of the view, closer to the viewer. The park has mature trees and grass with no understory. A boat ramp is visible, and the shoreline has a section of rip-rap.

The highway has frequent traffic and the shoulder is heavily littered. The wide vista of the lake draws the viewer's attention, but the bridge and causeway are still prominent features in the viewshed.

The overall effect of the viewscape is that of developed parkland and undeveloped opposite shore. The park is peaceful, but looks like it is heavily used. The opposite shore and hill slope appear undeveloped and natural. Opportunities for viewing wildlife are good.

# 3.6 Cultural and Historic Resources

## 3.6.1 Area of Analysis (Cultural and Historic Resources)

The area of analysis for this section includes the USACE-owned lands surrounding Eufaula Lake that may be affected by federal management actions at the lake. 36 CFR Part 800 requires the establishment of an areas of potential effect (APE), which is defined as the "geographical area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties" (36 CFR 800.16(d)).

The APE for this project includes the proposed lease area for the Carlton Landing development of 301 acres (121 hectares) of federal property managed by USACE at Eufaula Lake.

## 3.6.2 Regulatory Setting (Cultural and Historic Resources)

A number of federal laws, executive orders, and USACE regulations govern the preservation of cultural resources. NEPA requires that federal agencies consider effects to the cultural and historic environment of proposed projects, programs, and all federal undertakings. Further, the Act states that "it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate federal plans, functions, programs, and resources to the end that the Nation may preserve important historic, cultural, and natural aspects of our national heritage...".

The relevant regulations include the National Historic Preservation Act, Executive Order 11593: Protection and Enhancement of the Cultural Environment, the Antiquities Act, Archaeological Resources Protection Act, and Archaeological and Historic Preservation Act, Executive Order 13175: Consultation and Coordination with Indian Tribal Governments, and Engineer Pamphlet 1130-2-540 – Environmental Stewardship Operations and Maintenance Guidance and Procedures. These regulations are described in

Section 1.6. In addition to the regulations described in Section 1.6 there are a few additional regulations that are relevant to cultural and historic resources.

### *Presidential Memorandum for Heads of Executive Departments and Agencies, 1994: Government-to-Government Relations with Native American Tribal Governments, and the Department of Defense Annotated Policy Document, 1999: American Indian and Alaska Native Policy*

The Presidential Memorandum for Heads of Executive Departments and Agencies, 1994: Government-to-Government Relations with Native American Tribal Governments requires that USACE, as a federal agency, must formally consult with Tribes in a government-to government relationship. The memorandum also outlined the following:

- Consultations shall occur prior to actions being taken that affect Tribal governments. These consultations are to be candid and open.
- Federal agencies shall "assess impacts from plans, projects, programs and activities on Tribal trust resources and assure that Tribal government rights and concerns are considered during the development of such plans, projects, programs and activities."

The Department of Defense Annotated Policy Document, 1999: American Indian and Alaska Native Policy guides the Department of Defense's compliance with the Presidential Memorandum on Government-to-Government Relations with Native American Tribal Governments. The policy stipulates that USACE "shall consult with tribes whenever proposing an action that may have the potential to significantly affect protected tribal resources, tribal rights, or Indian lands." These actions include but are not limited to: "land-disturbing activities, construction, training, over-flights, management of properties of traditional religious and cultural importance, protection of sacred sites from vandalism and other damage, access to sacred sites, access to treaty-reserved resources, disposition of cultural items, and land use decisions."

### *Engineer Pamphlet 1130-2-540 – Environmental Stewardship Operations and Maintenance Guidance and Procedures*

Engineer Pamphlet 1130-2-540 (dated 15 November 1996 and revised 11 August 2008) "establishes guidance for the management of environmental stewardship related operations and maintenance activities at USACE civil works water resource projects" and supplements ER 1130-2-540, *Environmental Stewardship Operations and Maintenance Policies*.

## 3.6.3 Existing Conditions (Cultural and Historic Resources)

### 3.6.3.1 Cultural Context

The following provides a summary of the history of the Eufaula Lake area. More detail on the cultural context of the study area is in Appendix G.

### *Prehistoric Period*

The prehistoric cultural chronology of Oklahoma is divided into a series of periods that generally correspond to major shifts in subsistence procurement strategies, social organization, technology, and settlement patterning. They are also linked to distinct material cultural styles, particularly in projectile point shapes and (in later times) ceramic vessel form and decoration. These periods form a convenient framework for the discussion of human societies in North America.

At Eufaula Lake the general prehistory of the study area can be usefully divided into four major periods – Paleoindian, Archaic, Woodland, and Late Prehistoric.

**Paleoindian Period -** The arrival of humans in the region of the study area was probably linked to the movements of the Pleistocene glaciers. During the Paleoindian period, the last of these glacial advances and retreats, called Great Lakes Stadial (after 9,900 B.C.), occurred. A cooler, moister climate affected the composition and distribution of floral and faunal communities (Delcourt and Delcourt 1982; Klippel and Parmalee 1982).

The Paleoindian period includes the Pre-Clovis period. The Pre-Clovis period dates from sometime before 11,000 B.C. to 9,500 B.C. There are two possible pre-Clovis sites in Oklahoma; the Burnham site in northwestern Oklahoma (Hofman 1989; Hofman and Graham 1998; Wyckoff 1999) and the Cooperton site in Kiowa County (Anderson 1975).

The Clovis culture dates from ca. 9,500 B.C. to 8,800 B.C., and is widely documented throughout North America (Anderson *et al.* 1996; Haynes 2002; Tankersley 1990a). Clovis projectile points are the hallmarks of the early part of the Paleoindian period. The Clovis groups are characterized as big game hunters (Kelly and Todd 1988; Tankersley 1990b, 1996) but the overall Clovis subsistence strategy may have been more diverse using both big game and a variety of other subsistence choices (Cannon and Meltzer 2004; Collins 2007; Kornfield 2007; Meltzer 1993).

The Middle Paleoindian phase ranges from ca. 9,000 B.C. to 8,500 B.C., and was a time of great climatic change, leading to the extinction of most species of Pleistocene mega-fauna (Anderson *et al.* 1996; Delcourt and Delcourt 1981; Grayson 1987; McWheeney 2007; Morse *et al.* 1996). The change in the environment lead to a more intense reliance on small game and locally available plant sources (Walker 2007). The Middle Paleoindian lithic toolkits reflect this subsistence change in the wider range of tool types. In addition, the toolkits relied more on local sources of chert, often of a lower quality. The increase in the utilization of local materials could represent a more settled lifestyle.

The Late Paleoindian period dates to ca. 8,500 to 7,500 B.C. During this period, the usage of local raw materials continues to be evident and the toolkit is even more diverse than that of the Middle Paleoindian period.

**Archaic Period -** The Archaic period includes a long span of time during which important cultural changes took place. During the Early Archaic, the last glaciers retreated and the arctic-like boreal forest began developing into the eastern deciduous forest. By the Middle Archaic, the environment was warmer and drier than it is today. In response to the changing climate and associated changes in plant and animal life, Late Archaic peoples developed a more diversified subsistence strategy. This included hunting, plant food gathering, fishing, and, in some areas, the beginnings of plant domestication in a planned seasonal round exploitation strategy.

The limited amount of Early Archaic material found at most sites and the general absence of middens, features, and burials, suggests that most occupations were of short duration. Early Archaic social units were small, probably consisting of bands comprised of related individuals. The relatively high percentage of projectile points in Early Archaic assemblages made from non-local cherts suggests that social groups were highly mobile. Items manufactured from non-local chert would have been incorporated into tool kits when groups traveled near the source areas. Some tools manufactured from certain kinds of high quality

chert were used and held onto for an extended period of time and later discarded far from the source area (Binford 1979; Jefferies 1990:151; 2008).

According to Jefferies (2008), except for the adoption of new projectile point styles, Early Archaic tool kits are nearly identical to those of the Paleoindians. The scarcity of tools associated with the preparation of plant foods and fishing in the early part of the Archaic indicates that hunting was probably still the major subsistence activity (Dragoo 1976:II). As with the Paleoindian period, there are few Early Archaic sites in Oklahoma.

The environment during the Middle Archaic sub-period was dryer and warmer than modern conditions. By the beginning of the Middle Archaic period, environmental remnants of the Pleistocene had disappeared and animal and plant communities more closely resembled those present at the time of European-American contact. Increasing regionalization of artifact inventories and the addition of new artifact classes and projectile point styles implies the development of extensive exploitation strategies. The Middle Archaic is marked by the introduction of groundstone artifacts, a number of which are interpreted as plant food processing artifacts, indicating an increasing utilization of plant food resources during the Middle Archaic.

The Late Archaic was a time of continued cultural expansion and growing complexity. Judging from the greater number of sites that have been recorded, an increase in population can be postulated. Evidence of longer and more intensive site occupation suggests, in some cases, extended habitation within an area. Seasonally available food resources were exploited at appropriate times during the social group's annual settlement/subsistence cycle. Group organization and movement were structured to efficiently accomplish these tasks. The occasional presence of plants not known to have a wild counterpart at some sites suggests that some Late Archaic groups were experimenting with horticulture (Chomko and Crawford 1978; Cowan *et al.* 1981; Watson 1985).

The Late Archaic in the Arkansas River Valley and Northern Ouachitas of Oklahoma is represented by the Wister Phase (Early and Sabo 1990). The Wister Phase is identified by midden or 'black mound' sites (Early and Sabo 1990). The Wiser Phase midden mounds are described as base camps. The sites contain various features including pits, hearths, rock concentrations, dog burials, and human burials (Early and Sabo 1990). The subsistence strategy focused on deer and hickory nuts, but turtle, turkey, small mammals, fish and mollusks were also exploited (Early and Sabo 1990).

**Woodland Period -** Woodland cultures eventually diverged sharply from their Archaic beginning. The Woodland period development produced burial mounds and earthwork enclosures. These went along with intensification in the earlier efforts at plant domestication present in the Archaic period, the development of fired clay ceramic containers (first used as ceremonial containers, later used more widely), and the intensification of trade with distant regions of the Midwest in materials used specifically as burial offerings.

Little is known about the Woodland period in the regions of Oklahoma. The Woodland period is also described as a transitional period with ceramic assemblages added to the earlier Archaic assemblages. The subsistence pattern for the phase is not significantly different from the Late Archaic period. There may be more emphasis on plant foods based on the increased quantities of grinding stones (Early and Sabo 1990).

**Late Prehistoric Period -** The Late Prehistoric period in eastern Oklahoma is a Mississippian manifestation which dates to between 1000 Before Present (BP) and 300 BP. New forms of social integration emerged in the southeast and mid-continent. Mississippian society is characterized by hierarchical social organization.

Local and regional mound centers, which were ruled over by religious and political elites, are the most obvious evidence of this development. The distinct regional manifestation of the Mississippian culture in eastern Oklahoma is known as the Arkansas Valley Caddoan Tradition (Early and Sabo 1990). This tradition is divided into three phases: the Harlan Phase (1000 BP -800 BP; the Spiro Phase (800 BP – 550 BP); and the Fort Coffee Phase (550 BP – 300 BP).

The development of the mound centers and mortuary ceremonialism in the Arkansas River Valley in Oklahoma is marked by the Harlan Phase. During the Harlan Phase shell was introduced for tempering ceramics. New ceramic forms such as jars and bowls appear during this phase. Other artifacts included bone and copper covered wooden hairpins, copper beads and hair ornaments, and bone and shell beads.

During the Spiro Phase the Spiro site became the paramount political and religious center in the Arkansas River Valley (Early and Sabo 1990). The artifact assemblage includes triangular arrow points with notched bases, plain utilitarian ceramics almost entirely tempered with shell dominate the ceramic assemblage, and vessel forms include legged jars, miniatures, rim effigy bowls, hooded bowls and wide mouthed bottles (Early and Sabo 1990). The phase is also noted for ritual objects such as engraved shell cups, gorgets, and copper plaques. Food remains for the phase included corn and hickory nuts, deer, turkey, turtle, fish, and mollusks (Early and Sabo 1990).

The Fort Coffee phase no longer had a strong social hierarchy and the associated ritual activity. Mound construction ceased. The society shifted its orientation from eastern connections to connections with Plains-oriented societies (Early and Sabo 1990). Corn and hickory nuts remained an important part of the subsistence strategy, but bison replaced deer as the primary meat source (Early and Sabo 1990). Climate changes during this period are seen as potential factors in the social changes. The migration of bison from the Plains heartland may have increased the availability of this food source (Early and Sabo 1990).

### *Historic Period*

The historic period begins in the mid-1700s when French traders first entered into the region, and continues to the present with the creation of Eufaula Lake.

**Early Explorers and Trail Blazers -** In the mid-1700s, French traders first traversed the area along the Arkansas and Canadian Rivers as they attempted to find a route to Santa Fe (New Mexico) in order to establish trade with the Spanish (Stout and Baxter 1986:7). In the 1820s, when trade with Santa Fe resumed, Major Stephen Long's party mistook the Canadian River for the Red River and came upon Standing Rock, as it came to be known. The rock rose approximately 65 feet above the water in the middle of the Canadian River and was a sandstone formation eroded from the cliffs north of the Canadian River. It became a landmark for travelers throughout the 1800s but is now under the lake waters.

When the discovery of gold in California led to a rush of settlers heading west, travelers used Gregg's trail to leave from Fort Smith, stopping for supplies in North Fork town. Gregg's trail was previously established in 1839, when Josiah Gregg led an expedition to find a southern route to Santa Fe from Fort Smith, Arkansas for trading purposes, hoping it would be faster than the Santa Fe Trail through Kansas (Stout and Baxter 1986:24-25).

Aside from east-west trails through this area, a north-south trail was established in the 1830s. Settlers from Midwestern states, bound for settlements in Texas, entered Indian Territory from Missouri and traveled south, crossing the North Fork of the Canadian River near North Fork town. This trail became

known as the Texas Road, and it was also known as the Shawnee Trail by Texas cattlemen who used it to drive their cattle north to markets in Missouri. The trail crossed the Rock and Coal Creeks north of present-day McAlester. After the Civil War, the cattle trail split to go west to markets in Wichita and Baxter Springs, Kansas and the portion through the study area became known as the East Shawnee Trail (Baxter 1986a:13).

**Native Americans -** In the 1830s, Native American tribes located in the southern states were pressured and then forced to move west to territory in what became Oklahoma. These tribes, Cherokee, Chickasaw, Choctaw, Creek, and Seminole, became known as the Five Civilized Tribes. The study area is included in the Creek and Choctaw allotment of lands in Oklahoma. The Canadian River served as the border between the Choctaw and Creek lands.

In 1820 the Treaty of Doaks Stand was signed by the federal government with the Choctaw tribe which set the stage for the eventual cession of Choctaw lands in Mississippi and removal to southern Indian Territory. The treaty was supposed to be an incentive for voluntary removal but had little effect (Baird *et al.* 1989:17). Forced removal came with the 1830 Treaty of Dancing Rabbit Creek. Land between the Canadian River to the north and Red River to the south with the State of Arkansas to the east was provided to the Choctaws. In 1837 the Chickasaw tribe joined with the Choctaws and settled on the western portion of the Choctaw allotment. The land provided to the Choctaws was the Ouachita Mountain range which had rich bottomlands and timbered foothills (Hoefling 2008:7).

In 1825 the Lower Creeks under Chief McIntosh signed a treaty to remove to lands in Indian Territory that were between the Arkansas and Canadian Rivers. In 1832, Upper Creeks and any Lower Creeks that remained in Alabama signed a treaty under Chief Opothleyahola to remove to Indian Territory. The Creek tribe was split between the Lower Creeks, so named due to the location of their towns in coastal areas primarily in Georgia, and Upper Creeks, located in the Appalachian areas. Lower Creeks had had more association with English settlers and often intermarried, while Upper Creeks had had little association with settlers and tended to retain more traditional ways. When the Creeks were removed to Indian Territory, Lower Creeks primarily settled along the Arkansas and Verdigris Rivers while the Upper Creeks settled along the Canadian River (Baird and Gebhard 1991:66-69).

Upper Creeks typically recreated the town structures in Indian Territory that had existed before removal. In the study area, the public square at the town of Hichiti is now under lake waters and the Tukabatchee location is unknown but was reported to be on the north shore of the Canadian River (Baird and Gebhard 1991:56, 99). North Fork Town, so called because of its location on the north branch of the Canadian River, was established as a settlement town by the Creeks at the point where the Creek Trail of Tears ended along the Texas Road as it crossed the Canadian River. This town became a cultural focal point for the Creeks and also a commercial center serving travelers along the Texas Road.

During the Civil War, the Confederates looked to the Five Civilized Tribes in Indian Territory as allies because they could provide food, horses, and soldiers to the Confederate cause and provide a bridge to the west. The issue divided the Creeks with the Choctaw and Lower Creeks who were slaveholders siding with the Confederates and the Upper Creeks siding with the Union.

The Texas Road was a supply route during the Civil War that both sides wanted to control. This led to a battle at Honey Springs near Rentiesville (north of the study area in northern McIntosh County) in July 1863 where Confederate forces under Native American Colonel Stand Watie tried to prevent a federal supply train from reaching Fort Gibson (Oklahoma Employment Security Commission n.d.:3). With the

Confederate defeat, North Fork town and other homes and villages in the area were burned (Morris 1993:5).

After the war, the tribes as a whole suffered for having sided with the Confederates. A treaty with the federal government in 1866 forced the cession of their central and western lands for what became Oklahoma Territory, for the settlement of Plains Indian tribes. Within Indian Territory, in the eastern portion of what became Oklahoma, tribes were forced to cede land for right-of-way to railroads (Baird and Gebhard 1991:78).

After unassigned lands in central Oklahoma Territory became available for settlement in 1889, the pressure for more lands to be opened led to Congress setting up the Dawes Commission in 1893 to negotiate with the Five Civilized Tribes for the cession or allotment and division of their lands within Indian Territory (Morris 1993:6). The 1898 Curtis Bill allowed for larger towns already established in Indian Territory to buy their lots from the tribes in order to officially incorporate as a town (Morris 1993:6). With the dissolution of Indian Territory, sovereignty of tribal governments was officially dissolved in the eyes of the federal government and all tribal citizens went through a process of enrollment in order to each receive their allotted 160 acres (Baird and Gebhard 1991:84). For the Choctaw, the coal fields in their territory were sold with proceeds spread among tribal members.

**Railroads and Coal -** Using the right-of-way grants provided to railroads to cross Indian Territory, the Missouri, Kansas and Texas Railroad (MK&T or Katy RR) became the first to cross the region from Kansas to Texas in 1872. The route they chose followed the Texas Road but may also have been influenced by the presence of coal in the area of the crossroads of the Texas and California Roads. J.J. McAlester recognized the value of the coal deposits and opened a store at the crossroads of the Texas and California Roads. The Osage Coal and Mining Company was the first to commercially mine coal in the area, with a mine located east of what became the city of McAlester. The company was owned by the railroad and leased the land from J.J. McAlester (Hoefling 2008:9).

Railroads dominated the mines through the 1890s until independent mines could successfully establish a local market for their smaller production. A local market first became available with the influx of immigrant miners and then expanded with the opening of parts of Oklahoma Territory after 1889 and a dramatic influx of settlers (Bryans 1990:23). Smaller companies no longer had to depend on the railroads to buy their coal production. One such local mine within the study area is the Pocahontas Mine owned by Indian Coal and Mining Company (Pittsburg County Historical and Genealogical Society 1997:532).

At first, mines were strip pits which mined coal close to the surface with picks and shovels. Once the larger companies were established shaft mining became possible, which included a vertical opening from the surface down to the coal seam, which was then mined laterally. Most mines in the area were slope mines, which were constructed on outcrops on the hillsides and tunneled at an incline through the hill following the coal seam (Bryans 1990:36). Support buildings on the surface for the mining operation might include a power house which had engine mounts for the hauling system, a machine shop for tools, tipples which sorted and loaded coal into rail cars, a powder house for explosives, office buildings, and an air shaft (Bryans 1990:63). Not much physical evidence has been left of the mines except dump piles, foundations of buildings and engine mounts, and flooded openings such as at the Pocahontas #1 Slope Mine site.

To fulfill the labor needs for the coal fields, coal companies began bringing in labor, even paying for transportation for immigrants from other countries. Italians, Poles, Lithuanians, and Mexicans were the

most numerous of the various ethnic groups that migrated to work the coal mines (Bryans 1990:31). The coal industry was the primary employer in Pittsburg County from the 1870s through the 1930s when demand for coal decreased. Workers at first lived in company houses and shopped at company stores. These were cheaply built dwellings and few remain.

While the mines were in the Choctaw Nation they did not have to follow United States' mining safety regulations; thus, these were some of the most dangerous mines (Baxter 1986b:9-11). Miners were paid only for the coal they brought up so taking short-cuts was common, as they were not paid for activities such as shoring up mine roofs or securing rails. Also, deadly gases were sometimes unexpectedly released from the coal (Bryans 1990:38-39). The fatality rate in the Choctaw mines constantly surpassed the national average.

Following World War I, the demand for coal gradually decreased for several reasons: the usage of oil and natural gas as fuel increased; railroads, typically the heaviest users, began switching to different fuel sources; and local market demand generally decreased with the Depression. By the 1930s only enough coal was mined in the area to serve the local markets. Towns built on coal mining lost population with some becoming mere ghost towns (Bryans 1990:58).

**Towns and Outlaws -** In 1872, during construction of the Katy RR, an area approximately three miles west of North Fork town was set up as a terminus for warehouse supplies and as a tent camp for workers in preparation for bridging the Canadian River. Progress was halted with repeated washouts and collapses of the bridge supports. This delay quickly attracted merchants to the area as well as outlaws and thieves. The delay lasted only a month but by then a city had been born and was named Eufaula after a Creek town in Alabama. Those at North Fork town gradually moved to the new town site. By 1874 Eufaula had a post office and by 1892 the population was 500 (Morris 1993:5). The North Fork town site is now inundated by the lake and part of the eastern portion of Eufaula was forced to move when the lake was constructed.

Named in 1902 for its founder, Dr. William Crowder, Crowder was constructed at the junction of the north-south Katy and the east-west Fort Smith and Western (FS&W) rail lines. The FS&W was constructed between Fort Smith, Arkansas and Guthrie, Oklahoma to take advantage of the coal fields. The rail line was eventually abandoned in this area as the bridge across the Canadian kept washing away and there was not enough rail traffic to keep it in repair. The town itself declined when the realignment of U.S. 69 in the early 1970s bypassed it and the Katy RR stopped passenger service (Pittsburg County Historical and Genealogical Society 1997:488).

Prior to statehood, Indian Territory relied on tribal laws and courts to maintain law and order. With its mountains, canyons, and caves, this region became an easy hideout for those escaping federal lawmen. Belle Starr, nicknamed 'Queen of the Bandits', headed a group of thieves and murderers during the 1880s and 1890s, an era of outlaws in this region (Morris 1993:6). Before and after the Civil War, a band of outlaws named the Quantrills roamed a region that stretched from Kansas to Texas. Belle Starr, an excellent horsewoman, became involved with the outlaw band, marrying several of its members at various times. One of their hideouts and meeting points was Cole Younger's ranch at Younger's Bend on the north bank of the Canadian River just east of the confluence of the South and North Canadian Rivers. Belle Starr later made this her home, which today is near the dam site north of the river, and she was buried there after being shot in the back after an argument with several outlaws (Oklahoma Employment Security Commission n.d.:4).

**Agriculture -** Agriculture has a large role in the history of Oklahoma, from the prehistoric peoples who practiced agriculture in floodplains to modern mechanized agriculture geared for a global economy.

In this region, cotton was the most important cash crop (Carney 1990:38). Eufaula had four cotton gins and a cotton oil mill by the turn of the twentieth century (Harkey 1992:7). Other notable cotton gins with remnants still standing include the Cochrane and the Winston cotton gins in Hanna, located west of Indianola, and the Pierce cotton gin, south of Interstate 40. Beginning in the 1920s, with improved local roads and the coming of the automobile, farmers increasingly sold their products or livestock directly to bigger markets in bigger cities via the railroad, bypassing small towns like Eufaula and its cotton gins (Carney 1990:61).

Farms in McIntosh County typically had high rates of sharecropping and tenancy on relatively small farms of around 40-80 acres for each sharecropper or tenant (Carney 1990:50). Beginning in 1927, the cotton market declined due to falling prices, continued drought, soil erosion, and the Great Depression (Pittsburg County Historical and Genealogical Society 1997:507). The prolonged drought in the first few years of the 1930s, combined with poor cultivation methods, led to depletion of the topsoil. The topsoil literally blew away with the winds; hence the term Dust Bowl was given to this region of the country.

In 1938, Senator Joe Whitaker from Eufaula urged McIntosh County farmers to set up a soil conservation program through President Roosevelt's newly created U.S. Soil Conservation Service. Plots of land in this region were typically small owners, and later sharecroppers, wore out the land through continuous planting. Combined with the devastating effects of the Dust Bowl weather conditions, the land needed to revert to grassland for a few years to recover nutrients. Senator Whitaker set up the first soil conservation districts in Oklahoma, with McIntosh County as the first soil conservation project in the U.S. The First Soil Conservation District Dedication Site is located two miles northwest of Eufaula. A dedication ceremony was held December 2, 1939 to inaugurate a change in farming practices to return the land back to productivity and conserve soil and water (Curths 1980). This conservation district site was the first where soil conservation was demonstrated on a privately-owned farm, as opposed to university or government-owned farms. WPA workers planted grasses and black locust trees, filled in eroded areas, and converted fields to grass pastures (Harkey 1992:106).

Cattle ranching was introduced into eastern Indian Territory via the cattle trails. Texas cattlemen found the grasses of this region desirable to fatten cattle for market and began paying local tribes for grazing rights (Carney 1990:49). Railroads facilitated the transportation of Texas cattle, as well as cattle owned by Native Americans within Indian Territory, to markets in Missouri and Kansas, which eliminated the need for the Texas Road (Baxter 1986a:6). When the cotton market declined, many farmers turned to raising cattle and turned their eroded crop lands to pastureland. Although the lake waters flooded the prime grazing lands, ranches can still be found in the countryside surrounding Eufaula Lake.

**Lake Building -** Talk of damming the Canadian River actually began in the 1930s for flood control purposes. Later on, damming the river was seen as vital to the Arkansas River Navigation System, a plan that originated during the early 1940s to allow navigation from the Mississippi River into the Tulsa area. The Rivers and Harbors Act of 1946 became the catalyst needed for the construction of what became Eufaula Lake. The lake was authorized by Congress in 1946 and surveying and acquisition began soon after (Harkey 1992:60). The reservoir to be formed would not only serve navigation purposes for the Arkansas system but recreation, hydroelectric power, and flood control for the local population. President Johnson dedicated Eufaula Lake, the largest man-made lake in Oklahoma, on September 25, 1964.

USACE maintains the lake and its recreational facilities that were constructed soon after the opening. These recreational facilities typically contain boat ramps, picnic tables/shelters and fireplaces, swim beach and change houses, and RV hookups. Some have marinas associated with them such as Belle Starr, Evergreen, and Number Nine marinas. These marinas are operated as commercial concessions under a lease agreement with USACE. Two state parks, Arrowhead and Fountainhead, were constructed with lodges, cottages, swimming pools and tennis, a golf course, two airstrips, and a restaurant.

### 3.6.3.2 Data Collection and Field Investigation

*Previous Studies*

Eufaula Lake has been the subject of a number of archaeological surveys during the twentieth and twenty-first centuries. When reviewing the historic periods of archaeological research applicable to Eufaula Lake, it is useful to chronologically divide them into the following historical investigation periods: Works Progress Administration (WPA) (1936 through 1941), Reservoir Salvage (1946 through 1966), and Cultural Resource Management (1967 to present). Expanded descriptions of these periods and a listing of the surveys done during each one are included in Appendix G.

The WPA Period (1936-1941) spans years during which economic hardships led to increased looting of archaeological sites for items to sell for quick money. The Oklahoma Antiquity Law was passed in 1936, in response to large-scale commercial looting of throughout the state. After the passage of this law, large work crews from the University of Oklahoma were sent to excavate intact sites as part of the federal government's WPA depression relief program. One of the first excavations undertaken in the Eufaula Lake area was conducted at the Eufaula Mounds, in McIntosh County.

The Reservoir Salvage Period (1946-1966) produced large scale archaeological surveys related to lake construction (Oklahoma Archaeological Survey 1985:V-5). A total of 118 sites were located by two surveys; Wenner located 66 sites (Wenner 1948:3; Bell 1949:309) and Johnson identified a total of 52 sites (1950:3). In all, 13 of these sites were recommended for further excavation.

In 1951, the University of Oklahoma tested six of the sites recommended for further excavations along with an additional site that was not originally recommended for further excavation (Proctor 1953). These six sites were excavated in hopes of adding to the understanding of the prehistoric sequences and traits and the additional site was chosen for further testing after the landowner discovered burials there. Small data samples recovered from each site did not add to the overall understanding of known cultures, but did provide information about the prehistory of the Eufaula Lake area in relation to the prehistory of Oklahoma (Proctor 1953:52).

Not a lot of additional archaeological work was conducted in the years following the initial surveys for Eufaula Lake (Oklahoma Archaeological Survey 1985:V-6). Archaeological finds and reports were generally limited to artifacts eroding out of the shoreline.

The Cultural Resource Management Period (1967 to present) is defined by Guy to refer to the development of a new archaeology in response to the enactment of several cultural resource protection laws. Much of the archaeological research conducted during this time, and presently, is driven by these new or newly-enforced federal and state laws and directives (Guy 1990:87), with an emphasis on reconnaissance surveys and testing of sites. Approximately nine cultural resources surveys have been conducted at Eufaula Lake since 1976 encompassing specific development projects such as the realignment of U.S. 69 to broader

evaluations of cultural resources on USACE-owned lands at specific recreation areas and around the lakeshore (Appendix G).

### *Field Investigation*

As part of the scoping process for this EIS, the Tulsa District USACE received a project specific request that would require a lease of government property. This request would involve developing a mixed use community on privately-owned land that is located along the central part of Eufaula Lake and leasing the adjacent USACE-owned shoreline for the purpose of developing a variety of public recreational facilities and a marina (shown on **Figure 1-2** and on **Figure 2-3**).

A Phase I archaeological survey was conducted on the 301-acre (121 hectare) proposed lease area for the Carlton Landing development. This greater level of field investigation was determined to be necessary at Carlton Landing because of the specific nature of the development proposal and the potential for direct effects due to proposed construction along the shoreline and ground disturbing activities.

Fieldwork was conducted in two phases, the first in June 2012 and the second in August 2012 (see Appendix G). Both archaeological surveys employed surface and subsurface methods to identify and assess the eligibility of cultural and historic resources for listing on the National Register of Historic Places (NRHP) at the proposed Carlton Landing development. Archaeological files and records accessed and reviewed included those held by the USACE Tulsa District office and the Oklahoma Archaeological Survey, University of Oklahoma, Norman. Approximately three percent of the area of potential effect at Carlton Landing (10 acres, 4 hectares) was not tested due to excessive slope. A total of seven sites were examined within the 301-acre APE; five were revisits and two were newly discovered sites.

Field methods included:

- Surface Inspection - visual inspection of exposed ground surface was conducted at 15-meter intervals in areas where greater than 30 percent of the ground surface was exposed; intervals were shortened to 5 meters if an archaeological site was encountered. Artifacts were collected, bagged, and labeled with appropriate provenience and locational information for analysis.
- Shovel Turns - systematic shovel turns, *i.e.,* approximately 30 cm deep, of the surface soil were used to gain visibility of the surface in areas where less than 30 percent of the ground surface was exposed. If a turn containing either artifacts or features was encountered, formal shovel tests were dug to at least 100 cm deep.
- Examination for rock shelters - where accessible, exposed rock faces were visually examined for the presence of rock shelters and other possible cultural features.
- Site boundary identification - site boundaries were determined as accurately as possible for all sites using standard shovel testing and determining the extent of artifact and cultural features on the surface. Shovel tests were used at historic sites with surface features to verify whether subsurface deposits exist or extend beyond surface materials.

The analytical methods used involved the use of an artifact classification scheme that created categories useful for evaluating National Register eligibility. Artifacts recovered during field investigations were cataloged and analyzed. Materials were washed and sorted by general material type, and then analyzed according to methods specific for prehistoric and historic artifact assemblages. Analysis of prehistoric

assemblages included tool analysis, raw material analysis, and mass analysis. These techniques provided complementary data and allowed extrapolation of stronger inferences about the organization of lithic technology at the five sites. Historic artifacts were cataloged according to the system of artifact-function association modified from South (1977), which allows comparison of results from state to state and region to region. A number of prehistoric and historic artifacts, dating from the Late Archaic to the early- to mid-twentieth century were recovered from the archaeological sites. Based on the research potential remaining for these sites, none of them were determined to be eligible for listing on the National Register.

*Existing Conditions*

There are approximately 490 known archaeological sites and 13 historic properties within the reservoir. Most of the archaeological sites are prehistoric, a few are historic, some have both historic and prehistoric occupations, and a few cannot be ascribed a cultural occupation. Most of the historic properties are associated with coal mining, historic Native American locations, or transportation related structures. Of the known archaeological and historic sites, 13 are listed on the NRHP or are eligible for listing. Many of the archaeological sites are under the waters of the lake. A USACE database of cultural resource sites on the lakeshore includes approximately 140 cultural and historic resources (USACE 2012).

Of the 301-acre (121 hectare) site surveyed along the shorelines at the proposed Carlton Landing development, five previously identified sites were re-evaluated and two new sites were identified. Four of the sites at Carlton Landing are prehistoric sites and one is a historic site. Only one of the sites was determined to be eligible for listing on the NRHP.

# 3.7 Recreation

This section describes the existing environment as it relates to recreation. There are three main types of recreation described in this section: land-based recreation, water-based recreation (including the land/water-interface), and dispersed use recreation. Information in this section is based on the Recreation Study Report (Appendix E).

## 3.7.1 Area of Analysis (Recreation)

Located on the Canadian River, Eufaula Lake was authorized by Congress through the 1946 Rivers and Harbors Act for the purposes of flood control, water supply, hydroelectric power, and navigation. Subsequent legislation added fish and wildlife management and recreation as authorized project purposes. Construction of the dam and lake began in December 1956 and was completed in February 1964.

Located mainly in McIntosh and Pittsburg counties, with small portions in Haskell and Okmulgee counties, the lake has over 800 miles of shoreline and 97,008 surface acres, which makes it the largest lake in Oklahoma. The area of analysis includes the lake area and shoreline areas owned by USACE. The area of analysis includes all lake access points including those that may be on private lands. Recreational facilities and visitation at Eufaula Lake were compared to other USACE facilities within 50 miles.

## 3.7.2 Regulatory Setting (Recreation)

The recreation mission of USACE is to manage and conserve natural resources, while providing quality public outdoor recreation opportunities to serve the needs of present and future generations. Several regulations are relevant to an evaluation of impacts to recreation including the Rivers and Harbors Act; the

Flood Control Act; the Water Project Recreation Act of 1965; Rules and Regulations Governing Public Use of Water Resources Development Projects (36 CFR 327); and ER 1130-2-550 and EP 1130-2-550 Recreation Operations and Maintenance Guidance and Procedures. These regulations are described in Section 1.6. Several additional regulations that are particularly relevant to recreation management and recreation surveys are listed here.

#### 3.7.2.1 Engineer Manual 1110-1-400 - Recreation Facility and Customer Service Standards

This Engineer Manual (EM) provides general guidance for the rehabilitation of existing, and the design and construction of new, recreation areas and facilities, the provision of customer services, and recreation program evaluation activities at recreation areas managed by USACE. The overall purpose of this EM is to establish a uniform level of quality nationwide by which USACE-managed parks will meet the needs of current and future park customers. The criteria in the EM apply to both new recreation areas and the rehabilitation of existing areas, and it serves primarily as a conceptual design document for use by operations personnel when developing public facilities.

#### 3.7.2.2 EM 1110-2-410 - Roads and Circulation Standards

This document provides guidance and standards for roads and circulation access for roadways within and leading to USACE recreation areas.

#### 3.7.2.3 ER 1110-2-400 - Design of Recreation Sites, Areas, and Facilities

This ER establishes policy and guidance for the design of recreation sites, areas, and facilities.

#### 3.7.2.4 ER 1130-2-550 - Recreation Operations and Maintenance Guidance and Procedures

This regulation establishes the policy for the management of recreation programs and activities and for the operation and maintenance of USACE recreation facilities and related structures at civil works water resources projects.

#### 3.7.2.5 ER 1165-2-400 - Recreation Planning, Development and Management Policies

This regulation defines the objectives, philosophies, and basic policies for the planning, development, and management of outdoor recreation and for the enhancement of fish and wildlife resources at USACE water resources development projects.

#### 3.7.2.6 ER 1165-2-503 - Office of Management and Budget Clearance for the Questionnaires for U.S. Army Engineer Civil Works Studies and Projects

This regulation provides instructions on clearance for the *Questionnaires for U.S. Army Engineer Civil Work Studies and Projects* (OMB Control Number 0710-0001) and provides guidance on the development and use of the questionnaires under this approval.

#### 3.7.2.7 USACE Policy for Non-Recreational Outgrants – 2009

The purpose of this guidance is to establish a consistent nationwide policy that will be applied to evaluate non-recreational real estate outgrant requests for use of Civil Works lands and waters.

#### 3.7.2.8 USACE Policy for Recreational Outgrants – 2005

The purpose of this guidance is to establish a consistent nationwide policy that will be applied to evaluate requests for recreation development at USACE water resources development projects.

#### 3.7.2.9 USACE Recreation Strategic Plan – March 31, 2011

The Recreation Strategic Plan provides long-term guidance for the USACE recreation program to ensure that the program continues to provide safe, quality outdoor recreation opportunities for the public. The plan recognizes that water-based recreation is the major attraction of USACE recreation areas. The plan represents a framework that can guide field manager decisions to achieve recreation program strategic goals and objectives.

#### 3.7.2.10 Water and Land Recreation Opportunity Spectrum Handbook - 2011, U.S. Department of the Interior, Bureau of Reclamation

The Water and Land Recreation Opportunity Spectrum (WALROS) is a tool to understand the type and location of six types of water-related recreation opportunities, otherwise known as WALROS classes. The six WALROS classes range across a spectrum of urban, suburban, rural developed, rural natural, scenic, primitive, and primitive recreation opportunities. A particular "package" of activities, setting attributes, experiences, and benefits defines each WALROS class.

#### 3.7.2.10 Water-Related Development Policy for Fort Worth District Lakes, April 2002

This policy was developed by the USACE Fort Worth District to evaluate proposals for water-related development and is used by districts in the Southwestern Division including the Tulsa District.

### 3.7.3 Land-based Recreation

#### 3.7.3.1 Land-based Recreation Data Collection

Data was collected from existing data sources and from field studies conducted specifically for this analysis (Appendix E). Because of the size of the study area, Eufaula Lake and adjoining lands were divided into six lake areas, as shown on **Figure 3.7-1** and described in **Table 3.7-1**.

Existing data sources that provided land-based recreation data included:

- Operations and Maintenance Business Information Link (OMBIL)
- Natural Resources Management System (NRMS)
- National Recreation Reservation Service (NRRS)
- Real Estate Management Information System (REMIS)
- Oklahoma Department of Wildlife Conservation
- Oklahoma Highway Patrol, Marine Division
- Institute for Water Resources (IWR)
- Oklahoma State University
- U.S. Department of the Interior – Bureau of Reclamation
- Oklahoma Recreation and Tourism Department
- Outdoor Industry Association – Outdoor Foundation
- American Recreation Coalition
- Published studies and surveys conducted by other entities

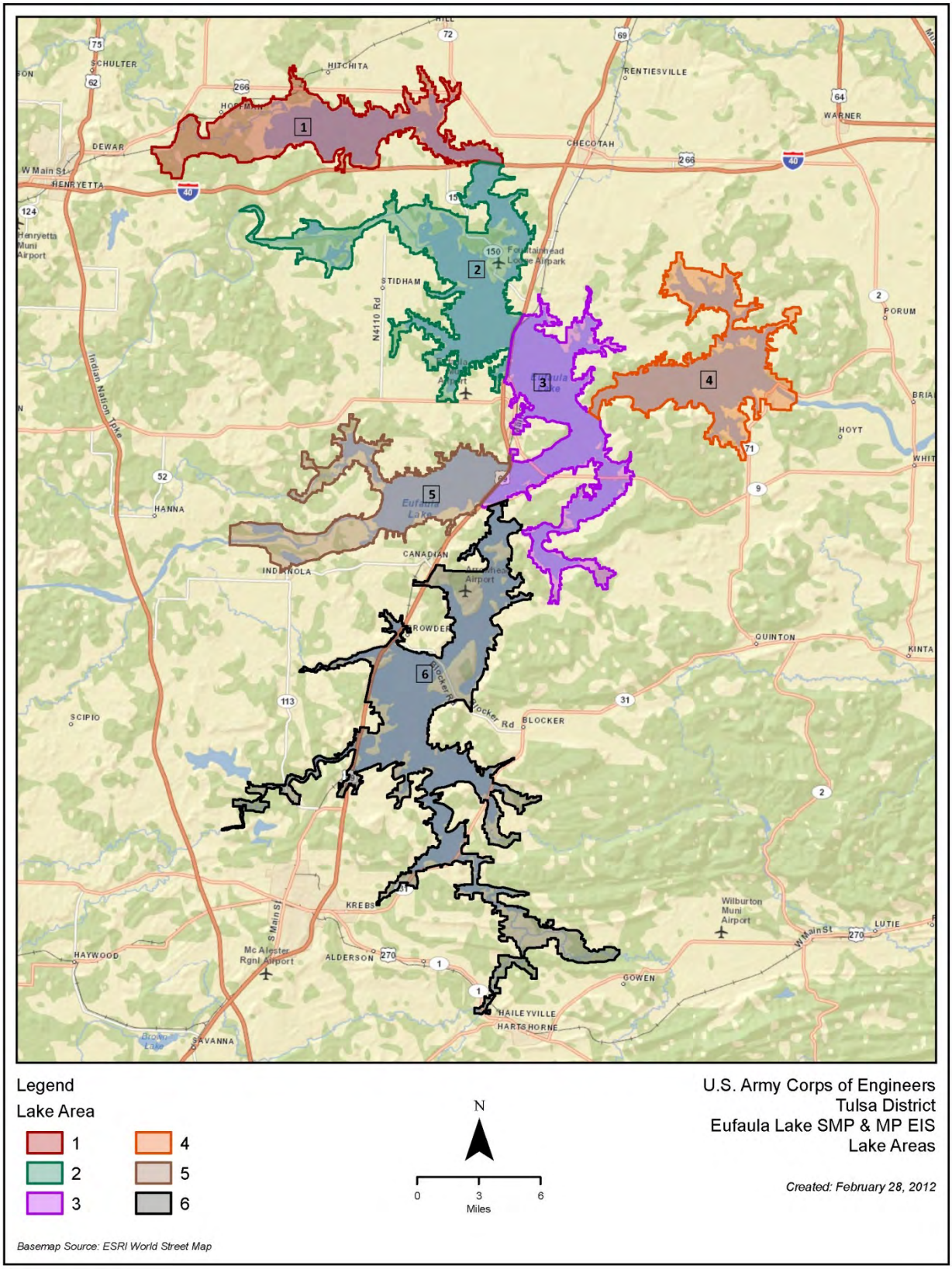



**Figure 3.7-1. Lake Areas**

**Table 3.7-1. Lake Area Number and Description**

| Lake Area # | Area Description | Lake Area Acreage[1] |
|---|---|---|
| 1 | Portion of the lake lying north of I-40 | 12,385 |
| 2 | Portion of the lake lying south of I-40 and west of US 69 | 16,173 |
| 3 | Portion of the lake lying east of US 69, north of Hwy 9A and west of Standing Rock Cut | 18,128 |
| 4 | Portion of the lake lying east of Standing Rock Cut | 15,115 |
| 5 | Portion of the Canadian River Arm lying west of US 69 | 9,963 |
| 6 | Portion of the lake lying south of Hwy 9A | 25,244 |
| **Total** | | **97,008** |

*1 – Acreage is measured from elevation 585 feet above MSL.*

The data was collected, reviewed for accuracy, analyzed, and compiled to describe the existing conditions. The data was also quantified to characterize existing land-based recreation opportunities and uses and identified trends that may influence future decisions regarding land-based recreation at the lake.

The land-based recreation data collection and analysis focused primarily on opportunities and activities that typically occur on or adjacent to USACE land, such as camping, hiking, hunting, and picnicking. Visitation statistics, occupancy rates, and user density were included in the analysis. The data provided a snapshot of existing land-based recreation facilities and conditions, which serves as a baseline from which to compare the potential impacts to the alternatives.

Field verification visits were conducted for representative sites and/or areas of concern to ensure the accuracy of data collected from other sources.

### 3.7.3.2 Land-based Recreation Affected Environment

Land-based outdoor recreation includes opportunities, activities, areas, and facilities that typically occur on, or adjacent to, USACE-owned land and water, such as camping, hiking, hunting, picnicking, all-terrain vehicle (ATV) use, wildlife/bird viewing, or sightseeing. The purpose of the analysis of land-based recreation is to identify, quantify, characterize, and map land-based recreation areas and facilities around Eufaula Lake, which will provide a baseline from which to measure potential impacts to land-based recreation that would be associated with each of the alternatives under consideration.

#### *Land-Based Recreation Areas in the Region*

To better understand the current recreation conditions at Lake Eufaula, recreation areas and facilities within a 50-mile radius of the Lake were compared to Lake Eufaula. There are four USACE lakes within 50 miles of Eufaula Lake, including Fort Gibson Lake, Robert S. Kerr Lake, Tenkiller Ferry Lake and Webbers Falls Reservoir. In addition, there are six state parks managed by the State of Oklahoma and three privately-owned RV parks. These entities provide 981 campsites, 52 miles of trails and comprise 52,342 acres. Each of these recreation areas has a variety of land-based recreation areas and facilities. **Table 3.7-2** provides a comparison of recreation areas and facilities within the region, and identifies the percentage of the regional total located at Eufaula Lake.

The regional average is 90 annual visits per acre of land. There is a regional average of 4,068 annual picnickers per picnic site, 1.57 hunters per acre of land within the region, and 57 annual sightseers per land acre.

**Table 3.7-2. Regional Recreation Areas, Facilities, and Physical Attributes Compared to Eufaula Lake**

| Physical Attribute | Regional Average | Regional Total | Eufaula Lake Total | Eufaula Lake % of Regional Total |
|---|---|---|---|---|
| Water Surface Area | 32,088 | 192,529 | 97,008 | 54% |
| Land Acres | 14,043 | 146,594 | 56,880 | 29% |
| Shoreline Miles | 280 | 1,680 | 808 | 48% |
| # of Recreational Areas | 8 | 99 | 21 | 21% |
| # of Campsites | 257 | 3,591 | 993 | 28% |
| # of Picnic Sites | 35 | 173 | 79 | 46% |
| Miles of Trails | 6 | 79 | 15 | 29% |
| # of ATV Areas | 1 | 1 | 1 | 100% |

*Source: USACE, Value to the Nation 2010 data set*

## *Land-Based Recreation Areas at Eufaula Lake*

There are a variety of land-based recreation opportunities, actives, areas, and facilities located at Eufaula Lake. Three land use classifications identified in the Eufaula Lake Master Plan (MP) and Operational Management Plan (OMP) may be applied to land used for recreation: High Density Recreation, Future/Inactive Recreation Areas, and Low Density Recreation. In addition to land classified specifically for recreation, a fourth classification, Wildlife Management, is also used extensively for recreational purposes, such as hunting. Although all of these lands are owned by USACE, they are managed by several different entities. **Table 3.7-3** provides a summary by land use classification, acreage and managing entity.

**Table 3.7-3. Land Allocation Acres and Managing Entity**

| Land Classification | Managing Entity | Acres[1] |
|---|---|---|
| High Density Recreation | USACE | 4,490 |
| | Oklahoma State Parks | 5,388 |
| | Municipal and County Parks | 688 |
| | Commercial Concession Marinas | 221 |
| Total High Density Recreation | | 10,787 |
| Low Density Recreation | USACE | 20,773 |
| Total Low Density Recreation | | 20,773 |
| Wildlife Management | USACE | 8,756 |
| | Oklahoma Department of Wildlife Conservation | 21,136 |
| Total Wildlife Management | | 29,892 |
| **Grand Total – Lands Used for Recreation** | | **61,452** |

*1 – The acres shown in this table may vary somewhat from the values shown in Table 2-8 due to differences resulting from different data sources.*

There are 20 designated public recreation areas at Eufaula Lake that total 10,455 acres. The areas are operated by a variety of entities, include the USACE, State of Oklahoma, county and municipal governments, and private commercial concessionaires.

The recreation areas contain a wide range of land-based recreation facilities and amenities, including campsites, picnic sites, group shelters, and trails. In total, there are 933 campsites, 79 picnic sites, 10 group shelters, 15 miles of trails, and 93 miles of roadways that provide access to the lake.

The designated recreation areas at Eufaula Lake routinely receive a total of over two million visits annually. Three different measurements are used to quantify visitation: visits, visitors hours, and visitor days.

### *Visitation*

A "visit" is defined as one person participating in recreation activities within a developed recreation area for any period of time. For example, one person picnicking for 30 minutes is one visit; one person camping for 14 consecutive days is also one visit.

A "visitor hour" is an aggregate of use, by one or more persons engaging in recreational activities, during continuous or intermittent periods of time, amounting to one hour. For example, one person recreating for one hour or two persons recreation for one half-hour each, are both equal to one visitor hour.

A "visitor day" is used to normalize "visits" and "visitor hours." For example, one person camping for 24 hours is equal to one visitor day, and one person hiking for four hours is also equal to one visitor day.

**Table 3.7-4** provides a summary of visitation types to Eufaula Lake from 1999 to 2011.

**Table 3.7-4. Annual Visitation Data for Designated Recreation Areas at Eufaula Lake**

| Year | Visits | Visitor Hours | Visitor Days =(VH/12) |
|---|---|---|---|
| 1999 | 2,127,100 | 30,832,300 | 2,569,358 |
| 2000 | 2,023,218 | 27,270,326 | 2,272,527 |
| 2001 | 1,677,042 | 24,686,224 | 2,057,185 |
| 2002 | 2,064,190 | 26,979,323 | 2,248,277 |
| 2003 | 1,684,023 | 24,553,386 | 2,046,116 |
| 2004 | 1,479,222 | 20,772,372 | 1,731,031 |
| 2005 | 1,160,328 | 16,530,554 | 1,377,546 |
| 2006 | 2,439,782 | 38,299,340 | 3,191,612 |
| 2007 | 2,010,768 | 28,722,746 | 2,393,562 |
| 2008 | 2,115,305 | 26,878,585 | 2,239,882 |
| 2009 | 3,171,728 | 37,353,764 | 3,112,814 |
| 2010 | 2,295,601 | 23,986,225 | 1,998,852 |
| 2011 | 2,608,951 | 23,218,664 | 2,020,895 |

The number of annual visits per acre of designated recreation land was calculated in order to make normalized comparisons of visitation. **Table 3.7-5** identifies the number of annual visits per acre of designated recreation area land within each lake area.

**Table 3.7-5. Annual Visits per Land Acre within Designated Recreation Areas by Lake Area**

| Lake Area Number | Annual Visits/Lake Area (Land Acres) |
|---|---|
| 1 | 125 |
| 2 | 65 |
| 3 | 674 |
| 4 | 404 |
| 5 | 555 |
| 6 | 54 |

The highest concentration of lake recreation use occurs in Lake Areas 3 and 4. The highest concentration of use occurs in the Eufaula City Park and Highway 9 Landing recreation areas. The average for all recreation areas combined is 430 annual visits per acre. For all USACE lands nationwide, there is an average of 84 annual visits per acre. Therefore, comparatively, the number of average annual visits per acre at Eufaula Lake is significantly higher than other USACE lakes across the country.

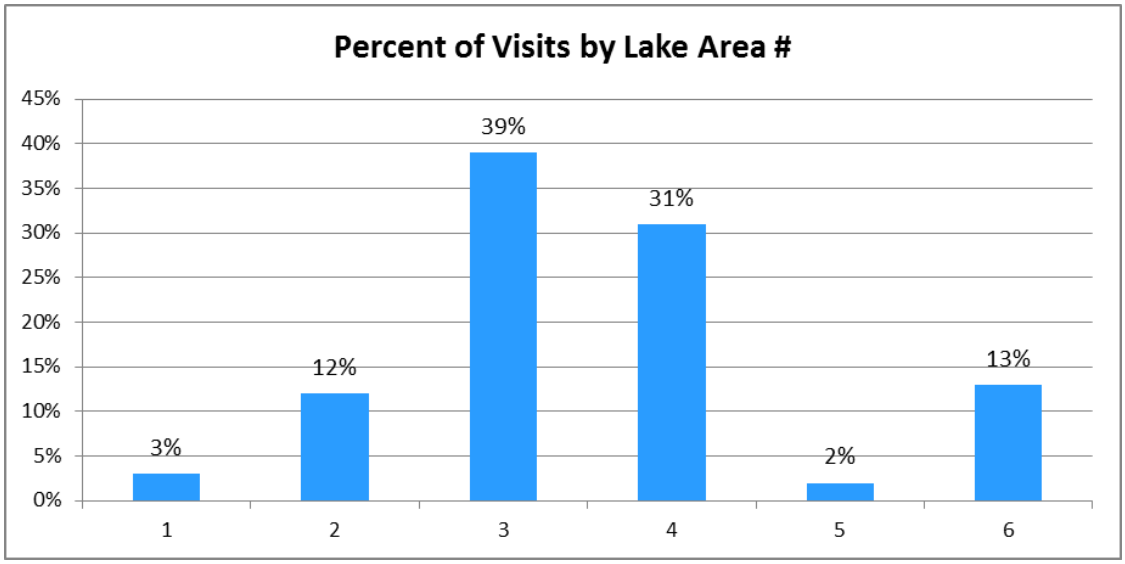



**Figure 3.7-2. Percent of Visits by Lake Area**

### *Recreation Areas Managed by USACE*

USACE manages 16 recreation areas: six campgrounds, one day-use area, three multi-purpose areas, four boating access areas, one fishing area below the dam, and one ATV area below the dam. All of these recreation areas have land-based recreation facilities. Each facility is described in detail in Appendix E. Average annual visits per acre are shown in **Figure 3.7-3**.

Campground occupancy rates vary greatly between campgrounds and between weekdays and weekends. The overall average weekday occupancy rate for USACE-managed campgrounds is 21.95 percent, while the

overall average weekend occupancy rate is 36.77 percent. The overall total average occupancy rate is 28.34 percent.

Camping, like many other outdoor recreational activities, is seasonal. Peak use occurs during the summer months with July consistently being the heaviest-use month of the year. During July, the overall campground occupancy rate is 45.68 percent and the weekend occupancy rate is 65.53 percent. Belle Starr Campground has the highest weekend occupancy rate at 83.18 percent.

### *Recreation Areas Managed by Other Entities*

There are two state parks and six state WMAs located on Eufaula Lake. The two state parks are Arrowhead State Park and Lake Eufaula State Park. Local governments manage five recreation areas including Crowder City Park and Crowder Point Recreation Area, Eufaula City Park and Eufaula Cove South, Yogi Bear's Jellystone Park-Camp Resort, and Juniper Point Recreation Area. Other existing land-based recreation areas and facilities include Checotah/Lake Eufaula West KOA Campground, and Terra Starr RV park. Each of these facilities is described in detail in Appendix E. Number of visits in 2011 and the number of annual visits per acre are shown in **Table 3.7-6** and **Figure 3.7-3**.

**Table 3.7-6. Visitation at Recreational Facilities Managed by Others**

| Recreational Facility | Number of Visits in 2011 | Annual Visits per Acre |
|---|---|---|
| **State Parks** | | |
| Lake Eufaula State Park | 390,843 | 27 |
| Arrowhead State Park | 72,839 | 65 |
| **County- and City-Managed Areas** | | |
| Crowder City Park and Crowder Point Recreation Area | 57,535 | 911 |
| Eufaula City Park and Eufaula Cove South | 265,903 | 2,570 |
| Yogi Bear's Jellystone Park Camp Resort | 27,346 | No Data |
| Juniper Point Recreation Area | 21,576 | 77 |

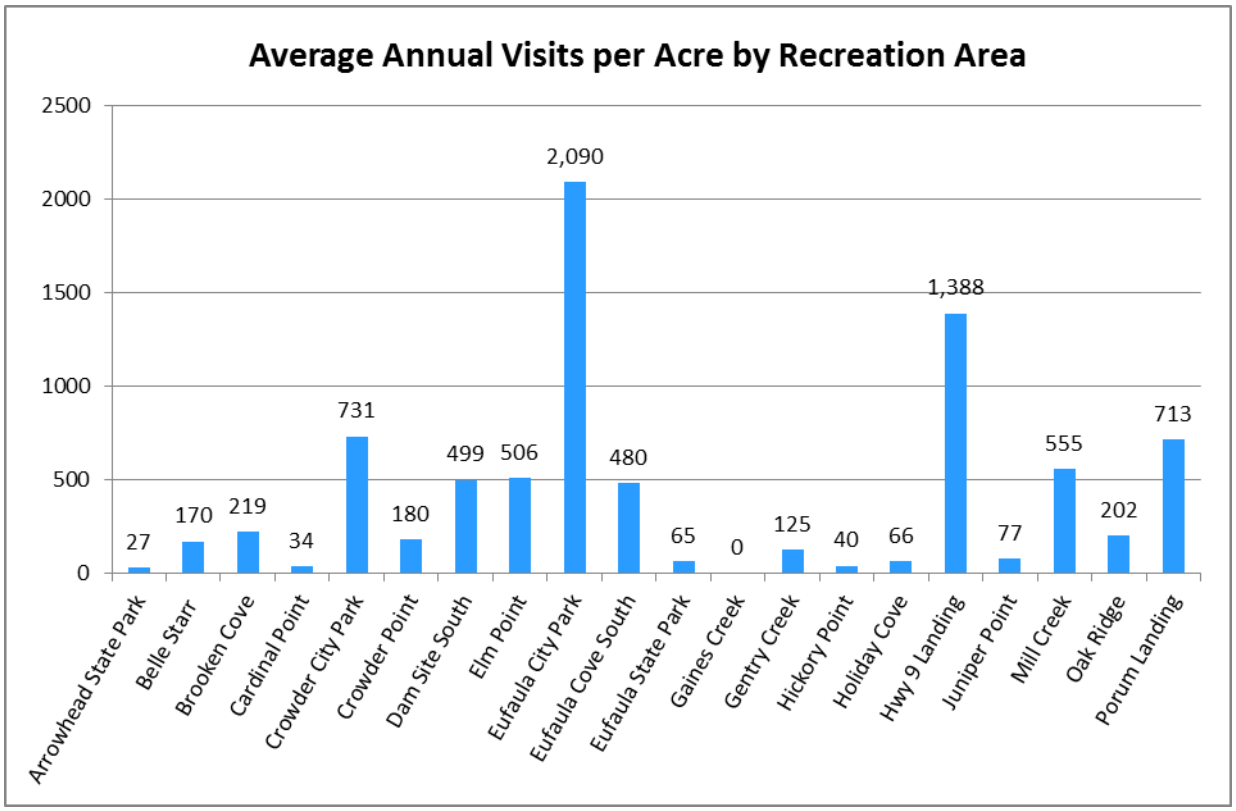



**Figure 3.7-3. Average Annual Visits per Acre by Recreation Area**

*Land-Based Recreation Economic Value*

According to visitation data provided by USACE, approximately 59 percent of the annual visits to Eufaula Lake are attributable to land-based recreation activities. This equates to approximately 1,416,000 visits annually.

The USACE uses the Recreation Economic Assessment System (REAS) to compute the economic value of the land-based recreation at Eufaula Lake. Land based recreation visitors spend an average of $23.54 per visit, which is approximately $33,332,640 of annual economic value to the 30-mile region around Eufaula Lake. For all types of recreation at Eufaula Lake, the annual economic value is estimated to be $56,496,600.

## 3.7.4 Water-based Recreation

### 3.7.4.1 Water-based Recreation Data Collection

The data collected through the water-based surveys was used to identify, quantify, and characterize water-based recreation activities (including land/water-interface recreation facilities) occurring on Eufaula Lake. These surveys include boat density counts, boat trailer counts at boat ramp parking lots, marina slip counts, and a mail-in survey sent to lake area residents.

For the purpose of water-based recreation surveys, all water areas of the lake were categorized as "restricted" or "unrestricted" water. Restricted water is defined as water that is less than three feet deep at the normal pool elevation of 585.0 feet above mean sea level (MSL) and/or water where there is standing timber (**Figure 3.7-4**). Restricted water is only considered safe for operating non-motorized watercraft or motorized watercraft engaged in fishing activities. Unrestricted water is defined as open

water that is considered safe for all types of boating activities (**Figure 3.7-5**). These definitions are also used in formulating recommendations concerning the boating carrying capacity for the lake.

The amount of "restricted" and "unrestricted" water within each of the six lake areas was quantified (**Figure 3.7-6**). Two primary reasons for the high percentage of restricted water area are 1) the overall shallowness of the lake and 2) the large amount of standing timber intentionally left in the lake during construction for the purpose of fish habitat improvement.

Land/water-interface recreational opportunities include facilities and activities that occur at swimming beaches, marinas, fishing piers, private/community docks, and boat ramps. Visitation statistics and user density were included in the analysis. Existing facilities and conditions related to land/water-interface recreation were identified and documented.

Boat density and lake capacity were evaluated using the concepts and methodologies outlined in the Water and Land Recreation opportunity Spectrum (WALROS) published by the Department of the interior and used extensively by federal, state, and local land and water management agencies. Using these standards, a preliminary estimate of the acceptable density range for Eufaula Lake was determined to be 20 to 50 acres of unrestricted water surface acres per boat (Rural Developed). This standard was used to evaluate data obtained during surveys and was applied to each of the six lake areas, as well as the entire lake.

**Figure 3.7-4. Example of Restricted Water**


**Figure 3.7-5. Example of Unrestricted Water**

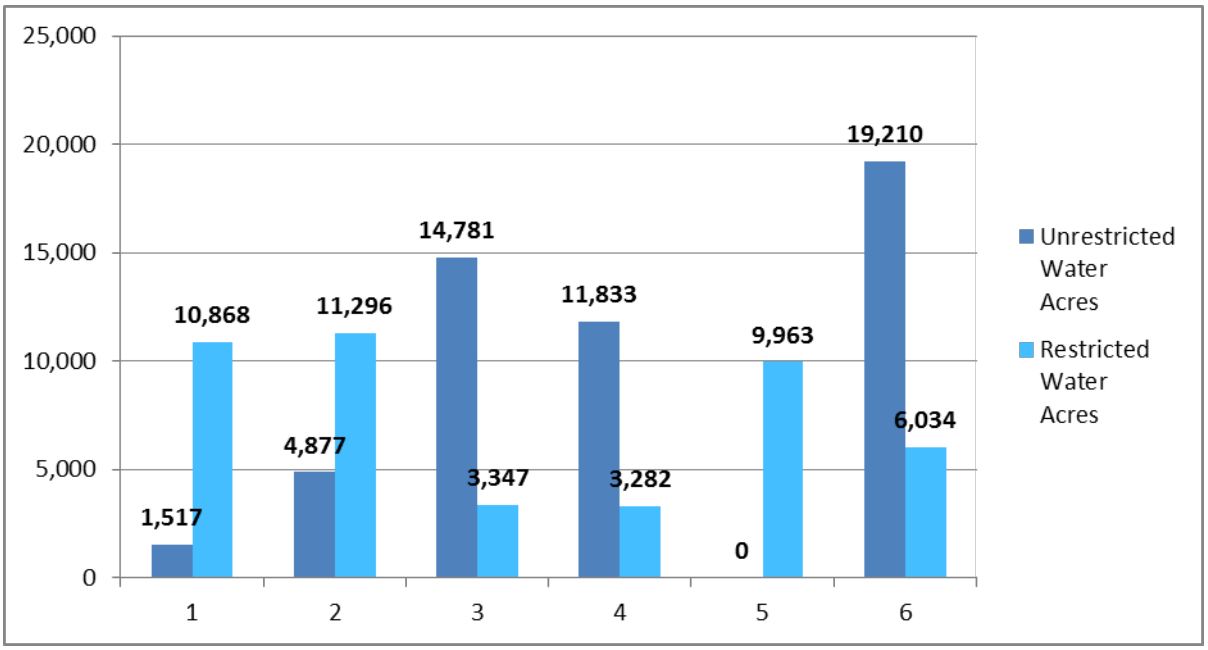



**Figure 3.7-6. Restricted and Unrestricted Water Acres – Eufaula Lake**

Several methods were used to collect data on boat use of the lake, including inventories of occupied car/trailer spaces at public boat ramps, marina (wet and dry) storage slip occupancy, private dock slip numbers and occupancy. Surveys were conducted on four heavy use weekends during the 2012 recreation season (April 7/8, May 26/27, June 16/17, June 30/July1). Aerial surveys of boat activity on the water were conducted by helicopter on the same weekends as the other recreation use data collection efforts. At the

same time as each of the aerial surveys, ground observation teams were dispatched to all major recreation areas, swimming beaches, fishing piers, boat ramps, and marinas to document usage from the ground. During these surveys, the number of empty boat trailers, rented but empty boat slips, and empty dry storage slips at each marina were tallied. In addition, ground observation surveys were conducted in areas with designated swimming beaches. Shoreline and air surveys were conducted twice each survey day; once in the morning and once in the afternoon.

### 3.7.4.2 Water-based Recreation Affected Environment

There are a variety of water-based opportunities and land/water interface recreation facilities at Eufaula Lake, including swimming, boating, fishing, and water skiing/tubing, as well as land/water interface recreation facilities that enable those opportunities and activities. Land/water interface recreation facilities are the critical links that allow water-based recreation activities to occur. For example, recreational boating activities cannot occur without a marina, boat ramp, or boat dock to provide access to the water surface. Land/water interface facilities include boat ramps, swimming beaches, marinas, and private and community docks.

#### *Regional Water-based and Land/Water Interface Recreation Activities*

To better understand the current recreation conditions at Lake Eufaula, recreation areas and facilities within a 50-mile radius of the Lake were compared to Lake Eufaula. Water-based recreational opportunities are limited by the quantity of land/water interface recreation facilities that provide access to the water, such as boat ramps, marinas, swim beaches, private and community docks. An inventory of land/water interface recreation facilities was conducted to quantify the opportunities for water-based recreation available in the region.

There are five other USACE-owned lakes within 50-miles of Eufaula Lake. Facilities at Eufaula Lake currently comprise the following percentages of the available recreational opportunities within the region at USACE-owned lakes:

- Water surface acres – 54 percent
- Public boat ramps – 30 percent
- Car/trailer spaces – 30 percent
- Marina slips – 40 percent
- Private/community boat docks – 67 percent
- Boats served by private/community boat docks – 79 percent
- Swim beaches – 26 percent

#### *Water-Based Recreation at Eufaula Lake*

***Swimming***

There are five designated swim beaches located on Eufaula Lake, as follows:

- Arrowhead State Park – Lake Area 6
- Eufaula City Park – Lake Area 3

- Lake Eufaula State park – Lake Area 2
- Highway 9 Landing Recreation Area – Lake Area 3
- Porum Landing Recreation Area – Lake Area 4

On the swim beaches at Highway 9 Landing, Porum Landing, and Eufaula City Park have delineated and buoyed swim areas. Information on each swim beach is found in **Table 3.7-7**.

**Table 3.7-7. Designated Swimming Beach Information**

| Recreation Area Name | Lake Area # | Sand Beach (Square feet) | Delineated Swim Area (Square feet) | Number of Car Parking Spaces |
|---|---|---|---|---|
| Arrowhead State Park | 6 | 195,024 SF | 0 SF | 158 |
| Eufaula City Park | 3 | 44,255 SF | 9,210 SF | 115 |
| Lake Eufaula State Park | 2 | 9,000 SF | 0 SF | 300 |
| Highway 9 Landing | 3 | 27,820 SF | 94,250 SF | 112 |
| Porum Landing | 4 | 6,112 SF | 16,320 SF | 49 |
| **Total** | | **282,181 SF** | **119,780 SF** | **734** |

Based on the square feet of delineated swim area and using the USACE standard of 30 feet per swimmer, the delineated swim areas at Eufaula Lake will accommodate approximately 3,993 swimmers at one time. This does not include the water areas at swim beaches without delineated swim areas. The limiting factor for all swim beaches at Eufaula Lake is not the amount of sand beach or water swim area, but rather the number of available parking spaces. In total, there are 734 vehicle parking spaces located near swim beaches. Using a load factor of three people per vehicle, the estimated maximum number of people that could park at swim beaches at one time is 2,202, which is significantly less than the 3,993 people that can be accommodated within delineated swim areas at the lake.

The same limiting factor is true for the sand beach areas at all swim beaches. Based on the existing square feet of sand beaches area and using the USACE standard of fifty square feet per person, the sand beach areas will accommodate approximately 5,644 people, which is significantly higher than the limiting factor of vehicle parking spaces of 2,202 people.

During the weekend recreational surveys, recreational use at designated swim beaches was observed. There are five designated swim beaches on Eufaula Lake. Over all of the swim beach surveys, there were a total of 1,104 swimmers actually present in the water, 854 people on the sand portion of the beaches and 560 people on the turf areas adjacent to the beaches. While parking spaces may be theoretically limiting, many cars were observed parked in undesignated areas at a number of recreational areas. However, even with the amount of parking that occurs in undesignated areas, none of the swim beaches were near capacity during any of the survey periods.

***Boating***

Recreational boating opportunities are dependent upon and limited by the quantity of land-based and land/water-interface recreational infrastructure such as boat ramps, marinas, boat docks, and car/trailer parking spaces, which provide boating access to the water.

There are six categories of boating activities included in the study; four for powerboats and their associated activities and two for non-powered boats and their associated activities. These include: power boat/cruising (pleasure boating), power boat/fishing, power boat/waterskiing/tubing, personal water craft, non-powered/kayak-canoe/row boat, and non-powered sail boat. Recreational boating activities for Eufaula Lake and each of the six lake areas are summarized in **Table 3.7-8**. Using methods described in Section 3.7.4.1, and shown in **Table 3.7-8**, there are approximately 8,934 recreational boating opportunities provided at Eufaula Lake.

***Fishing Tournaments and Special Event Permits***

Each year, Eufaula Lake is host to a variety of fishing tournaments and other boating-related special events such as regattas, poker runs, and parades. There are approximately 56 fishing tournaments per year, with an average of 58 boats each, for a total of 3,299 boats per year. In addition, there are usually about nine boating-related special events per year, with an average of 268 boats each, for a total of 2,600 boats per year.

The majority of the fishing tournaments and special events occur during the summer when the lake is the busiest. Typically, fishing tournaments and other special events are of short duration, so their effects on boat capacity are relatively short-lived. However, boats associated with these events may create higher than usual boat traffic and congestion. In addition, when these events occur on holiday weekends, they may create significant safety issues and/or visitor conflicts.

**Table 3.7-8. Recreational Boating Opportunities by Lake Area Number – Eufaula Lake**

| Lake Area | Water Surface Acres | # of Car/Trailer Spaces and Public Boat Ramps | # of Marina Slips | # of Boats Served by Private and Community Boat Docks | Estimated # of Boats Served by Boat Ramps Managed by Non-government Entities | Total Number of Existing Boating Opportunities |
|---|---|---|---|---|---|---|
| 1 | 12,185 | 23 | 0 | 149 | 95 | 267 |
| 2 | 16,173 | 186 | 82 | 700 | 197 | 1,165 |
| 3 | 18,128 | 419 | 762 | 1,647 | 339 | 3,167 |
| 4 | 15,115 | 154 | 235 | 2,053 | 152 | 2,594 |
| 5 | 9,963 | 10 | 0 | 198 | 96 | 304 |
| 6 | 25,244 | 304 | 18 | 776 | 339 | 1,437 |
| **Total** | **97,008** | **1,096** | **1,097** | **5,523** | **1,218** | **8,934** |

***Boating Accidents***

The Oklahoma State Highway Patrol Marine Division is responsible for enforcing the boating laws within the state. From 2003 through 2011, there were 58 boating accidents reported on Eufaula Lake involving 82 vessels. Property damage from boating accidents totaled $256,350, or an average of $4,420 per accident. A total of 62 injuries and 12 deaths were caused by these accidents.

### *Water-Based Boating Surveys*

The aerial boat count survey recorded a total of 11,656 boats during the sixteen aerial boat count surveys. Of all the boats counted, 99 percent were power boats. The most popular boating-related recreation activity was fishing (43 percent), followed by pleasure boating/cruising (33 percent), personal watercraft (20 percent), water skiing/tubing (3 percent), kayak/canoe/row boat (1 percent), and sailboat (less than 1 percent). Overall, for the survey periods, Lake Area 3 tallied the most number of boats, with 4,833 boats observed, followed by Lake Area 4 with 4,047 boats (**Figure 3.7-7**).

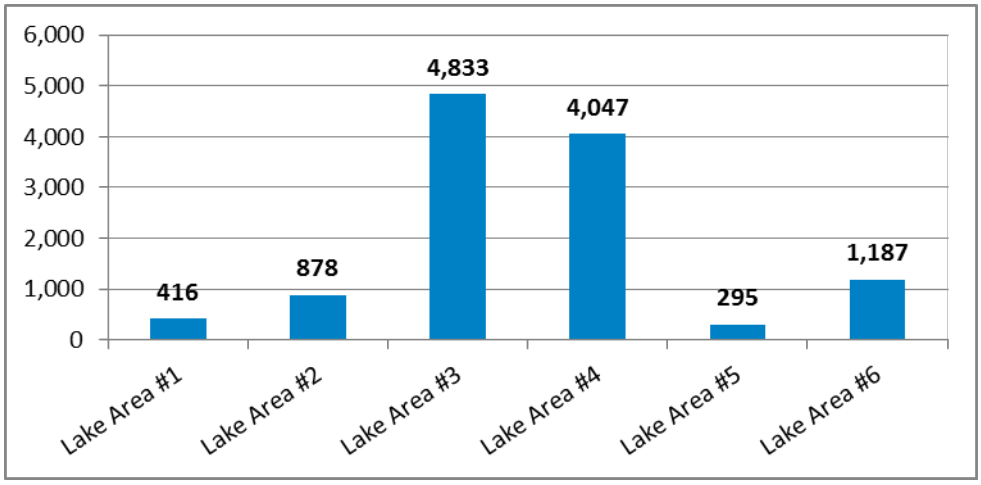



**Figure 3.7-7. Total Boat Counts by Lake Area**

There are seven commercial concession marinas located on Eufaula Lake that contain a total of 1,099 wet slips. The overall occupancy rate for all marinas at the time the marina surveys were conducted was 85 percent (**Table 3.7-9**).

**Table 3.7-9. Marinas at Eufaula Lake**

| Marina Name | Lake Area # | Number of Wet Slips | Average Number of Rented Wet Slips | Average Wet Slip Occupancy Rate (Percent of Capacity) |
|---|---|---|---|---|
| Arrowhead State Park (Area 51 Marina) | 6 | 18 | 1 | 6% |
| Belle Starr Marina | 3 | 122 | 116 | 95% |
| Coles Evergreen Marina | 4 | 108 | 89 | 82% |
| Duchess Creek Marina | 4 | 140 | 131 | 94% |
| Eufaula Cove Marina | 3 | 397 | 305 | 77% |
| Lake Eufaula State Park Marina | 2 | 82 | 82 | 100% |
| Highway 9 Landing Marina | 2 | 232 | 208 | 90% |
| **Total** | **N/A** | **1,099** | **933** | **85%** |

A total of 4,935 empty boat trailers were tallied during the survey. Empty boat trailers observed during the survey period were an indicator of boats on the lake. The percentage of empty boat trailers by lake area were:

- Lake Area 1 – 3 percent
- Lake Area 2 – 4 percent
- Lake Area 3 – 44 percent
- Lake Area 4 – 30 percent
- Lake Area 5 – 2 percent
- Lake Area 6 – 17 percent

According to data provided by USACE, there are a total of 1,096 car/trailer parking spaces located in recreation areas where empty boat trailer counts were conducted. At several recreation areas there were one or more survey periods where the number of empty boat trailers exceeded the number of available car/trailer parking spaces, including Belle Starr Marina, Brooken Cove Campground, Cardinal Point, Crowder Point, Eufaula Cove South, and Porum Landing.

Even though boat trailer parking capacity was exceeded at the above recreation areas during some of the survey periods, it was not a common event. Overall, boat ramps at Eufaula Lake operated at 28 percent of total boat trailer parking capacity on average during the survey.

The land survey teams counted boat trailers at boat ramps in public recreation areas and vacancies at marinas. The aerial survey team counted boats actually on the water at the same time. The difference provides an estimate the number of boats originating from private/community docks and boat ramps located in subdivisions during the same survey periods (approximately 1,695 boats) (**Figure 3.7-8**). **Table 3.7-10** shows the total boat count tallies from the land survey teams and aerial boat counts for all survey periods. The data also indicate that boats that may originate in one lake area do not stay in that lake area. For example, the negative number in column F in **Table 3.7-10** indicates that boats that enter the water from Lake Area 3 likely move to other lake areas and were not in Lake Area 3 at the time of the aerial survey.

**Table 3.7-10. Combined Survey Results**

| Lake Area | A Empty Boat Trailers at Boat Ramps | B Empty Marina Slips | C[1] Empty Trailers at Marina Boat Ramps | D Total Land Count (Empty Marina Slips and Empty Boat Trailers) | E Aerial Boat Count | F[2] Estimated Number of Boats from Private Docks/Subdivision Boat Ramps |
|---|---|---|---|---|---|---|
| 1 | 136 | 0 | 0 | 136 | 416 | 280 |
| 2 | 175 | 651 | 42 | 868 | 878 | 10 |
| 3 | 2,148 | 3,127 | 208 | 5,483 | 4,833 | -650 |
| 4 | 1,503 | 709 | 225 | 2,437 | 4,407 | 1,610 |
| 5 | 123 | 0 | 0 | 123 | 295 | 172 |
| 6 | 850 | 16 | 48 | 914 | 1,187 | 273 |
| **Total** | **4,935** | **4,503** | **523** | **9,961** | **11,656** | **1,695** |

[1]*Column D is the sum of columns A+B+C*

[2]*Column F is calculated by subtracting Column D from column E*

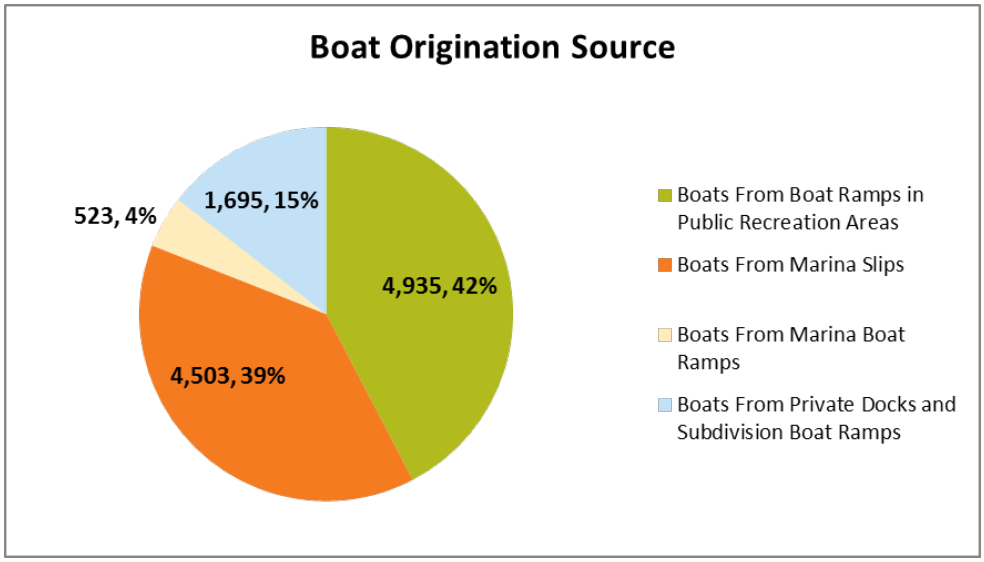



**Figure 3.7-8. Origination Source for all Boats during Survey Periods**

### *Boating Lake Use Rates*

The maximum number of boats counted during any survey period was 2,174. The maximum overall boating Lake use Rate of 24 percent can be calculated by dividing the maximum boat count (2,174) by the number of boating opportunities (8,934). Therefore, during peak use periods, one can reasonably expect that 24 percent of all the boats from all origination sources will be on the lake at any given time.

Lake Use Rates by boating origin were found to be:

- Overall – 24 percent

- Marinas – 26 percent
- Boat ramps in public recreation areas – 28 percent
- Private/Community Docks in and Subdivision Boat Ramps – 25 percent

*Boat Capacity for Eufaula Lake*

Based on the review of previous studies, it was determined that 10 to 15 acres of water surface per boat represented a conservative aggregate estimate of optimum boating density. High-speed watercraft, such as PWCs and boats with motors greater than 50 horsepower, require more space; therefore, 15 acres of water surface per boat was used as the optimum boating density for calculating carrying capacity for the Eufaula Lake.

The formula for calculating boating carrying capacity is the amount of unrestricted water surface acres (52,218) divided by the optimum boating density (15). Therefore, the optimum number of boats for Eufaula Lake is 3,481 boats. This number has been rounded up to 3,500 for the purpose of this analysis. When there are more than 3,500 boats on the lake, it may be said that the carrying capacity of the lake has been exceeded.

Using the current Lake Use Rate of 24 percent, the maximum number of boats that could be safely accommodated at mooring facilities, such as private boat docks and commercial marinas, and from boat ramps, should not exceed a combined total of approximately 14,200 boats.

Therefore, Eufaula Lake has currently reached 54 percent of its total boat capacity (the total of 5,439 boats moored at private docks, 1,099 marina slips, and 1,096 car/trailer parking spaces divided by a maximum of 14,200 boats) and 62 percent of the capacity of boats on the water at one time (the maximum number of 2,174 boats counted during one survey period divided by the carrying capacity of 3,481 boats).

## 3.7.5 Dispersed Use Recreation

### 3.7.5.1 Dispersed Use Recreation Data Collection

Dispersed use recreation is defined as visitation to USACE-owned land and water that is located outside of designated recreation areas and which is not captured via any type of traffic counting device. The majority of dispersed use recreation at the lake occurs from the following user groups:

- Shoreline Use Permit Holders
- Minor Real Estate License Holders
- Households in subdivisions adjacent to USACE property
- Marina wet slip and dry storage renters
- Hunters/fisherman using wildlife management areas located on/adjacent to USACE property
- Visitors to private campgrounds

To obtain a comprehensive understanding of recreational use in and around Eufaula Lake, a survey was developed and mailed to lake area residents (Appendix E). The focus of the dispersed use recreation survey was to obtain information related to frequency, duration, character, and location of recreational

uses and information on perceptions of lake and shoreline management, specific management issues, and policies related to shoreline and lake management.

A list of potential dispersed recreation users was compiled that included all Shoreline Use Permit holders and households within areas adjacent to Eufaula Lake. Information related to economic impacts and expenditure patterns by private and community dock owners was obtained from surveys conducted at similar USACE lakes.

Information obtained from the survey included: demographics, boat ownership and use, vessel types and use, frequency and amount of use, lake area recreational preferences, recreational activities, perceptions on density and overuse, and perceptions about lake and shoreline management issues and policies at Eufaula Lake. The survey data obtained from the mail-in survey was used to estimate the total dispersed use recreation at the lake.

### 3.7.5.2 Dispersed Use Recreation Affected Environment

Out of the 4,000 surveys that were mailed, 995 were returned for a 25 percent return rate. Survey results indicated the following:

- Most respondents own their residence (99.77 percent)
- 43 percent allow others to use their residence when not present
- 44 percent claim this residence as their permanent address/56 percent indicate a seasonal home
- 92 percent live in Oklahoma
- Respondents have recreated on Eufaula Lake for an average of 22.9 years (18,597 combined years)
- Boat owners have operated boats on Eufaula Lake for an average of 22.6 years and operate a total of 1,631 vessels (91 percent of the boats are powered)
- 65 percent have a Shoreline Use Permit for a boat dock
- Respondents operate their boats an average of 75.5 days per year, an average of 5.5 hours per day, with an average of 4.4 people on board
- In 2011, there were 53,818 visitor days attributable to respondents participating in water-based recreation
- In 2011, respondents spent a total of 128,321 visitor days recreating outside a designated recreation area (58 percent land-based, 42 percent water based)
- In 2011, respondents spent a total of 146.3 dispersed use recreation visitor days recreation on USACE land and/or water
- Extrapolating the survey data and applying it to the total population living within one-quarter mile of Eufaula Lake indicates that in 2011 there were approximately 2,971,207 dispersed use recreation visitor days spent on USACE land and/or water

### *Residents within One-quarter Mile of Eufaula Lake*

Survey respondents engaged in a total of 128,321 dispersed use recreation visitor days, for an average of 146.3 visitor days annually, on USACE land and/or water outside of designated recreation areas. Multiplying this number by the total population within one-quarter mile of the lake (20,309 people), there were approximately 2,971,207 dispersed use recreation visitor days resulting from local residents' use of USACE land and water at Eufaula Lake (**Table 3.7-11**).

### *Dispersed Use Recreation from Marina Slip Renters*

According to three studies published by USACE in February 2008 for marinas located on Harry S. Truman Dam and Reservoir, Raystown Lake, and Lake Sidney Lanier, it was estimated that marina slip renters average approximately thirty trips per year to participate in boating-related activities, with an average of 3.71 people on board during each trip.

There are 1,099 wet slips at marinas on Eufaula Lake with an occupancy rate of 85 percent, for a total of 934 occupied wet slips. With each slip averaging 30 trips per year, a total of 28,020 boat trips per year are generated from the wet slips. At 3.71 visitors per boat trip, a total of 103,954 annual visitor days occurred by wet slip renters at marinas (**Table 3.7-11**).

### *Dispersed Use Recreation from WMAs*

There are approximately 10,858 annual dispersed use recreation visitor days attributable to WMAs at Eufaula Lake (**Table 3.7-11**).

### *Dispersed Use Recreation from Campgrounds Immediately Adjacent to Eufaula Lake*

There are two private campgrounds immediately adjacent to USACE property at Eufaula Lake. The Terra Starr RV Park is a local residential development and dispersed recreation visitation associated with this area is included in visitation estimates from residents within one-quarter mile of the lake.

The Checotah/Lake Eufaula West KOA Campground receives approximately 20,808 annual visits. Approximately 75 percent of the visitors to the campground also use the hiking trails at the campground and participate in kayaking and canoeing from the campground. When hiking on trails, visitors participate in nature photography, wildlife viewing, and fishing from the shoreline. This indicates that approximately 15,606 dispersed use recreation visitor days occur annually on USACE property from this campground (**Table 3.7-11**).

**Table 3.7-11. Annual Dispersed Use Recreation Visitation Data – Eufaula Lake**

| Source of Dispersed Use Recreation | Annual Dispersed Use Recreation Visitor Days | Annual Dispersed Use Recreation Visitor Hours |
|---|---|---|
| Residents located within one-quarter mile of Eufaula Lake | 2,971,207 | 35,654,484 |
| Marinas | 103,954 | 1,247,448 |
| Wildlife Management Areas | 10,858 | 130,296 |
| Campgrounds Immediately Adjacent to USACE property | 15,606 | 187,272 |
| **Total** | **3,101,630** | **37,219,560** |

# 3.8 Noise

This section describes the existing noise environment in the area of analysis. Potential impacts resulting from implementation of the No Action and action alternatives are described in Section 4.8. The following sections include a description of the area of analysis (Section 3.8.1), applicable regulations (3.8.2), and a description of basic noise concepts and terminology as well as existing noise conditions in the area of analysis (Section 3.8.3).

## 3.8.1 Area of Analysis (Noise)

The area of analysis for noise consists of the area directly around Eufaula Lake located primarily in Pittsburg and McIntosh Counties.

## 3.8.2 Regulatory Setting (Noise)

### 3.8.2.1 Federal

NEPA requires an analysis of potential effects on the human social environment and on public health (40CFR 1508.8), which may include the potential effects of noise. NEPA does not specify federal thresholds of significance for impacts related to noise. However, NEPA requires considerations of both context and intensity in determining the significance of potential impacts on the human environment. Context means that the significance of an action must be analyzed in the context of the affected region and the locality and not just from a federal perspective. The criteria of intensity means that the analysis must consider unique characteristics of the geographic area such as proximity to ecologically critical areas and whether the action threatens a violation of federal, state, or local laws or requirements imposed for the protection of the environment (40 CFR 1508.27).

### 3.8.2.2 State

There are no state regulations applicable to noise in the area of analysis.

### 3.8.2.3 Local

There are no local noise ordinances or regulations applicable to the area of analysis.

## 3.8.3 Existing Conditions (Noise)

The area around Eufaula Lake is primarily rural and rural areas tend to have lower background noise levels than more urbanized areas. Sources of noise around Eufaula Lake include motor boats, recreationists, automobiles, lawn mowers, leaf blowers, and heavy machinery and equipment used in construction. Some of these noise sources would be relatively constant for periods of time and others would be more intermittent with a greater potential for disruption. Noise sources such as these can disrupt both humans and animals.

Noise is measured in decibels (dB) and is a measurement of sound pressure level. The human ear perceives sound, which is mechanical energy, as pressure on the ear. The sound pressure level is the logarithmic ratio of that sound pressure to a reference pressure, and is expressed in decibels. Environmental sounds are measured with the A-weighted scale (dBA) of the sound level meter. The A scale simulates the frequency response of the human ear, by giving more weight to the middle frequency sounds, and less to the low and high frequency sounds. A-weighted sound levels are designated as dBA. Generally, a change of one dBA is not detectible by the human ear, while a change of 3 dBA is noticeable to most people. An

increase of 10 dBA would be perceived as a doubling of a noise level. **Figure 3.8-1** below shows the range of sound levels for common indoor and outdoor activities in dBA.

The equivalent noise level ($L_{eq}$) is the constant sound level that in a given period has the same sound energy level as the actual time-varying sound pressure level. $L_{eq}$ provides a methodology for combining noise from individual events and steady state sources into a measure of cumulative noise exposure. It is used by local jurisdictions and the Federal Highway Administration (FHWA) to evaluate noise impacts.

The day-night noise level ($L_{dn}$) is the energy average sound level for a 24-hour day determined after the addition of a 10-dBA penalty to all noise events occurring at night between 10:00 p.m. and 7:00 a.m. The $L_{dn}$ is a useful metric of community noise impact because people in their homes are much more sensitive to noise at night, when they are relaxing or sleeping, than they are to noise in the daytime. The $L_{dn}$ is used by local jurisdictions to rate community noise impacts from transportation noise sources.

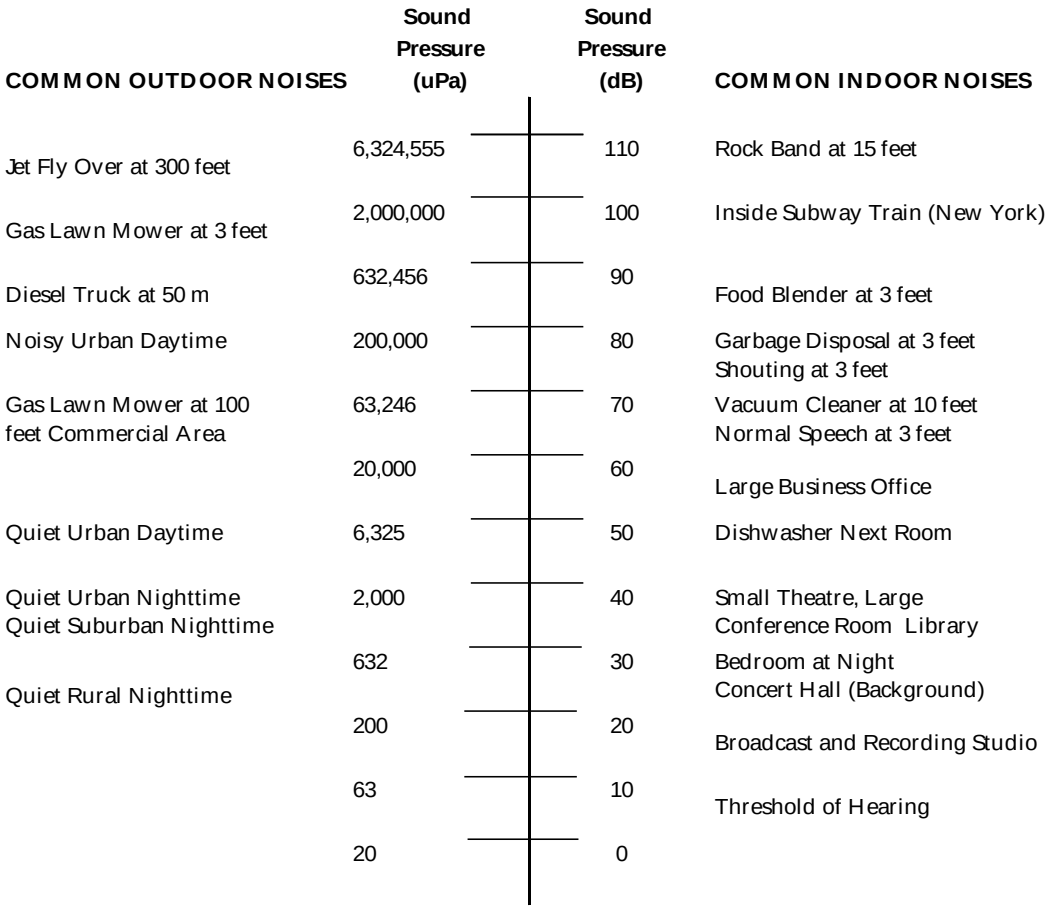
The propagation of sound can be greatly affected by terrain and the elevation of the receiver relative to the sound source. Over level ground or water, noise travels in a straight line-of-sight path between the source and the receiver. The addition of a berm or other area of high terrain reduces the sound energy arriving at the receiver. Breaking the line of sight between the receiver and the sound source can result in a sound level reduction of approximately 5 dBA. Terrain, vegetation, and other buildings may all reduce the perception of noise from a source. This is why sound is perceived to carry further over water than over land.

In addition to distance from a sound source, the background levels and the randomness of a noise affect perception. People will often find a moderately high, constant sound level more tolerable than a quiet background level interrupted by frequent high-level noise intrusions. An individual's response to sound depends greatly upon the range that the sound varies in a given environment. For example, steady traffic noise from a highway is normally less bothersome than occasional aircraft flyovers in a relatively quiet area.

With respect to noise, guidance established by FHWA in 23 CFR 772 can be used to assess appropriate noise levels for various environments. The FHWA noise abatement criteria (NAC) are based on specific land use categories and one-hour average $L_{eq}$ noise levels (**Table 3.8-1**). A noise impact might be considered to occur if predicted Leq(h) noise levels approach within 1 dBA of the FHWA noise abatement criteria. Thus, if a noise level were 66 dBA or higher, it would approach or exceed the FHWA noise abatement criterion of 67 dBA for residences.

Land uses in the area of analysis and along regional and local roadways are predominantly Activity Categories B, C, and E. Although, within the rural residential areas around Eufaula Lake, most people would tend to experience noise levels associated with activity category A most of the time.

Environmental noise at high intensities directly affects human health by causing hearing loss. Although scientific evidence currently is not conclusive, noise is suspected of causing or aggravating other diseases. Environmental noise indirectly affects human welfare by interfering with sleep, thought, and conversation. The FHWA noise abatement criteria are based on speech interference, which is a well-documented impact that is relatively reproducible in human response studies.




*Source: FHWA 1980*

**Figure 3.8-1. Common Noise Levels**

**Table 3.8-1. FHWA Noise Abatement Criteria (NAC)**

| Activity Category | $L_{eq}$ (1hr) (dBA) | Description of Activity Category |
|---|---|---|
| A | 57 (exterior) | Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve intended purpose. |
| B | 67 (exterior) | Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals |
| C | 72 (exterior) | Development lands, properties, or activities not included in Categories A or B |
| D | -- | Undeveloped lands |
| E | 52 (interior) | Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums |

*Source: 23 CFR Part 772*

# 3.9 Transportation

This section describes the regional and local roads, transportation modes, and parking facilities in the area of analysis. Applicable regulations are described in Section 3.9.2 and existing conditions of roads in the area of analysis are described in Section 3.9.3.

## 3.9.1 Area of Analysis (Transportation)

Changes in shoreline designations around the lake could result in increased recreational opportunities and higher visitation levels during peak recreation times of the year. Additional visitors to the lake could increase traffic and demands on regional and local roadways, and parking facilities at the lake. Thus, the area of analysis for traffic impacts consists of local roads serving the towns and other lands around the lake, public access roads around the lake, service roads around the lake, and major roads and highways in McIntosh and Pittsburg Counties that lead to the lake. The existing condition and potential impacts to parking facilities at recreation areas around the lake are considered.

Local roads as well as roads that run in and around the lake consist of paved and unpaved roads ranging in condition from good to poor. Highways and other regional roads in the area of analysis include Interstate 40, US 69, US 266, State Highways 52, 31, 113, 150, 9, 9A, and 7, and the Indian Nation Turnpike. **Figure 3.9-1** shows regional roads and highways around the lake. In addition to roads, the area of analysis for transportation also includes parking facilities at designated recreational facilities around the lake.

## 3.9.2 Regulatory Setting (Transportation)

### 3.9.2.1 Federal

Engineer Manual (EM) 1110-2-4 addresses policies pertaining to the design of recreation areas and facilities. Chapter 2 of this EM defines the three different types of roads serving recreation areas. These consist of access roads, circulation roads, and service roads and are defined as follows:

- Access Road: a road which permits vehicles to move between an existing public thoroughfare and the recreation site or area.
- Circulation Road: a road which connects with an access road or other circulation road and leads to and through recreation use areas and facilities.
- Service Road: a road used primarily for maintenance and supply vehicles within recreation areas. These roads may also serve as public hiking/biking trails and firebreaks.

The EM includes guidance that the design of roads serving recreation areas should be based on traffic data as well as the amount and distribution of traffic generated by the park design load (defined as visitation anticipated on a normal weekend day during the principal recreation season).

### 3.9.2.2 State

The Oklahoma Department of Transportation (ODOT) defines roadway condition and function through their roadway sufficiency method. This roadway rating takes into account roadway design and condition including such measurements as shoulder width, stopping sight distance, and drainage (ODOT 2009). Operating status, consisting of functional class, traffic volume, and level of congestion, is also factored into the sufficiency rating. The rating is adjusted when a roadway segment is congested or projected to be congested. Congestion occurs when existing traffic volume exceeds highway design capacity.

Point values that are related to minimum design and surface condition standards are assigned to these elements of roadway design and condition, with a maximum point value of 100. The ratings are broken down as follows, and used in Section 3.9.3 to discuss the existing condition of roadways in the area of analysis.

- Adequate: Roadway facilities have a sufficiency rating of 80-100
- Tolerable: Roadway facilities have a sufficiency rating of 70-79
- Inadequate: Roadway facilities have a sufficiency rating of 60-69
- Critical: Roadway facilities have a sufficiency rating of 59 or less

#### 3.9.2.3 Local

Pittsburg and McIntosh Counties have standards for minimum road design, construction, and maintenance for all new public roads constructed in the county (Rogers 2012a, Henley 2012).

### 3.9.3 Existing Conditions (Transportation)

#### 3.9.3.1 Roads

As described above, Eufaula Lake is accessed by a number of state, county, and local roads in addition to Interstate 40. Interstate 40 runs through the northern part of McIntosh County, south of US 266 and passes between Lake Areas 1 and 2, just south of the City of Checotah. Highway 150 serves as a connector between Interstate 40 and US 69, which roughly bisects the lake north to south passing through the cities of Eufaula and Crowder and intersecting with Highway 9, Highway 9A, and Highway 113. Highway 9 roughly bisects the lake east to west running through the City of Eufaula and then jogging south to intersect with Highway 9A and before heading further east through Longtown. Highway 7 runs north and south in the area of Dam Site East and intersects on the east side of the lake with Highway 9 and Highway 31. Highway 31 curves around towards the bottom of the reservoir connecting with US 69. Highway 113 and Indian Nation Turnpike both run along the southwestern part of the lake. **Figure 3.9-1** shows the location of these roads around Eufaula Lake.

**Table 3.9-1** summarizes the road types, miles, and roadway conditions in McIntosh and Pittsburg Counties (Oklahoma DOT 2009). Road classifications in these counties are defined as follows:

- Principal Arterial: Highways that serve major, long distance traffic corridors, including the interstate system.
- Minor Arterial: Highways that serve inter-county travel corridors, providing an interconnecting network between major cities.
- Collector: Highways that primarily serve intra-county traffic corridors and act as a collector road tying into the arterial system.

As shown in **Table 3.9-1**, both counties contain a mixture of principle arterials and collectors. McIntosh County does not contain any minor arterials and Pittsburg County does not contain any interstates. **Table 3.9-1** also shows that the condition of the majority of rural roads in McIntosh and Pittsburg Counties are rated either adequate or tolerable. Collector roads in Pittsburg County are about equally split between adequate/ tolerable and inadequate. No additional roads in either county are expected to be rated inadequate in the foreseeable future. Road condition does not reflect traffic volumes or congestion on the roadway.

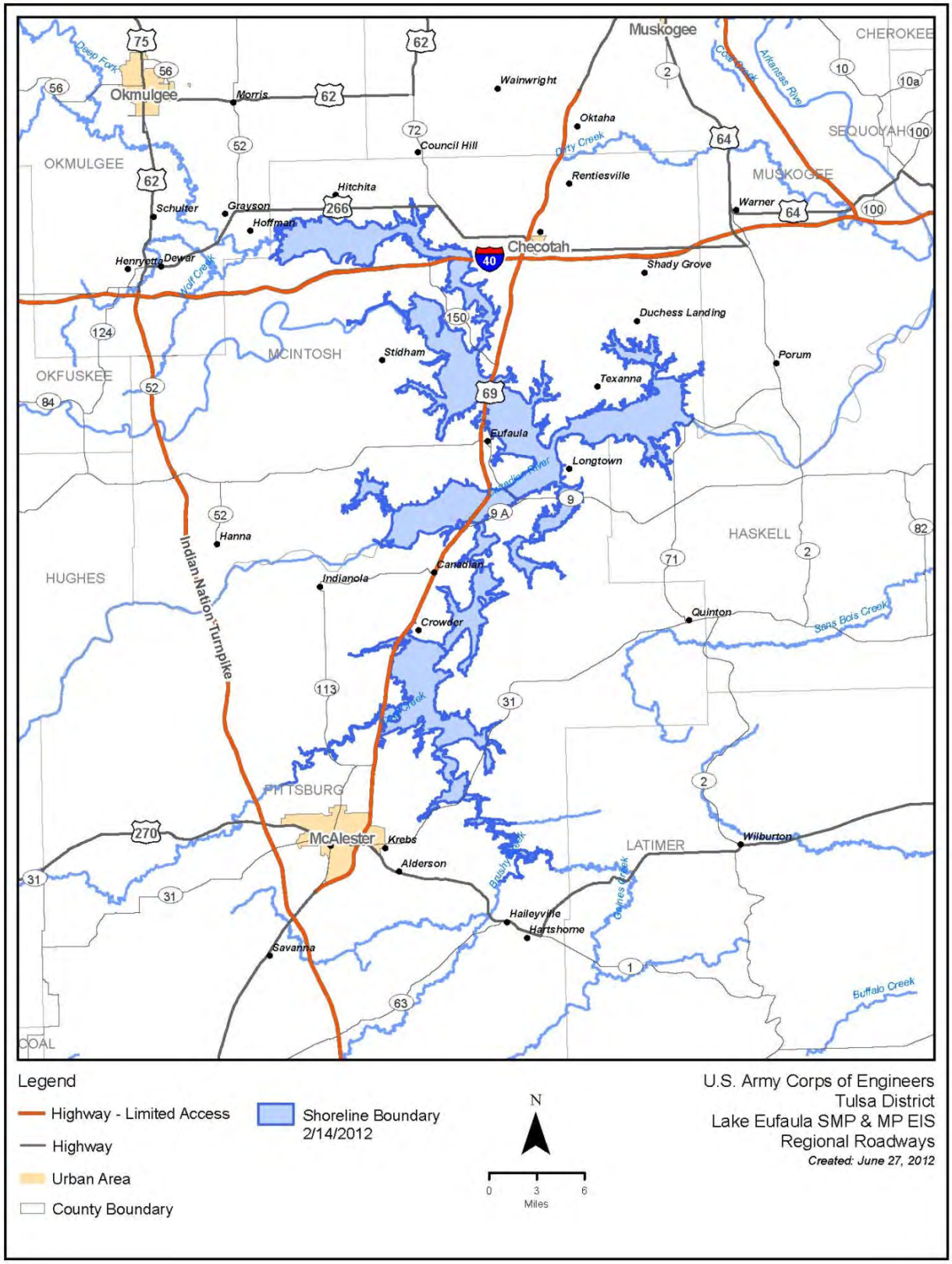



**Figure 3.9-1: Regional Roadways around Eufaula Lake**

**Table 3.9-1. County Roads and Conditions Summary**

| County | Roadway Classification | Mileage of Each Roadway Condition Category | | | Total (miles) |
|---|---|---|---|---|---|
| | | Adequate | Tolerable | Inadequate | |
| McIntosh | Interstate | 23.88 | 0 | 4.61 | **28.49** |
| | Principal Arterials | 4.68 | 7.18 | 7.10 | **18.96** |
| | Minor Arterials | 0 | 0 | 0 | **0** |
| | Collectors | 25.36 | 32.49 | 9.87 | **67.72** |
| | **Total System** | 53.92 | 39.67 | 21.58 | **115.17** |
| Pittsburg | Interstate | 0 | 0 | 0 | **0** |
| | Principal Arterials | 37.12 | 2.83 | 0.82 | **40.77** |
| | Minor Arterials | 27.17 | 11.32 | 0 | **38.49** |
| | Collectors | 27.78 | 21.77 | 52.09 | **101.64** |
| | **Total System** | 92.07 | 35.92 | 52.91 | **180.90** |

*Source: Oklahoma Department of Transportation 2009*

*Note: 1 - Mileage includes only rural roads as classified by the Oklahoma Department of Transportation as roads outside of municipal areas.*

Given the rural nature of the area of analysis, no traffic or congestion issues currently exist on major state routes or highways around the lake (Rogers 2012b). The areas where Interstate 40 and US 266 pass by Eufaula Lake contain limited development and traffic volumes are low in these areas. Highway 150 passes through Eufaula State Park and there is more residential development along this road; however, traffic volumes remain low. Generally, in areas where there is more development such as along Highway 9 near the City of Eufaula and Eufaula Cove North as well as the paved road in the vicinity of Belle Starr Park, there is more traffic. The City of Eufaula is a more urbanized area at the lake and more vehicle traffic comes to this area due to the marina at Eufaula Cove North, a number of restaurants in the city, as well as a small casino.

Lake Areas 3 and 4 are where most on-water recreation takes place; therefore, there is more vehicle traffic on the roads in these areas. Along US 69 south of Highway 9 and Highway 9A, lands around the lake are more lightly developed and would be classified as more rural again. In this area, US 69 passes through Crowder, a very small town with one main street. Lake Area 6 is also very rural until US 69 reaches the City of McAlester, which is a larger urban area containing department stores and restaurants. Some of the heavier traffic on the larger roads around the lake is from trucks transporting goods throughout the state and the country.

Public and county roads in the immediate vicinity of the lake are a mixture of gravel, graded and drained, paved, and some unimproved roads (Oklahoma DOT 2007). These secondary roads around the lake are generally two-lane, rural roads. There is no traffic congestion on these roads; however, some road condition issues have been noted on unpaved roads, as these can be difficult to pass in the rain.

Under existing conditions, peak recreation occurs from April through September with July representing the highest levels of visitation to the lake. December, January, and February typically have the lowest number

of recreation visits. During the summer months, when recreation is at its highest level, there can be heavy traffic on roadways around the lake. Roads around the lake generally accommodate slower traffic with speeds of 25 to 35 miles per hour. High traffic volumes combined with traffic that moves at differing speeds can lead to congestion on these roadways (Henley 2012).

Road improvements currently ongoing consist of updates to US 69 north of the City of Eufaula. In addition, Van Allen Road, in Pittsburg County, which leads directly to the lake south of Longtown, is being raised to prevent flooding when the lake level rises (Rogers 2012a). In McIntosh County, Texana Road is a larger roadway that feeds into many of the smaller local roads servicing subdivisions around the lake. Texana Road has been widened over the past couple of years and further improvement projects are planned to continue to widen it in order to improve traffic flow (Henley 2012).

### 3.9.3.2 Parking

Recreation facilities around the lake include parking spaces for cars and trailers. Some recreation facilities and associated parking areas are managed by USACE, while others are managed by lease holders. It was determined during field investigations that an exact number of car and trailer parking spaces could not be determined due to inexact or missing pavement markings (**Figure 3.9-2**).

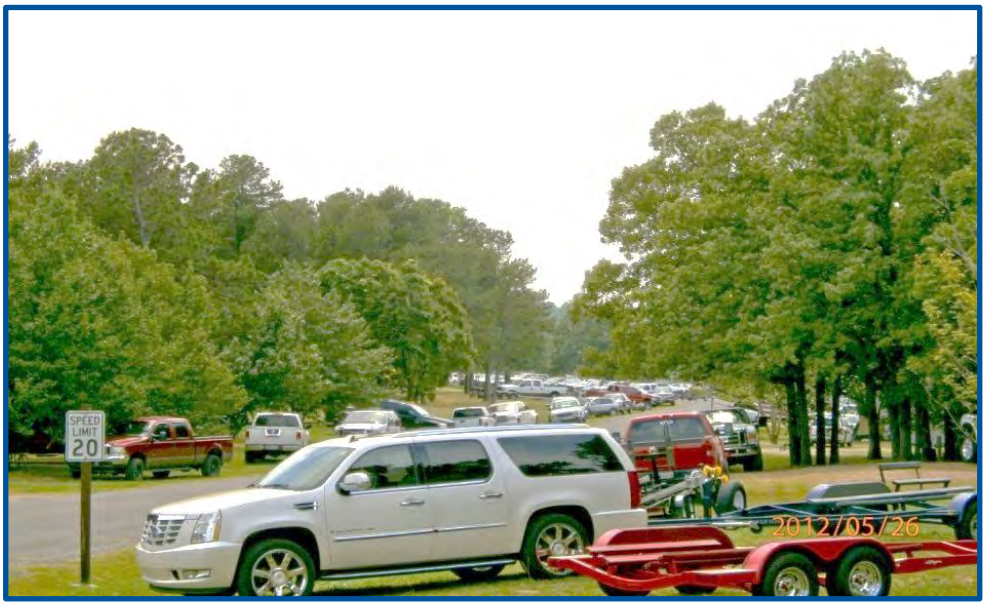



**Figure 3.9-2. Use of Un-designated Parking in a Recreational Area**

## 3.10 Public Lands and Access

This section provides information on existing conditions with respect to public lands and access at Eufaula Lake. Within the context of this section, access refers to the right of members of the public to enter and use areas around the lake. This section also discusses access for disabled persons.

## 3.10.1 Area of Analysis (Public Lands and Access)

The area of analysis for this section includes the lake and the adjacent public lands surrounding the lakeshore (**Figure 2-1** through **Figure 2-7**). The Carlton Landing study area includes the public lands, the private lands proposed for development, and any associated areas that might be affected by the development. Public lands include those lands that were purchased by USACE and those lands over which USACE has a flowage easement. These flowage easements are areas where the underlying ownership is private, but USACE purchased the right to allow the land to flood during high water events (where the lake may rise up to an elevation of 605 feet above the normal lake elevation of 585 feet).

## 3.10.2 Regulatory Setting (Public Lands and Access)

In addition to the regulations found in 36 CFR 327 and the Flood Control Act (described in Section 1.6), there are a few regulations that are specific to public access issues.

### 3.10.2.1 Federal

*The Americans with Disabilities Act of 1990, as amended; 28 CFR Parts 35 and 36*

The Americans with Disabilities Act (ADA) recognizes and protects the civil rights of people with disabilities. The ADA requires that newly constructed and altered state and local government facilities, places of public accommodation, and commercial facilities be readily accessible to and usable by individuals with disabilities. ADA standards cover both state and local public entities (Title II) and private (Title III) facilities, including recreational facilities and other places of public accommodation.

*USACE ER 1110-2-400, Design of Recreation Sites, Areas, and Facilities, 1988*

This USACE ER sets forth a requirement for barrier free design such that equal access to and utilization of facilities by all visitors must be considered when planning and designing recreation areas and facilities. It states that the design standards for handicapped facilities in the Uniform Federal Accessibility Standards (UFAS), as published in Volume 49, *Federal Register*, page 31528, 7 August 1984, must be used.

*USACE EM 1110-1-400, Recreation Facility and Customer Standards, 2004*

This USACE EM provides general guidance for the rehabilitation of existing and the design and construction of new recreation areas and facilities, the provision of customer services, and recreation program evaluation activities at recreation areas managed by USACE. It states that all new and updated facilities shall be designed to be universally accessible. Any new recreation facility purchases, such as picnic tables, grills, playground equipment, utility tables, and water fountains shall specify universally accessible items.

### 3.10.2.2 State

*Oklahoma Statutes*

Title 25 of the Oklahoma Statutes prohibits discrimination against disabled persons in public accommodations, employment, and housing. State law pertaining to handicapped parking is found in Title 47 of the Oklahoma Statutes, Chapter 15. The Oklahoma Office of Disability Concerns is responsible for ensuring that the nondiscrimination, accessibility and other requirements established by Title II of the ADA are met by state entities.

## 3.10.3 Existing Conditions (Public Lands and Access)

Access to public lands within shoreline areas at Eufaula Lake is dependent on the shoreline designation, as defined in the Eufaula Lake SMP. **Figures 2-1** through **2-7** depict the location and extent of the current

shoreline allocations. In general, any member of the public can access public recreation areas along the shoreline at Eufaula Lake, while the other three shoreline designations (Limited Development, Protected, and Prohibited), restrict public access to varying extents.

Public Recreation shorelines (which correspond to High Density Recreation areas in the MP) are designated as developed public recreational sites for federal, state or similar public use and for commercial concessionaire facilities. Privately-owned floating facilities are not permitted in these areas. Currently, there are 102 miles of shoreline (13 percent) classified as Public Recreation and 10,533 acres managed as High Density Recreation.

Public recreation facilities at Eufaula Lake include marinas, nature centers, state parks, campgrounds, public boat launches, playgrounds, and picnic areas (**Figure 3.10-1**). In addition, some areas that are publicly-owned but under management control of quasi-public or private organizations include those areas used by organizations such as the Boy Scouts, Girl Scouts, YMCA, and YWCA.


**Figure 3.10-1. Lake Eufaula Marina**

Public recreation areas are equipped with facilities for the disabled (**Figure 3.10-2**). Depending on the facility type, disabled-access facilities include wheelchair-accessible restrooms, picnicking facilities, camping pads and tables, hiking trails, fishing docks, and boat-loading (USACE 2012).

**Figure 3.10-2. Wheelchair-Accessible Picnic Area**

Protected shoreline is designated for approximately 431 miles (53 percent of the total shoreline area). Land access and boating are permitted along these shorelines, provided there is no damage to aesthetics and natural resources. These areas are commonly associated with aesthetic, fish and wildlife, cultural, or other environmental values that require protection. In some cases, they may also be areas prone to heavy siltation, rapid dewatering, erosion or exposure to high wind, wave, and current action.

Prohibited Access areas are allocated for security reasons, the protection of ecosystems, and the physical safety of the recreation visitor. These include hazardous locations and areas located near dams or spillways (**Figure 3.10-3**). Mooring of private floating facilities is not permitted in these areas. There is one mile (0.1 percent) of shoreline classified as Prohibited Access.

Currently approximately 273 miles of shoreline are designated as Limited Development. Private shoreline uses are allowed in these areas with a shoreline use permit, such as private dock installation and construction of an improved walkway to the shoreline. Informal access across government lands is allowed in these areas unless overuse creates an erosion problem. If erosion becomes a problem, then the use must cease or adjacent property owners may apply for a shoreline use permit to construct an improved walkway. An improved walkway is one with any type of surface material applied to delineate the path or improve access except concrete or asphalt, which are prohibited. USACE will also make accommodations for persons with walking disabilities as they may apply for a permit to construct a substantial walkway that is paved with concrete or asphalt to allow wheelchair access to the water.

Generally motor vehicles are not allowed on government-owned shorelines with the exception that golf carts and slow moving tractors may be allowed on permitted and improved walkways. Riding lawn mowers are also allowed on permitted lawn areas in accordance with the terms of a vegetation modification permit.

**Figure 3.10-3. Prohibited Access Area at Eufaula Dam**

# 3.11 Socioeconomics and Demographics

This section describes the socioeconomic and demographic characteristics within the study area, including population, housing, employment, education, and children's health and safety. Other social factors that are not addressed in this section may be found under Recreation, Section 3.7 and Section 4.7 or in the discussion on Environmental Justice in Appendix H. For example, issues related to public safety, economic values of recreation, and leisure and recreation are discussed in Section 3.7, Recreation. Children's health and safety is included in this section. Public participation is discussed in Chapter 7 and demographic information that informs and supports the outreach effort is described in this section.

## 3.11.1 Area of Analysis (Socioeconomics and Demographics)

The area of analysis includes the six counties that encompass Eufaula Lake: Haskell, Latimer, McIntosh, Muskogee, Okmulgee, and Pittsburg Counties with a particular focus on the 16 census tracts located within one mile of the government lands boundary of Eufaula Lake. As of July 2012, census tracts are the smallest geographic unit for which 2010 U.S. Census income data is available. Therefore, to be consistent, census tracts are the smallest geographic unit used for the socioeconomic and demographic analysis.

## 3.11.2 Regulatory Setting (Socioeconomics and Demographics)

### 3.11.2.1 Federal

NEPA regulations state that when economic or social and natural or physical environmental effects are interrelated, an environmental impact statement should discuss these effects on the human environment, which is defined as the relationship of people with the natural and physical environment (40 CFR 1508.14).

An understanding of the socioeconomic environment and how it may be affected by alternatives is important to understanding potential effects on the human environment.

Executive Order 13045 (EO 13045), *Protection of Children from Environmental Health Risks and Safety Risks,* requires federal agencies to make it a high priority to identify and assess environmental health and safety risks that might disproportionately affect children and ensure that their policies, programs, activities, and standards address disproportionate risks to children that result from environmental health or safety risks.

Engineer Circular EC 1105-2-409, Planning in a Collaborative Environment, outlines a policy of providing consideration of other social effects in planning studies along with the factors of economic development and natural resource protection.

#### 3.11.2.2 State

The State of Oklahoma does not have any regulations or policies that focus on socioeconomic or demographic concerns.

#### 3.11.2.3 Local

There are no local or regional policies or regulations that focus on socioeconomic or demographic concerns.

### 3.11.3 Existing Conditions (Socioeconomics and Demographics)

#### 3.11.3.1 Population

Over the past century, both the U.S. and the State of Oklahoma's population have grown exponentially from 92,228,531 to 308,745,538 in the nation and from 1,657,155 to 3,751,351 in the state. **Table 3.11-1** shows the growth rate in the U.S. and in Oklahoma since 1910 according to U.S. Census Bureau data. Though the state saw a decrease in population between 1930 and 1950, overall its population has more than doubled over the past 100 years.

**Table 3.11-1. Estimated Growth Rate in Population 1910-2010 (Percent)**

| Geographic Area | 1910-1920 | 1920-1930 | 1930-1940 | 1940-1950 | 1950-1960 | 1960-1970 | 1970-1980 | 1980-1990 | 1990-2000 | 2000-2010 | 1910-2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| U.S. | 15.0 | 16.2 | 7.3 | 14.5 | 18.5 | 13.3 | 11.5 | 9.8 | 13.2 | 9.7 | **234.8** |
| Oklahoma | 22.4 | 18.1 | -2.5 | -4.4 | 4.3 | 9.9 | 18.2 | 4.0 | 9.7 | 8.7 | **126.4** |

**Table 3.11-2** shows the total population in the U.S., the state, the six counties and 16 census tracts of the study area.

**Table 3.11-2. Total Population in 2010**

| Geographic Area | Total Population |
|---|---|
| U.S. | 308,745,538 |
| Oklahoma | 3,751,351 |
| Counties | 201,071 |
| Census Tracts | 62,795 |

**Table 3.11-3** shows the estimated annual percent growth in population from 2000 to 2010 in the U.S., Oklahoma, and the six counties in the study area. Though not as high as in the nation or the state as a whole, the six counties showed positive growth from 2000 to 2010. Haskell County showed the greatest increase in population while Okmulgee County showed the smallest increase. The greatest single year of growth in both Oklahoma and the six counties of the study area was from 2009 to 2010.

**Table 3.11-3. Estimated Annual Growth Rate in Population 2000-2010 (Percent)**

| Geographic Area | 2000-2001 | 2001-2002 | 2002-2003 | 2003-2004 | 2004-2005 | 2005-2006 | 2006-2007 | 2007-2008 | 2008-2009 | 2009-2010 | Total Growth 2000-2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| U.S. | 1.0 | 1.0 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 0.9 | 0.9 | 0.6 | **9.4** |
| Oklahoma | 0.3 | 0.6 | 0.4 | 0.5 | 0.5 | 1.2 | 1.1 | 0.9 | 1.2 | 1.7 | **8.6** |
| **County** | | | | | | | | | | | |
| Haskell | -0.6 | -0.2 | 1.2 | 0.7 | 0.0 | 0.9 | 0.4 | 1.4 | 1.0 | 3.0 | **8.0** |
| Latimer | -0.7 | 0.0 | -0.8 | 0.2 | -0.3 | 0.0 | -0.4 | 1.3 | 0.4 | 5.0 | **4.7** |
| McIntosh | -0.1 | 0.3 | -0.1 | -0.2 | -0.3 | 0.5 | 0.9 | -0.2 | 0.9 | 2.3 | **4.0** |
| Muskogee | 0.1 | 0.0 | 0.6 | -0.1 | 0.4 | 0.3 | 0.4 | 0.1 | 0.9 | -0.6 | **2.3** |
| Okmulgee | -0.1 | -0.2 | 0.2 | -0.1 | -0.5 | -0.4 | 0.3 | -0.4 | 0.5 | 2.0 | **1.1** |
| Pittsburg | -1.4 | 1.0 | -0.2 | -0.1 | 0.6 | 0.8 | 0.4 | 0.8 | 1.0 | 1.4 | **4.3** |
| **Average** | **-0.5** | **0.1** | **0.2** | **0.1** | **0.0** | **0.3** | **0.3** | **0.5** | **0.8** | **2.2** | **4.1** |

As shown in **Table 3.11-4**, the median age in the study area is significantly older than in the state and nation overall. The median age in Oklahoma is slightly younger than in the nation as a whole; however, the median age in the six counties of the study area is 4.5 years greater than the state as a whole, and the median age within the 16 census tracts of the study area is 8.1 years greater than the state as a whole.

**Table 3.11-4. Median Age in 2010**

| Geographic Area | Median Age (years) |
|---|---|
| U.S. | 37.2 |
| Oklahoma | 36.2 |
| Counties | 40.8* |
| Census Tracts | 44.3* |

**Average across the six counties and 16 census tracts of the study area, respectively.*

The average household size in the study area is lower than that in the state and the country. **Table 3.11-5** shows that the average household size decreases as the study area becomes more closely focused on the areas immediately adjacent to Eufaula Lake.

**Table 3.11-5. Average Household Size in 2010**

| Geographic Area | Total Number of Households | Household Size |
|---|---|---|
| U.S. | 116,716,292 | 2.58 |
| Oklahoma | 1,460,450 | 2.49 |
| Counties | 78,140 | 2.47* |
| Census Tracts | 25,262 | 2.43* |

**Average across the six counties and 16 census tracts of the study area, respectively.*

### 3.11.3.2 Housing

The homeowner vacancy rate (**Table 3.11-6**) in the study area is similar to the state overall; however, it is slightly lower than the nation overall. The rental vacancy rate is slightly higher than in the state overall, and higher than the nation overall. The median home value in the study area is considerably lower than the state and nation as a whole, as it is not even 40 percent of the national average.

**Table 3.11-6. Median Home Value and Housing Occupancy Rates in 2010**

| Geographic Area | Total Number of Housing Units | Homeowner Vacancy Rate (%) | Rental Vacancy Rate (%) | Median Home Value ($) |
|---|---|---|---|---|
| U.S. | 131,704,730 | 2.4 | 9.2 | 188,400 |
| Oklahoma | 1,664,378 | 2.2 | 11.0 | 104,300 |
| Counties | 95,790 | 2.1* | 11.8* | 76,233* |
| Census Tracts | 35,149 | 2.2* | 11.6* | 71,200* |

**Average across the six counties and 16 census tracts of the study area, respectively.*

### 3.11.3.3 Employment

The 2010 unemployment rate in the study area is higher than in the state overall. The unemployment rate in the census tracts of the study area is higher than in the nation overall, as well (**Table 3.11-7**).

**Table 3.11-7. Unemployment Rate in 2010**

| Geographic Area | Unemployment Rate (percent) |
|---|---|
| U.S. | 7.9 |
| Oklahoma | 6.2 |
| Counties | 7.3* |
| Census Tracts | 8.6* |

**Average across the six counties and 16 census tracts of the study area, respectively.*

As shown in **Table 3.11-8**, residents within the study area are more likely to be government or self-employed workers than in the state or nation as a whole.

**Table 3.11-8. Class of Worker in 2010 (Civilian Employed Population 16 Years and Older)**

| Geographic Area | Private Wage and Salary | Government | Self-Employed in Own Not-Incorporated Business | Unpaid Family |
|---|---|---|---|---|
| U.S. | 78.5 | 14.8 | 6.5 | 0.2 |
| Oklahoma | 75.3 | 17.1 | 7.4 | 0.3 |
| Counties | 69.3* | 21.0* | 9.4* | 0.3* |
| Census Tracts | 68.3* | 21.3* | 10.3* | 0.1* |

**Average across the six counties and 16 census tracts of the study area, respectively.*

The U.S. Census Bureau classifies occupations into six subcategories as shown in **Table 3.11-9**. Individuals within the study area are less likely to be in the armed forces, in management, business, science, and arts, or in sales and office professions than in the state or nation overall. However, study area residents are more likely to be employed in the service sector, in natural resources, construction, and maintenance, or in production, transportation, and material moving professions than in the state and nation overall.

**Table 3.11-9. Occupation in 2010 (Population 16 Years and Older)**

| Geographic Area | Armed Forces (%) | Management, Business, Science, Arts | Natural Resources, Construction, Maintenance | Production, Transportation, Material Moving | Sales and Office | Service |
|---|---|---|---|---|---|---|
| U.S. | 0.5 | 35.3 | 9.8 | 12.4 | 25.4 | 17.1 |
| Oklahoma | 0.7 | 31.9 | 12.1 | 13.4 | 25.5 | 17.0 |
| Counties | 0.1* | 27.5* | 15.5* | 15.8* | 23.2* | 18.0* |
| Census Tracts | 0.1* | 25.6* | 15.1* | 16.6* | 24.2* | 18.5* |

**Average across the six counties and 16 census tracts of the study area, respectively.*

The major employers within the study area include local government, local school systems, health care facilities, manufacturing companies, and Wal-Mart (**Table 3.11-10**). The median household income of the study area as compared to the state and nation overall is discussed in Section 2.11 of Appendix H.

**Table 3.11-10. Major Employers within the Study Area**

| Name | Location | Employment | Type |
|---|---|---|---|
| Ki Bois Community Action | Stigler, Haskell Co. | 800-850 | Community Services |
| Sans Bois Health Services | Stigler, Haskell Co. | 250-300 | Health |
| Stigler Public Schools | Stigler, Haskell Co. | 200-250 | Education |
| Country Style Health Care Inc. IV | Wilburton, Latimer Co. | 550-600 | Health |
| Franklin Electric Co Inc. | Wilburton, Latimer Co. | 400 | Manufacturing |
| Eastern Oklahoma State College | Wilburton, Latimer Co. | 200-250 | Education |
| Kiamichi Tech Center | Wilburton, Latimer Co. | 300-350 | Education |
| Checotah Public Schools | Checotah, McIntosh Co. | 200-350 | Education |
| Wal-Mart Associates Inc. | Checotah, McIntosh Co. | 200-350 | Retail |

| Name | Location | Employment | Type |
|---|---|---|---|
| Acme Engineering and Manufacturing Corporation | Muskogee, Muskogee Co. | 430 | Manufacturing |
| City of Muskogee | Muskogee, Muskogee Co. | 500-750 | City government |
| Dal-Tile Corp | Muskogee, Muskogee Co. | 525 | Manufacturing |
| Georgia-Pacific LLC | Muskogee, Muskogee Co. | 900-1,100 | Manufacturing |
| Jack Montgomery VA Medical Center | Muskogee, Muskogee Co. | 1,000-1,250 | Health |
| Muskogee School District | Muskogee, Muskogee Co. | 750-1,000 | Education |
| Muskogee Regional Medical Center | Muskogee, Muskogee Co. | 750-1,000 | Health |
| Med-Corp. Plus Inc. | Muskogee, Muskogee Co. | 600-750 | Health |
| Muskogee County | Muskogee, Muskogee Co. | 200-350 | Government |
| Veterans Administration Regional Office | Muskogee, Muskogee Co. | 1,250-1,500 | Community Services |
| Wal-Mart Associates Inc. | Muskogee, Muskogee Co. | 350-500 | Retail |
| Army Ammunition Plant | McAlester, Pittsburg Co. | 1,750-2,000 | Manufacturing |
| ASRC Management Services | McAlester, Pittsburg Co. | 300-350 | Financial Services |
| City of McAlester | McAlester, Pittsburg Co. | 250-300 | Government |
| Dept. of Corrections State Penitentiary | McAlester, Pittsburg Co. | 900-1,000 | State Penitentiary |
| McAlester Public Schools | McAlester, Pittsburg Co. | 500-600 | Education |
| McAlester Regional Hospital | McAlester, Pittsburg Co. | 800-850 | Health |
| Pittsburg County | McAlester, Pittsburg Co. | 200-250 | Government |
| Simonton Windows | McAlester, Pittsburg Co. | 400 | Manufacturing |
| U.S. Department of Defense | McAlester, Pittsburg Co. | 900 | Manufacturing |
| Wal-Mart Associates Inc. | McAlester, Pittsburg Co. | 450-500 | Retail |
| Anchor Glass Container Corp. | Henryetta, Okmulgee Co. | 425 | Manufacturing |
| Great Plains Coca Cola Bottling Co. | Okmulgee, Okmulgee Co. | 275 | Manufacturing |
| Muskogee Creek Nation | Okmulgee and Henryetta, Okmulgee Co. | 500-750 | Government |
| Wal-Mart Associates Inc. | Okmulgee and Henryetta, Okmulgee Co. | 350-500 | Retail |
| Okmulgee Public Schools | Okmulgee, Okmulgee Co. | 200-350 | Education |
| Okmulgee Memorial Hospital Inc. | Okmulgee, Okmulgee Co. | 200-350 | Healthcare |

*Source: Oklahoma Department of Commerce*

### 3.11.3.4 Education

The educational attainment of residents in the study area as compared to the state and nation is shown in **Table 3.11-11**. Residents within the study area are significantly less likely than the state or nation overall to have a bachelor's, graduate, or professional degree. Residents in the study area are slightly more likely than the nation overall to have some college or an associate's degree, but are less likely than persons in the state overall. Residents of the study area are considerably more likely to be a high school graduate than in the state or nation, but are also more likely to have less than a high school diploma than the state or nation overall.

**Table 3.11-11. Educational Attainment in 2010 (Population 25 Years and Older)**

| Geographic Area | Less Than High School Graduate (%) | High School Graduate or Equivalency (%) | Some College or Associate's Degree (%) | Bachelor's Degree (%) | Graduate or Professional Degree (%) |
|---|---|---|---|---|---|
| U.S. | 15.0 | 29.0 | 28.1 | 17.6 | 10.3 |
| Oklahoma | 14.6 | 32.6 | 30.2 | 15.2 | 7.4 |
| Counties | 19.8* | 37.0* | 29.2* | 9.7* | 4.3* |
| Census Tracts | 20.0* | 39.9* | 28.7* | 7.8* | 3.6* |

**Average across the six counties and 16 census tracts of the study area, respectively.*

### 3.11.3.5 Children's Health and Safety

The population within the study area under the age of 18 is 22.1 percent, which is less than the proportion of minors within the state and country as a whole (**Table 3.11-12**). Correspondingly, the population under the age of five is smaller within the study area than in the state or nation as a whole.

**Table 3.11-12. Minor Population in 2010**

| Geographic Area | Total Population Under 5 Years of Age | Under 5 Years of Age (%) | Total Population Under 18 Years of Age | Under 18 Years of Age (%) |
|---|---|---|---|---|
| U.S. | 20,201,362 | 6.5 | 7,4181,467 | 24.0 |
| Oklahoma | 264,126 | 7.0 | 929,666 | 24.8 |
| Counties | 13,040 | 6.4* | 47,686 | 23.7* |
| Census Tracts | 3,649 | 5.7* | 14,093 | 22.1* |

**Average across the six counties and 16 census tracts of the study area, respectively.*

The proportion of those living in poverty within the study area, particularly those under the age of 18, is greater than in the state and nation overall (**Table 3.11-13**). Further discussion on the total population poverty rate can be found in Section 2.11 of Appendix H.

**Table 3.11-13. Total and Minor Population in 2012 Living in Poverty**

| Geographic Area | Total Population (percent) | Under 18 Years of Age (percent) |
|---|---|---|
| U.S. | 15.3 | 19.2 |
| Oklahoma | 16.8 | 23.1 |
| Counties | 19.4* | 23.1* |
| Census Tracts | 18.8* | 25.3* |

**Average across the six counties and 16 census tracts of the study area, respectively.*

More minors within the study area live in households with at least one parent not in the labor force than minors in the state or nation as a whole (**Table 3.11-14**).

**Table 3.11-14. At Least One Parent in Household not in Labor Force**

| Geographic Area | Total Population (Percent) |
|---|---|
| U.S. | 29.0 |
| Oklahoma | 30.4 |
| Counties | 34.9* |
| Census Tracts | 32.4* |

**Average across the six counties and 16 census tracts of the study area, respectively.*

Thus, though residents within the study area are less likely to be children, the children that do reside in the study area are more likely to be living in poverty and are more likely to have a non-working parent.