II. Affected Environment

This section describes the environment that would be affected by the implementation of the alternatives. It is organized under the following four major topics: physical resources (i.e., topography, soils, climate, air, and water quality); biological resources (i.e., habitats, fish and wildlife species); socioeconomic conditions; and cultural resources. The affected area, which could potentially be impacted by the proposed action, is designated as the "area of influence" (AOI), which includes the Tennessee portion of the Paint Rock River watershed. For this Draft EA, the AOI was chosen to be the same area as the CPA and is located in Franklin County, Tennessee.

PHYSICAL ENVIRONMENT

This section describes the following physical resources in the 40,505-acre AOI: topography, geology, soils, climate, air quality, water quality, hydrology, and water quantity.

TOPOGRAPHY AND GEOLOGY

The AOI lies in the Cumberland Plateau, which is the westernmost of three divisions of the Appalachian Mountains, extending southwestward for 450 miles from southern West Virginia to northern Alabama. The plateau is 40 to 50 miles wide and lies between the Appalachian Ridge and Valley region to the east and the rolling plains to the west. It merges with the Allegheny Plateau on the north and with the Gulf coastal plain on the south. The region is dissected mainly by headstreams of the Cumberland and Kentucky Rivers and by tributaries of the Tennessee River, the valley of which in northern Alabama holds TVA reservoirs.

The roughest and highest portion of the plateau is a narrow linear ridge about 140 miles long that forms its eastern margin in eastern Kentucky and northeastern Tennessee; the name Cumberland Mountains is generally applied to this area. These mountains vary in elevation from 2,000 feet to 4,145 feet at Big Black Mountain, the highest point in Kentucky. The plateau is underlain by large deposits of coal, limestone, and sandstone, which are mined in some areas (Encyclopedia Britannica 2011).

SOILS

Soils in the AOI are dominated by upland types that are generally well-drained or not hydric. These include soil series such as: Baxter, Bodine, Bruno, Capshaw, Cumberland, Dellrose, Dickson, Hartsells, and Jefferson. Partially hydric soils include Lawrence, Taft, and Tyler. A small percentage of soils are hydric, such as Dunning, Emory, Guthrie, and Robertsville series.

CLIMATE AND CLIMATE CHANGE

The AOI has a land climate, with weather influenced primarily by air masses moving from the west and north, especially during the fall and spring. Summer weather may be influenced by low pressure systems coming off the Gulf of Mexico.

Area Climatology

Huntsville, Alabama, data (1981-2010) was used to represent general climate conditions of the AOI (NOAA 2011). The AOI has a humid subtropical climate and experiences hot, humid summers and generally mild winters. January is typically the coldest month, with lows averaging

about 31°F. A record low of -11°F was recorded in Huntsville on January 1985. July is generally the warmest month, with an average high of almost 90°F. The highest temperature measured (111°F) in Huntsville was in July 1930.

Precipitation averages 57.5 inches annually. Overall, rainfall ranges from an average of 3.3 inches (August) to 6.7 inches (March), with most months generally averaging about 5 inches. Extreme rainfall years include 1989, which totaled over 73 inches. The lowest reported annual rainfall was in 2007, which totaled only 28.7 inches. Precipitation is generally in the form of rain, although some snowfall is typically recorded during the period between December and March, but generally averages less than three inches annually. Some rare snowfall events have been reported, with over two feet accumulating in December 1963. More recently, over eight inches fell in January 2011.

Severe weather usually occurs during the spring and fall, with an increased chance for tornadoes. Notable years during which several tornadoes occurred include 1974, 1989, and 1995. During April 2011, Tennessee experienced a large outbreak of tornadoes. Occasionally, remnant tropical systems reach the area, producing high winds and heavy rain. Although flashfloods in localized valleys can occur in the AOI, widespread flooding is rare in this part of Tennessee. The drought of 2007 was one of the most extreme on record, with approximately half of the normal total amount of rainfall being reported that year.

Climate Change

Secretarial Order 3226 (Amendment 1) requires that climate change impacts be considered and analyzed when planning or making decisions within the Department of the Interior (U.S. Secretary of the Interior 2009). This order serves as an opportunity for the Service to incorporate climate change impacts into its conservation planning activities. Additionally, this proposal would contribute to the climate adaptation goals and objectives laid out in the Service's Strategic Plan for Responding to Accelerated Climate Change, "Rising to the Urgent Challenge" (USFWS 2009a).

Greenhouse gases absorb radiative energy from the sun, a process which has maintained temperatures on Earth within the tolerance limits for life to exist. However, human land use changes, energy use, and other activities contribute greenhouse gases to the atmosphere, with the potential to alter the global climate. In fact, "…warming of the earth's climate is unequivocal, as is now evident from observations of increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level," according to the Intergovernmental Panel on Climate Change (IPCC) Report (IPCC 2007). Climate change will lead to significant impacts across the United States (Wigley 2004). These may include increasing temperatures, altered rainfall patterns, and sea-level rise. The effect of climate change on wildlife and habitats is expected to be variable and species-specific, with a predicted general trend of ranges shifting northward and to higher elevations (Shugart et al. 2003). Nonnative species will likely increase (Walther et al. 2002). Figure 3 shows the projected changes in temperature for the AOI over the next 40 years (The Nature Conservancy, University of Washington, and University of Southern Mississippi 2012).

The AOI lies in a region that has seen a decline in precipitation over the years. Although the United States' annual average precipitation has increased by about 7 percent over the past 30 years, there has been pronounced drying over the southeast and the southwest. The trends in precipitation show that rainfall in parts of the southeast has substantially declined from 1901 to 2006 (Backlund et al. 2008). At the same time, the U.S. Global Change Research Program reports that extreme precipitation events are on the rise (Kunkel et al. 2008). Data collected between 1958 and 2008 show that even in drier regions, heavy precipitation events have increased, with the amount of precipitation falling in the heaviest 1 percent of rain events increasing nearly 20 percent during the

past 30 years. Meanwhile, there has been little change or a decrease in the frequency of light and moderate precipitation during that timeframe (Kunkel et al. 2008). The result is that some area will be more prone to flooding rains, followed by longer periods of drought. Warmer temperatures will only serve to compound these trends, as warmer air can hold more moisture, increasing the likelihood of heavy downpours. In between these extreme rainfall events, drought-like conditions will likely increase in frequency, as increasing temperatures will accelerate soil-moisture evaporation rates, reducing the amount of water available to plants. It is expected that water needed to recharge groundwater and surface waters will also diminish. Figure 4 shows the projected changes in precipitation for the AOI over the next 40 years (The Nature Conservancy, University of Washington, and University of Southern Mississippi 2012).

AIR QUALITY

The Clean Air Act of 1970 (as amended in 1990 and 1997), required the U.S. Environmental Protection Agency (EPA) to implement air quality standards to protect public health and welfare. National Ambient Air Quality Standards (NAAQS) were established based on protecting health (primary standards) and preventing environmental and property damage (secondary standards) (EPA 2011x). Criteria air pollutants in Tennessee include carbon monoxide (CO), lead, nitrogen dioxide (NO_2), ozone (O_3), particulate pollution (PM: $PM_{2.5}$ and PM_{10} ug/m3), and sulfur dioxide (SO_2). Primary sources of air pollutants are vehicle emissions, power plants, and industrial activities. These pollutants are monitored by a network of monitoring stations throughout each state and analyzed in order to better understand general air quality trends and to locate exceedances. The nearest air quality monitoring stations to the AOI are located in Huntsville, Alabama. Overall, air quality in Huntsville is good, and the city is designated as an attainment area for all pollutants with EPA-established NAAQS. One exception is ground-level ozone, for which Madison County has non-attainment status (ADEM 2009, City of Huntsville 2009). Nitrogen oxides (NO and NO_2 , collectively referred to as NOx), and volatile organic compounds (VOCs) are the primary sources of ozone (EPA 2011x). Motor vehicle sources were the largest emitters of NOx and VOCs in Madison County (ADEM 2009). Generally, air quality in the AOI likely exceeds that of Huntsville, given the lower number of emitters (traffic, industry). However, even in this sparsely populated region, certain pollutants may occasionally approach or reach non-attainment levels due to stagnant weather conditions, wildfires, etc.

WATER QUALITY

The Clean Water Act (CWA) of 1972 (as amended) authorizes the EPA, in partnership with the states, to regulate discharges of pollutants into the waters of the United States and set quality standards for surface waters. Since it implementation almost 40 years ago, CWA has significantly improved water quality in the United States, primarily as a result of controlling municipal and industrial point-source pollution (Andreen 2004). Point source pollution includes specific discharges from a factory or sewage treatment plant. Non-point source pollution (NPSP) comes from many sources and typically makes its way into waterbodies via surface runoff. It includes a range of materials, including fertilizers, oil, bacteria, road salt, sediment, and pesticides (EPA 2011x). NPSP is currently the largest cause of water quality degradation in the United States. NPSP is also present in the Paint Rock River watershed. Godwin (1995) documented 100 sources of NPSP at 85 sites throughout the watershed. There were 12 NPSP types recorded throughout the watershed, with the most prevalent being the lack of riparian vegetation. Other common NPSP types were livestock access to streams, vehicle fording sites, and sedimentation from a variety of sources. The most widespread apparent threat to continued water quality of the watershed was identified as siltation, with the most common cause being the erosion of stream banks lacking riparian vegetation (Godwin 1995). Ongoing voluntary

Figure 3. Changes in average annual temperatures in the AOI during the next 40 years

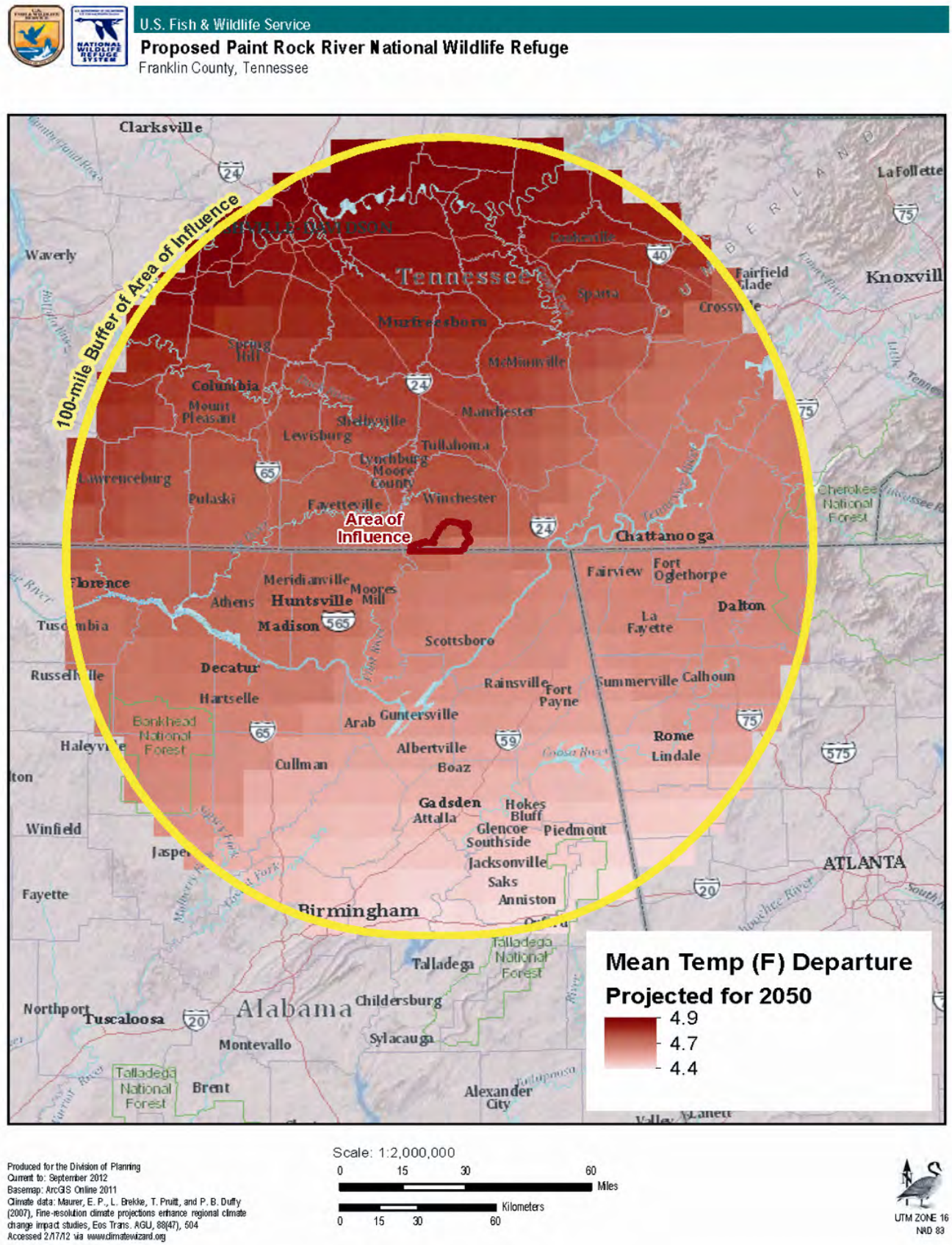
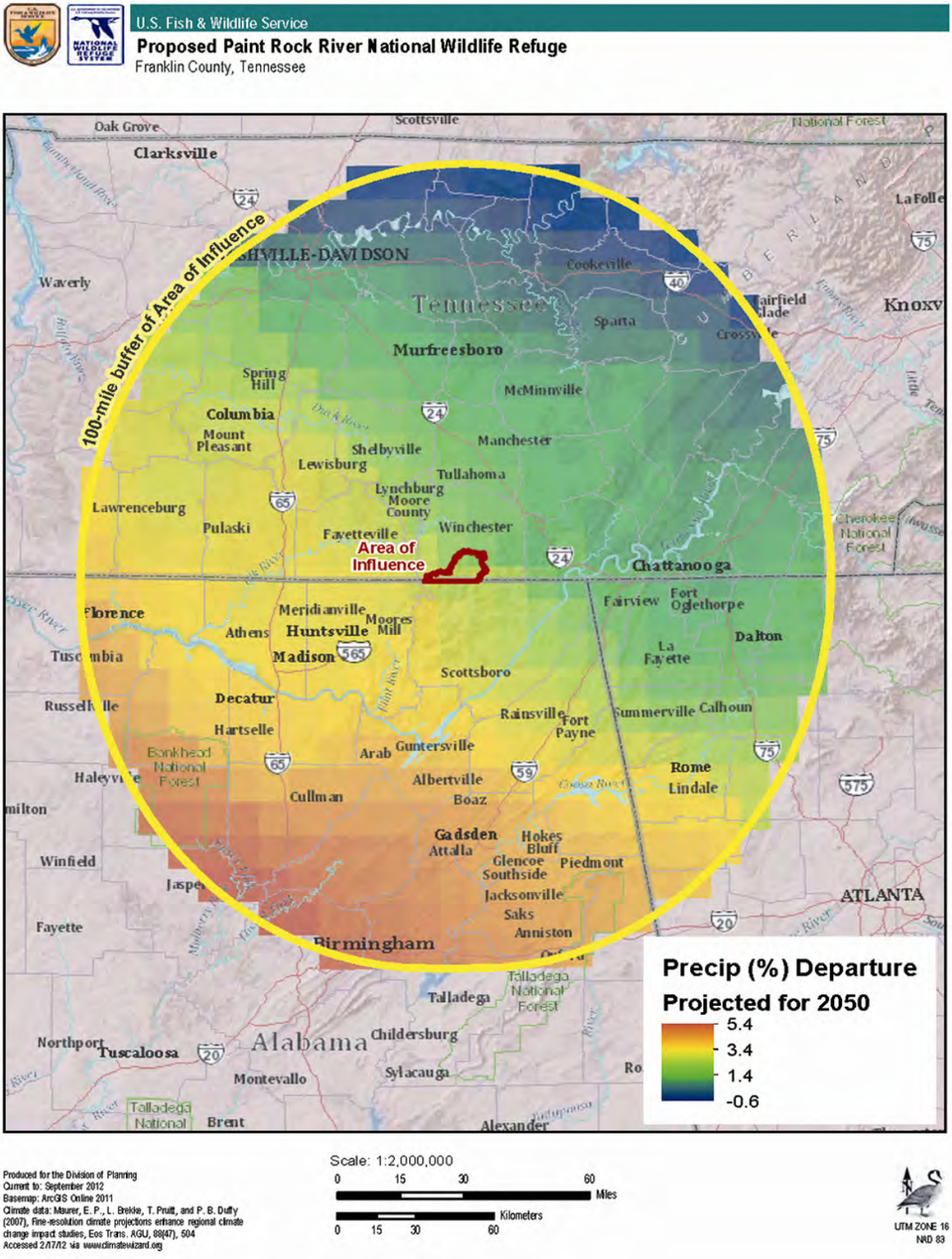


Figure 4. Changes in average annual precipitation in the AOI during the next 40 years



landowner incentive programs in Paint Rock River watershed aimed at protecting and improving water quality include the Wetlands Reserve Program (WRP), Landowner Incentive Program (LIP), and others that have helped stabilize stream banks, fenced cattle out of streams, and reforested riparian areas (R. Hurt, Wheeler NWR, pers. comm., November 2011).

The most comprehensive water quality, stream habitat, and macroinvertebrate data collected to date in the Paint Rock River watershed show some of the streams to be impacted by nutrients, sediment, fecal coliforms, and pesticides (ADEM 2000). Between July 1997 and January 2000, ADEM collected physical, chemical, and biological water quality data across the watershed. In addition, habitat and macroinvertebrate assessments were conducted. Data was collected in the following waterbodies: Clear Creek, Cole Springs Branch, Dry Creek, Estill Fork, Guess Creek, Hurricane Creek, Larkin Fork, Lick Fork, Little Paint Creek, Little Paint Rock, Creek, and Paint Rock River. Table 4 provides summaries of 15 physical, chemical, and biological water quality parameters monitored during the 2.5-year program (ADEM 2000). Elevated concentrations of nutrients were found throughout the lower Paint Rock River subwatersheds and included ammonia (>0.05mg/L; Cole Springs Creek and Lick Fork), nitrite/ nitrate (>1.5 mg/L, Cole Springs), and total phosphorus (>0.1 mg/L; Cole Springs Creek, Little Paint Creek, Little Paint Rock Creek, and Paint Rock River). These lower subwatersheds also have the highest percentage of agricultural land uses. Nutrients were also shown to be periodically elevated in the upper and mid-Paint Rock River subwatersheds (ammonia: Estill Fork, Guess Creek, Little Paint Rock, and Paint Rock; total phosphorus: Clear Creek, Dry Creek, Estill Fork, Guess Creek, Larkin Fork, and Lick Fork). Although the percentage of forest cover is higher, these subwatersheds may still be susceptible to water quality impairment from non-point source runoff. Biological oxygen demand was elevated at Little Paint Rock Creek, Cole Springs Creek, and Paint Rock River (ADEM 2000).

The presence of fecal coliform in waterbodies generally indicates that the water has been contaminated with the fecal material of human or animal origin. Fecal coliform bacteria can enter rivers through direct discharge of waste from mammals and birds, from agricultural and storm runoff, and from human sewage. Fecal coliform bacteria can cause disease in human and some animals through direct contact or via ingestion of water or shellfish (EPA 2011x). Average fecal coliform bacteria counts exceeded 1000 colonies/100mL over the 2.5-year study at Little Paint Rock. The report indicated that additional monitoring could be warranted to determine if bacterial counts exceed the limits established for the Fish and Wildlife Use Classification (monthly geometric mean of >1000 colonies/ 100mL water). Samples with >1,000 colonies of fecal coliform bacteria/ 100mL water were collected at Clear Creek, Cole Springs Creek, Dry Creek, Guess Creek, Larkin Fork, and Paint Rock River (ADEM 2000).

Several pesticides and other petroleum-based chemicals were found throughout the watershed. Atrazine and metolachlor, both used as herbicides, were detected at Dry Creek, Cole Springs Creek, and Lick Fork. Atrazine was detected at Paint Rock River. Di (2-ethylhexyl) phthalate (DEHP), a plasticizer used in the manufacture of poly vinyl chloride (PVC) materials, was detected at all stations. Di (2-ethylhexyl) adipate (DEHA), used as a hydraulic fluid and some PVC-based materials, was detected at Estill Fork, Clear Creek, and Little Paint Rock Creek (ADEM 2000).

Biological monitoring can also be used to determine environmental conditions, including water quality. One such method is to survey populations of aquatic insect larvae, crayfish, clams, snails, and worms that can be seen without a microscope and collectively known as “marcoinvertebrates.” Many macroinvertebrates are sensitive to water pollution, which means they can be used as indicator species of stream health (EPA 2011x). Macroinvertebrate assessments conducted as part of the 1997-2000 Paint Rock River water quality survey generally indicated Hurricane Creek, Dry Creek, Larkin Fork, and

Table 4. Select Paint Rock River tributaries water quality data (averages) collected between July 1997 and January 2000

Water body	DO	pH	Cond	Turb	Flow	Coli	BOD	TDS	TSS	NH_3	NO_3 & NO_2	TKN	PO_4	Alk	Hard
Estill Fork	9.0	7.8	298	3	25	107	1.1	188	1.5	0.017	0.120	0.209	0.017	139	170
Hurrican e Creek	8.7	7.6	245	25	36	143	1.1	149	3.8	0.011	0.123	0.207	0.017	109	137
Larkin Fork	8.5	7.6	310	4	39	291	1.1	190	2.7	0.013	0.311	0.231	0.028	144	175

Key: Alk=alkalinity (mg/L), BOD-5= 5-day biochemical oxygen demand (mg/L), Coli=fecal coliform colonies/100mL, Cond=conductance, DO=dissolved oxygen (mg/L), Flow=stream flow (cubic feet per second/cfs), Hard = hardness (mg/L), NH3=ammonia (mg/L), NO2+ NO3=nitrite & nitrate (mg/L), pH=acidity level, TDS=total dissolved solids (mg/L), TKN=total Kjedahl nitrogen (mg/L), TP=total phosphate (mg/L), TSS=total suspended solids (mg/L), Turb=turbidity (Nephelometric Turbidity Units/NTU)
Source: ADEM 2000

Lick Fork to be in excellent condition. Estill Fork, Guess Creek, and Clear Creek were assessed as good to excellent. The macroinvertebrate communities of Little Paint and Little Paint Rock Creeks were in good condition. Cole Springs Creek was in fair to poor condition (ADEM 2000).

HYDROLOGY AND WATER QUANTITY

Hydrology

The Paint Rock River watershed is located within the Cumberland Plateau section of the Appalachian Highlands physiographic region and encompasses approximately 478 mi^2 in northern Alabama and southern Tennessee. The watershed originates in Franklin County, Tennessee, and drains portions of several counties in Alabama before entering the Tennessee River at Wheeler Reservoir. The three major tributaries to the main stem river are Estill Fork, Hurricane Creek, and Larkin Fork, which all originate in Tennessee.

The Paint Rock River valley seldom exceeds one mile in width and meanders through a smooth alluvial plain throughout its length, with the valley bordered by high forested ridges of the Cumberland Plateau. The highest elevations in the watershed occur on the plateaus along the tributaries in the upper watershed, and differences in elevation between the streams and the ridge-tops can reach 1,000 feet. The river drops approximately 200 feet from the headwaters to its confluence with the Tennessee River. The river and its tributaries are generally shallow and relatively narrow, generally about 30 feet wide, with depths ranging from a few inches to over three feet deep. Maximum widths are up to 90 feet. Upper watershed tributaries are typically high gradient while the main channel near the mouth is slow-moving and controlled by pool-level fluctuations in the reservoir. Streams in the upper portion of the watershed are characterized by high gradients with a medium, occasionally swift, flow draining relatively steep, forested mountainsides. Stream substrates are coarse sand, gravel, cobble, and bedrock. The lower watershed is characterized more by flat to gently rolling hills and irregular plains. Streams are low to moderate gradient with substrates of gravel and bedrock, and stream flow is low and fairly sluggish, particularly for the main stem. The flow is greatly diminished several miles upstream of the Paint Rock River mouth, and at times may move upstream due to differential in water levels between the reservoir and the river. Lower gradient streams in the southern third of the watershed have sand-silt-cobble substrates, are generally turbid year-round, and have occasional flooding problems (Barbour 2003).

Water Quantity

Stream flow patterns for waterbodies in the AOI are typical of streams in the humid temperate region, with peak flows in late winter and early spring and lows occurring in late summer and early fall. Peak flows are relatively short-lived, as would be expected for a stream with mountain origins and substantial amounts of rock substrate Shaw (2002).

There is one active gauging station near Woodville on the Paint Rock River that is operated by the U.S. Geological Survey (USGS) and its partners. Parameters collected at the Woodville station (USGS site number: 03574500) include stream-flow (discharge) and gage height. River discharge (flow rate) data have been collected at the Woodville station since 1936, which has been summarized in Table 5 (USGS 2011). Since recordkeeping began, the annual average discharge rate at this site has been approximately 676 cubic feet per second (cfs). Mean monthly discharge rates range from 107 to 1,451 cfs. Minimum flows tend to be during the months of August through September, while maximum flow rates are generally recorded January through March. During the drought of 2007, the USGS station near Woodville had the lowest average annual flow rate (180 cfs) since 1936. Discharge rates dropped to 19 cfs in June and remained in

the double digits through the remainder of the year. Typically, average monthly flow rates in the summer range between about 100 and 200 cfs. Other years with low average flow rates include 1941 and 2006, when average monthly flow rates dropped to single digits in the summer. Conversely, years of exceptionally high water include 1975, 1977, 1990, 1991, and 2004, when average annual flow rates ranged between 1,004 and 1,106 cfs (USGS 2011).

Statistical analysis indicates no major changes in ecologically important flow parameters over the period of record, except for a possible decrease in the frequency of flows greater than 20,000 cfs beginning in the mid-1970s or early 1980s. At around this same time, annual peak flows began occurring earlier (as early as September or October) and later (as late as April or May) than had typically occurred prior to the mid-1970s. Similar patterns of change beginning in the late 1970s or early 1980s are evident in stream, spring, lake, and wetland data throughout the southeast and are likely the result of climate change (Shaw 2001); given the nature of the Paint Rock watershed, it is unlikely that these changes are the result of local changes in land use or water management. Geology of the watershed suggests that groundwater originating in extensive limestone formations provides the vast majority of baseflow to the river. Field observations suggest that sources of groundwater input to the river are still largely intact.

Table 5. Monthly Paint Rock River discharge data for 1936 – 2009

Month	Mean Discharge Rate (cfs)	Minimum Discharge Rate (cfs)	Maximum Discharge Rate (cfs)
January	1,295	160	3,519
February	1,451	246	3,941
March	1,448	300	4,185
April	1,008	218	3,018
May	586	69	2,538
June	245	24	1,263
July	208	14	1,465
August	107	10	746
September	140	4	1,136
October	176	3	2,597
November	444	10	3,056
December	997	35	3,849

cfs- cubic feet per second
Data from stream station 03574500 located on the Paint Rock River near Woodville, AL.
Source: USGS 2011

NOISE

Although noise studies are not known to have been conducted in the region, it is expected that the soundscape is relatively undisturbed. The rural nature and low density population are unlikely to cause significant noise levels in the area. Primary sources of noise are likely from highway traffic.

BIOLOGICAL ENVIRONMENT

The Paint Rock River is one of the most biologically diverse watersheds in North America for freshwater mussels with 48 species recorded between 1990 and 2008 (Fobian et al. 2008, Williams et al. 2008). The exceptional mussel diversity is likely due to the river's limited amount of habitat alteration, extensive habitat diversity, abundant nutrients, and calcium-enriched waters. Rare species can be found throughout the river, ranging from the shallow shorelines in the headwaters region downstream to the embayed region near the confluence of the Tennessee River (Wheeler Reservoir). Rare species can also be found in a variety of substrates ranging from coarse gravel and cobble to fine silt. Seven species of mussels occurring here are either protected under the Endangered Species Act or are candidates for protection. The pale lilliput (*Toxolasma cylindrellus*) occur nowhere else except for the upper Paint Rock River and its headwaters. The watershed is also home to the very rare Alabama lampmussel (*Lampsilis virescens*), once believed to occur nowhere else. However, during the spring of 2011, two leading malacologists found the lampmussel in the upper Emory River (Morgan County, Tennessee) when they were surveying for the purple bean (*Villosa perpurpurea*), another rare mussel species.

LAND COVER

For the purposes of this Draft LPP/EA, Southeast GAP (USGS and North Carolina State University 2010) land cover was used to broadly describe vegetative communities within the AOI. Table 6 shows the relative acres of the different land cover types in the AOI, in both the protected (i.e., state lands) and unprotected areas. See Figures 5a – 5c for the land cover maps. The three dominant types of upland forests (further described below), comprise over 90 percent of the total area. Within currently protected areas, these land cover types represents over 97 percent. The next largest land cover type in the AOI is cultivated/planted, which includes pasture, hay, and row crops. For more details of the lesser land cover types, please refer to USGS and North Carolina State University (2010).

Southern Ridge and Valley Dry Calcareous Forest
Natural vegetation consists of forests (or woodlands) dominated most typically by several oaks (*Quercus alba, Q. muehlenbergii*, and *Q. shumardii*), with varying amounts of hickories (*Carya* spp.), maples (*Acer saccharum, A. barbatum, A. leucoderme, A. rubrum*), and other species. This category also includes successional communities that have been impacted by logging or agriculture, including upland forest types dominated by tulip tree (*Liriodendron tulipifer*), pines (*Pinus* spp.), juniper (*Juniperus virginiana*), and black locust (*Robinia pseudoacacia*).

South-Central Interior Mesophytic Forest
Dominant tree species include sugar maple, American beech (*Fagus grandifolia*), tulip tree, *Tilia americana*, red oak, *Magnolia acuminata*, and eastern black walnut (*Juglans nigra*). Eastern hemlock (*Tsuga Canadensis*) may be a component of some stands. This forest type has a rich herb layer, often with abundant spring ephemerals.

Allegheny-Cumberland Dry Oak Forest and Woodland
These forests are typically dominated by various oaks (*Q. alba, Q. falcata, Q. prinus, Q. coccinea*), red maple, pignut hickory (*Carya glabra*), and mockernut hickory (*C. alba*). Sprouts of American chestnut (*Castanea dentata*) can often be found where it was historically a common tree. Shortleaf pine (*Pinus echinata*) and/or Viriginia pine (*P. virginiana*) may occur, particularly adjacent to escarpments or following fire. In addition, eastern white pine (*P. strobus*) may be prominent in some stands in the absence of fire.

Within the more broadly defined land cover types exist various habitats that are important to wildlife, which are further detailed in Table 6.

Table 6. Land cover types within the AOI

Land Cover Type	Unprotected Acres	Protected Acres	Total Acres
Southern Ridge and Valley Dry Calcareous Forest	20,445.80	2,002.10	22,447.90
South-Central Interior Mesophytic Forest	8,024.70	908.3	8,933.00
Allegheny-Cumberland Dry Oak Forest and Woodland	5,187.20	898.2	6,085.40
Cultivated/Planted[1]	1,652.20	38.0	1,690.20
Scrub/Shrub	499.9	12.0	511.90
Developed[2]	423.4	6.5	429.90
Southern Appalachian Low Mountain Pine Forest	205.3	5.8	211.10
Pine Plantations	59.2	0.0	59.20
Grassland/Herbaceous	49.6	20.3	69.90
South-Central Interior Small Stream and Riparian	21.6	3.6	25.20
Southern Interior Acid Cliff	14.2	0.0	14.20
Southern Interior Calcareous Cliff	10.5	6.0	16.50
Cumberland Riverscour	5.3	0.2	5.50
Open Water	5.1	0.0	5.10
Total	***36,604.00***	***3,901.00***	**40,505.00**

1 - combined pasture/hay and row crop
2 - combined developed open space and low intensity developed
Source: USGS and North Carolina State University 2010

Figure 5a. Land cover in the Paint Rock River watershed

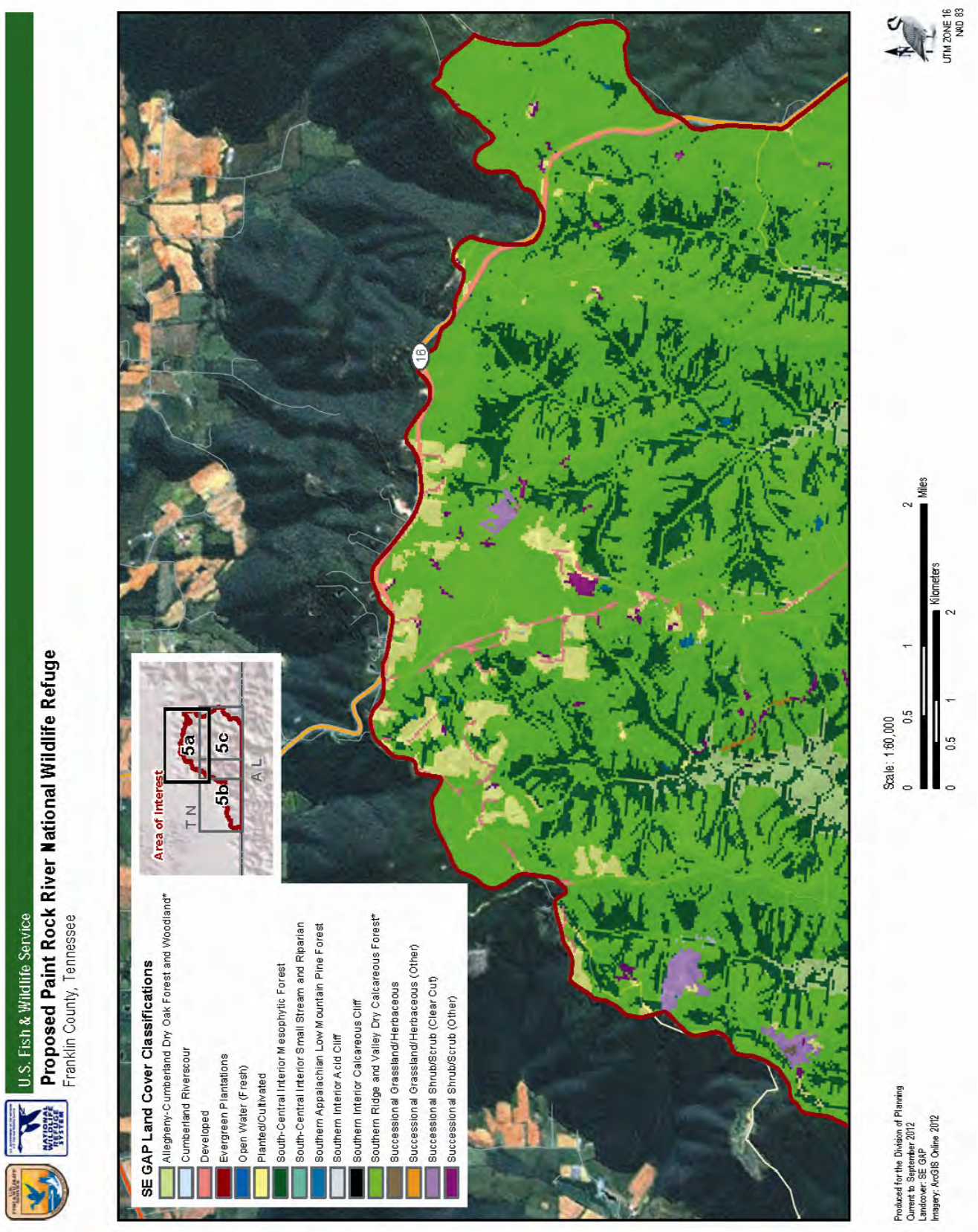


Figure 5b. Land cover in the Paint Rock River watershed

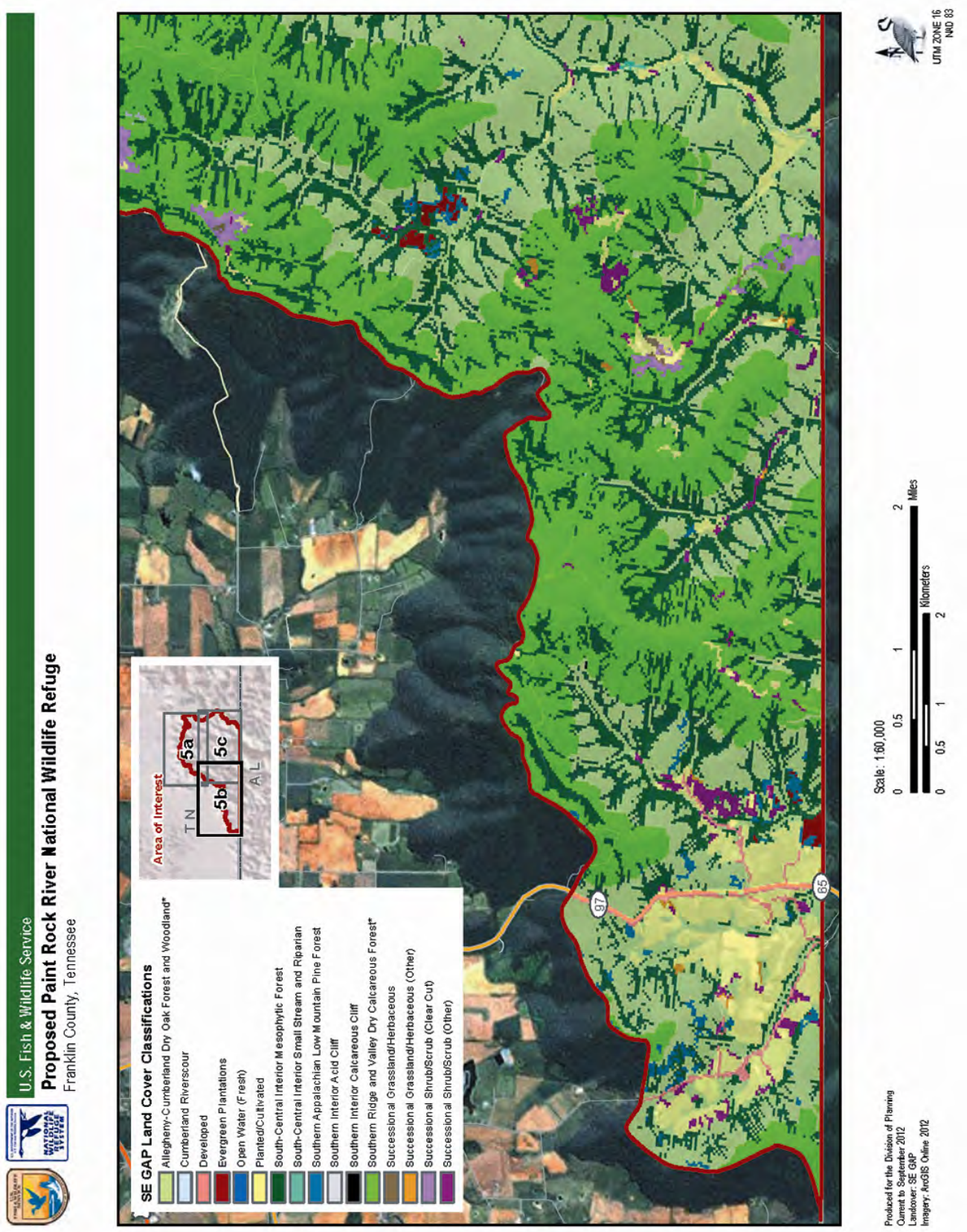
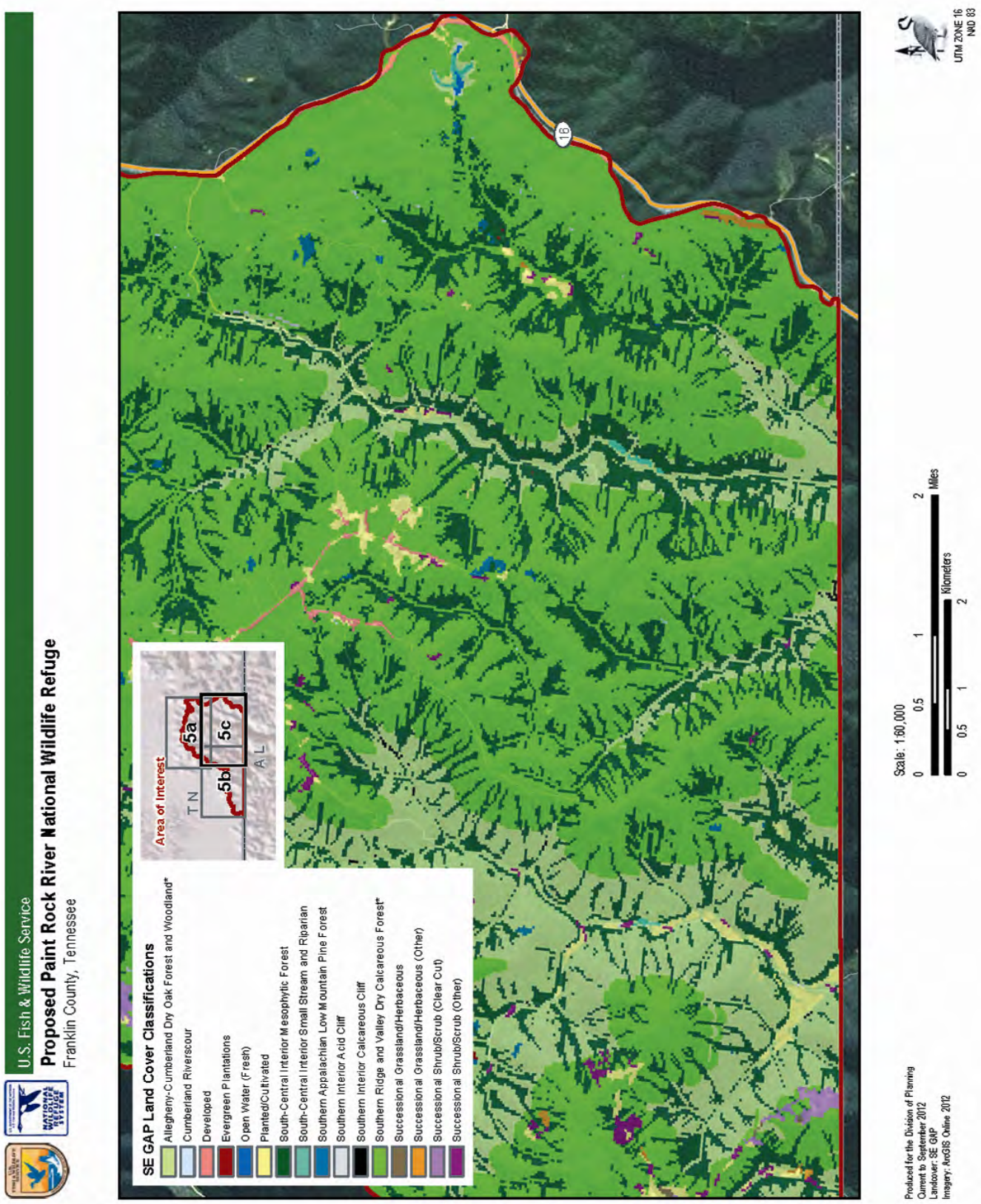


Figure 5c. Land cover in the Paint Rock River watershed



HABITAT

As previously mentioned, land cover type provides a general overview of the natural vegetative communities found in the AOI. More specific descriptions of habitats or environmental areas that are inhabited by a particular species within the AOI are discussed in this section. Within the AOI, there is currently no geospatial data available for some of the habitats described in this section. Aquatic habitats vary from headwater springs and small gravelly creeks to larger river bodies. In general, terrestrial habitats are composed of mixed oak-hickory-pine associations, with greater pine influences in forest types further south. Caves are a prominent feature due to the prevalence of limestone geology underlying the landscape. The western escarpment of the Cumberland Plateau, which constitutes a sizeable portion of the project area, has one of the densest concentrations of caves in the United States (Culver et al. 2000, Moss 1998). Primary habitats in the project area include: streams and rivers, riparian/bottomland hardwood forests, upland forests, canebrake, and cave/karst systems. Further descriptions of each habitat category are provided in the following sections:

Streams and Rivers

The streams flowing through the proposed project area contain some of the most biologically significant waters in the United States. Major streams in the AOI include the Tennessee portions of Estill Fork, Larkin Fork, and Hurricane Creek, three of the primary tributaries to the Paint Rock River. The streams vary in size, temperature, gradient, and percentage of groundwater contribution from spring-fed headwater streams to the Paint Rock River.

The headwater tributaries and streams are approximately 15 to 60 feet wide and shallow, seldom more than 6 feet in depth. Waters of the streams have a medium to swift flow and water quality is generally good; clarity tends to be excellent except after rain events. Substrate types in these streams vary widely from limestone bedrock to sandstone cobbles, and include a mixture of gravels, chert, sands, and silt. Streamside zones are well to moderately forested. Where the floodplain is narrow, forests continue from the stream up the nearby slopes, which may rise as much as 1,000 feet above the stream.

Cumulatively, these streams once harbored over 100 species of fish, over 60 mussel species and more than a dozen types of freshwater snails, and still support populations of rare animals with national and global significance. Two fish and seven mollusk species currently listed as federally endangered, threatened, or candidate are recorded as occurring in the Paint Rock River watershed.

Riparian/Bottomland Hardwood Forests

As mentioned earlier, the Southern Cumberlands Conservation Area is dominated by hardwood forests, which comprise 80 percent of land cover, the bulk of which are found on the slopes and mountain tops. As is the case throughout much of the south, bottomland hardwood forests have been extensively altered or eliminated in much of the southern Cumberlands, and likely represent one of the region's most endangered habitat types.

Several remnants of bottomland broadleaf communities remain evident in the Paint Rock River Valley, however. Noteworthy components of a remnant mature (late successional) forest include overcup oak (*Quercus lyrata*), swamp chestnut oak (*Q. michauxii*), water oak (*Q. nigra*), American elm (*Ulmus americana*), sweetgum (*Liquidambar styraciflua*), and shellbark hickory (*Carya lacinosa*). Other species, including swamp pin oak (*Q. palustris*) or swamp white oak (*Q. bicolor*), may have been more common in the original forests. The understory varies greatly depending on hydroperiod and soils, and may be dominated in places by giant cane (*Arundinaria gigantea*) or small trees and

shrubs (e.g., hollies, spicebush) or even by grass and sedge “meadows” mixed with such herbaceous species as eastern camas lily (*Camassia scilloides*).

Forests along the streams themselves may have somewhat higher diversity of species, both woody and herbaceous. Old stands show evidence that cottonwood (*Populus deltoides*) was once an important component of these streamside forests. Along and within the river channels, scour plains develop that may support a wide variety of grass and herbaceous species, including the rare Cumberland sandreed (*Calamovilfa arcuata*) (NatureServe 2006). These forest types have been dramatically reduced by agriculture nearly throughout the southern Cumberlands, and in the Paint Rock River watershed, have been largely replaced by pastures or field row agriculture.

Upland Forests

Due to the strongly dissected plateau surface in the southern Cumberlands, approximately 75 percent of the landscape is composed of gorges and associated “cove” areas. The forest matrix contains a large assortment of mixed-mesophytic tree species. The long growing season, high annual rainfall, and the abundance of microhabitats created by exposed limestone in the region provide favorable conditions for a diverse forest community structure. Depending on slope, aspect, and soil depth, dominant canopy tree species include: white oak (*Q. alba*), northern red oak (*Q. rubra*), white ash (*Fraxinus americana*), yellow poplar (*Liriodendron tulipifera*), hickories (*Carya* spp.), black oak (*Q. velutina*), maple (*Acer* spp.), and chestnut oak (*Q. prinus*). Lower slopes and rock outcroppings often contain basswood (*Tilia* spp.), American beech (*Fagus grandifolia*), magnolia (*Magnolia* spp.), walnut (*Juglans nigra*), chinkapin oak (*Q. muehlenbergii*), and buckeye (*Aesculus* spp.) (Smalley 1982).

A number of distinctive species of limited or sporadic distribution are associated with the limestone cove forests, including yellowwood (*Cladrastis kentuckea*), American smoketree (*Cotinus americanus*), blue ash (*Fraxinus quadrangulata*), and numerous shrubs (e.g., *Viburnum rafinesqueianum*, *V. bracteatum* and others). A number of species seem to be restricted almost entirely to the upland limestone forests of the southern Cumberlands, including Morefield’s leather flower (*Clematis morefieldii*) and Cumberland Pagoda (*Blephilia subnuda*), which appear to have their stronghold on limestone outcrops surrounding the Paint Rock River. These forests are also characterized by a diversity of herbaceous ephemerals of restricted occurrence, including Southern red trillium (*Trillium sulcatum*) and twinleaf (*Jeffersonia diphylla*). Embedded within these forests are poorly identified and described glade-like grasslands, with such species as American columbo (*Frasera caroliniana*)

The plateau tableland forest communities comprise approximately 15 percent of the land cover in the Southern Cumberlands Conservation Area. Due to the geology, the amount of tableland forest habitat decreases considerably towards the southernmost extent of the Cumberland Plateau. Tableland forest types are positioned atop a relatively thin sandstone cap with shallow, infertile soils. Forests in this zone share little in common with the limestone cove forests, and may be dominated by species that occur seldom, if at all, on the lower slopes. These species included scarlet oak (*Quercus coccinea*), shortleaf pine (*Pinus echinata*), Cumberland rhododendron (*Rhododenron cumberlandense*), mountain laurel (*Kalmia latifolia*), and numerous grasses. Distinctive communities include shortleaf pine-dominated grasslands, which structurally resemble longleaf pine grasslands farther south, with some of the same species and genera, and a number of rare or declining species. The newly described “hill cane” (*Arundinaria appalachiana*) makes up a surprisingly extensive portion of the understory here. Fire likely played a key role in the maintenance of habitat and diversity within these forests (Smalley 1982, NatureServe 2006, Gagnon 2009).

Canebrake

Canebrakes existed within forest openings, as an understory component of floodplain forest, and as broad cane thickets without forest overstory. Canebrakes are successional communities and may have originated following abandonment of aboriginal agricultural fields or following catastrophic natural disturbances (NatureServe 2006). They are believed to have been maintained in part by fires set by Native Americans. Giant cane is a common species within floodplain forests along the Paint Rock River and tributary streams. The absence of fire and the spread of exotic plants within temporarily flooded forests have reduced the distribution and abundance of cane.

Two species of cane dominate the southern Cumberlands, the larger (to 35 feet) giant cane and the newly described and much smaller (2 to 6 feet) hill cane. The first is widespread on many sites within the southern Cumberlands; the latter is restricted almost entirely to sandstone caps on the plateaus and ridgetops (Triplett et al. 2006).

The original extent of canebrakes in Alabama is poorly understood, as are the processes that maintained them. Some texts indicate that many hundreds of thousands of acres of the state were dominated by canebrakes in the late 18th century, but most of these areas were eradicated by overgrazing, conversion to agriculture or changes in fire regimes or hydrology by the late 19th century.

Since several bird species, such as Bachman's warbler (*Vermivora bachmanii*), Swainson's warbler (*Limnothlypis swainsonii*), hooded warbler (*Wilsonia citrina*), and Kentucky warbler (*Oporornis formosus*), seem to have been highly dependent on extensive areas of canebrake habitat for nesting success, it is likely that canebrakes were a more or less permanent feature of some landscapes. Other species, such as black bear (*Ursus americanus*) and Florida panther (*Puma concolor*), were often associated with canebrakes, and the high protein content of cane may have provided important seasonal forage to deer, bison, elk, and other species (Brantley and Platt 2001, Platt et al. 2001).

Giant cane is still a common species within floodplain forests and on mesic slopes along the Paint Rock River and tributary streams, and persists even in dense shade, though it rarely forms extensive canebrakes or provides much wildlife habitat under such conditions. The absence of fire, grazing by elk and bison followed by cattle and hogs, changes in hydroperiod within floodplain forests, and the spread of exotic species may all have contributed to a reduction in the abundance of cane. Both fire and flooding apparently play a distinctive role in maintaining canebrake communities. On upper floodplain terraces, canebrake communities thrive and spread with periodic fire, with return intervals of 2 to 25 or more years. Many large canebrakes may have become established through stand-replacement fires, though annual burning can eliminate cane entirely (Brantley and Platt 2001). Even in the absence of fire, certain hydroperiods appear to favor the development of a thick cane understory on lower terraces, sometimes nearly to the exclusion of trees.

The smaller and more restricted hill cane is now largely an understory species, but may be the dominant vegetation along the floodplains of headwater streams on sandstone plateaus of the southern Cumberlands. Little research has been done to identify the ecological role of this newly described and distinctive taxon.

The southeastern canebrake ecosystem is now considered to be critically endangered with over 98 percent of this habitat lost (Noss et al. 1995). Historically, cane was a prominent feature of the southern Cumberlands. These expansive canebrakes were described as being an almost impenetrable wilderness and always in view by Bartram (1791) during his wanderings in the southeastern United States, including areas just south of the CA. By 1901 (Mohr 1901), it was

described as a rapidly declining habitat type due to conversion of the fertile, alluvial bottomlands to agriculture and the conversion of uplands for grazing. By 1928 (Harper 1928), the vast canebrakes had all but disappeared. Today, there are remnant populations of cane as understory plants within forested areas and in small pockets along isolated portions of the banks of streams and rivers within the project area.

Cave and Karst Systems

Over 11,000 caves have been documented in Alabama, Georgia, and Tennessee. Most of these are concentrated in the Cumberland Plateau and Highland Rim physiographic provinces, which contain some of the highest densities of caves in the country (Culver et al. 2000). Caves in the area support one of the richest assemblages of cave-obligate species known in the country. However, due to large gaps in biological and hydrological data for the region, it is difficult to develop a comprehensive model for describing and delineating these intricate subterranean ecosystems.

WILDLIFE

General Wildlife Diversity and Abundance

A variety of species use the diverse habitats within the AOI. Common game species are described in the socioeconomic section.

In terms of biodiversity, the AOI is best known for its aquatic species richness, particularly mussels, snails, and fish. The existence of groundwater springs located throughout the upper reaches of the watershed that provide a year-round flow of clear, cool water to its tributaries, coupled with the fact that the watershed has had a lack of significant development along its tributary streams and the river, has served to sustain populations of native, endemic aquatic fauna there.

The AOI supports numerous snail species, including the federally endangered Anthony's riversnail (*Athearnia anthonyi*), the globally rare moss pyrg (*Pyrgulopsis scalariformis*), engraved Elimia (*Elimia perstriata*), and corpulent hornsnail (*Pleurocera corpulenta*). Of these species, only the engraved Elimia is currently known to occur in Cole Spring Branch and possibly a few other tributaries in the Paint Rock River watershed. Other snail species extant in the watershed and considered of high conservation concern at the state level are angled Marstonia (*Marstonia angulobasis*), described in 2004, and apparently an endemic to the Paint Rock River; and the rugged hornsnail (*Pleurocera alveare*), found in the middle and lower reaches of the Paint Rock River proper. The sooty Elimia (*Elimia paupercula*), found in the Paint Rock River proper and many tributaries, is a snail species considered of moderate conservation concern, primarily due to its taxonomic uncertainty.

Approximately 100 fish species are known to exist in the Paint Rock River (Boschung and Mayden 2004). Similar to the mussel assemblage in the Paint Rock River, rare fish can be found across a wide range of habitats from the headwaters to its terminus at the Tennessee River. Aquatic biologists speculate that fish populations throughout most of the watershed are thriving due to the abundance and quality of stream channel microhabitats (e.g., silt free gravel substrates, slab rock), befittingly spaced pools and riffles, and a mostly intact riparian corridor.

The forest-dominated cover characterized by the AOI provides habitat for at least 234 species of breeding, migrating, and wintering birds. Bird biodiversity is high in the area, particularly forest interior species, which rely on large tracts of intact forest. Surveys in the Estill Fork drainage found more than 50 different species within study areas of 1.6 acres (D. Haskell, University of the South, pers. comm. February 2013). North American populations for many of these species have

experienced steep population declines. Several are listed as threatened, endangered, or of special concern by TWRA. Many of these land birds are of continental conservation concern, some being extirpated from the region, or in dire need of conservation action (Appalachian Mountains Joint Venture 2005, Sauer et al. 2005).

Mammal species include many of those commonly found in the eastern United States and includes white-tailed deer, black bear, raccoon, opossum, river otter, cottontail rabbit, and beaver. Smaller species include a variety of rodents, ground-dwelling insectivores, and bats. Several imperiled bat species are found in the AOI, as further discussed in the section on listed species below.

Almost 50 species of reptiles and amphibians have been documented in the AOI. A 2008 survey on the Walls of Jericho and James D Martin Skyline WMAs found 21 reptiles and 26 amphibians. Several of these have been ranked as high conservation concern species by Alabama and Tennessee, including the green salamander (*Aneides aeneus*), Tennessee cave salamander (*Gyrinophilus palleucus*), southern five-lined skink (*Eumeces inexpectatus*), prairie king snake (*Lampropeltis calligaster*), and northern pine snake (*Pituophis melanoleucus*) (Wang and Chan 2008).

Nonnative Plants and Animals

The spread of nonnative or exotic species represents one of the most serious threats to biodiversity nationwide, undermining the ecological integrity of native habitats and pushing rare species to the edge of extinction. Once established, many exotic species are virtually impossible to eradicate. Exotic species rank only second to habitat loss in terms of threat level and they have been implicated in the decline of nearly half the imperiled species in the United States (Wilcove et al. 1998). Furthermore, economic losses associated with exotic weeds, forest and crop pests, human and livestock diseases, infrastructure damage, etc., has been estimated at 138 billion annually in the United States (Pimentel et al. 1999). The following exotic plant species are among others found in the AOI.

- Chinese privet (Ligustrum sinense)
- Kudzu (Pueraria montana)
- Mimosa (Albizia julibrissin)
- Japanese honeysuckle (Lonicera japonica)

Threatened, Endangered, and Other Imperiled Species

Federally Listed Species

Franklin County, Tennessee, and the Paint Rock River watershed contain at least 23 threatened, endangered, and candidate species (Table 7). Some of these occurred in the AOI historically, and have not been recently documented. Freshwater mussels make up a large portion of all the listed species.

Table 7. Federally listed and candidate species known from the Paint Rock River watershed and Franklin County, Tennessee

Common Name	Scientific Name	Status
Mammals		
Gray Bat	*Myotis grisescens*	E
Indiana Bat	*Myotis sodalis*	E
Fish		
Palezone Shiner	*Notropis albizonatus*	E
Snail Darter	*Percina tanasi*	T
Invertebrates		
Cumberland Monkeyface	*Quadrula intermedia*	E
Fluted Kidneyshell	*Ptychobranchus subtentum*	C
Littlewing Pearlymussel	*Pegias fabula*	E
Painted Tigersnail	*Anguispira picta*	T
Alabama Lampmussel	*Lampsilis virescens*	E
Fine-rayed Pigtoe	*Fusconaia cuneolus*	E
Pale Lilliput	*Toxolasma cylindrellus*	E
Pink Mucket	*Lampsilis abrupta*	E
Rough Pigtoe	*Pleurobema plenum*	E
Shiny Pigtoe	*Fusconaia cor*	E
Slabside Pearlymussel	*Pleuronaia dolabelloides*	C
Snuffbox	*Epioblasma triquetra*	E
Rabbitsfoot	*Quadrula cylindrica cylindrica*	C
Anthony's Riversnail	*Athearnia anthonyi*	E
Plants		
American Hart's-tongue Fern	*Phyllitis scolopendrium var. americana*	T
Morefield's Leather-flower	*Clematis morefieldii*	E
Price's Potato-bean	*Apios priceana*	T
White Fringeless Orchid	*Platanthera intergrilabia*	C

C = Species for which the Service has sufficient information to support proposals to list the species as threatened or endangered and for which the Service anticipates a listing proposal.
E = Endangered – a species at risk of becoming extinct.
T = Threatened – a species likely to become an endangered species in the foreseeable future.
Source: TDEC 2009

Mammals

Currently, the only federally listed mammals in the AOI are two bat species, gray and Indiana bats, further described below. As a group, bats are imperiled world-wide due to threats such as habitat loss and pesticide poisoning. These factors have also contributed to a decline in several North American bat species, but a disease that is new to the continent, white-nose syndrome (WNS), is accelerating the decline of some populations. The result of a fungus *(Geomyces destructans*), WNS primarily affects hibernating bats. First reported in the northeast, WNS has steadily spread westward, and was first reported in 2011-2012 in Alabama and Tennessee. Indiana bats are known to die from WNS. Gray bats are reported to have the fungus (White-nose Syndrome.org 2012).

Gray Bat

The endangered gray bat (*Myotis grisescens*) occurs throughout the Paint Rock River Watershed with the largest known hibernaculum of approximately 850,000 bats in Fern Cave. The Recovery Plan (USFWS 1982) states that the criteria for reclassification to threatened status is documentation of permanent protection of 90 percent of Priority 1 hibernacula and documentation of stable or increasing populations at 75 percent of Priority 1 maternity caves during a period of 5 years. Once the status of the gray bat has been changed from "endangered" to "threatened," it will be possible to delist this species by the documentation of permanent protection as well as stable or increasing populations during 5 years at 25 percent of Priority 2 caves. The most important feature of this plan would be the protection of roosting habitat. This would require gaining control of important hibernacula and maternity caves and protecting them from human disturbance. This can be done by direct purchase, cooperative agreements, easement, etc. We also believe that as much as practicable, foraging habitat consisting of bodies of water ranging from small streams to large reservoirs with accompanying riparian vegetation, must be maintained, protected, and restored. Finally, in order to ensure the success of recovery efforts, a monitoring program should be established to ensure that gray bat populations are responding positively. Establishment of this refuge would help protect these essential foraging habitats, protect known hibernacula within its boundaries, and contribute to down-listing and eventual delisting of the gray bat.

Indiana Bat

The endangered Indiana bat (*Myotis sodalis*) occurs in the AOI. The Recovery Plan (USFWS 2007) states that the Indiana bat can be downlisted from endangered to threatened when the following objectives are achieved: (1) Permanent protection of 80 percent of Priority 1 hibernacula; (2) a minimum overall population number equal to the 2005 estimate (457,000); and (3) documentation of a positive population growth rate over five sequential survey periods. The Indiana bat will be considered for delisting when the Reclassification Criteria have been met, and the following additional criteria have been achieved: (1) Permanent protection of 50 percent of Priority 2 hibernacula; (2) a minimum overall population number equal to the 2005 estimate; and (3) continued documentation of a positive population growth rate over an additional five sequential survey periods. If research on summer habitat requirements indicates the quality and quantity of maternity habitat is threatening recovery of the species, the Service will amend these objectives. As with the gray bat, establishment of this refuge could benefit the Indiana bat.

Fish

The region is known for its high freshwater fish biodiversity, and Alabama's fish species represent 38 percent of all North American freshwater fish (Lydeard and Mayden 1995). Although the area's biodiversity remains relatively high, it has declined since the early arrival of peoples from Europe, due to factors such as habitat loss and alteration, water pollution and diversion, among others. Even with conservation efforts, the rate of extinction among freshwater fish is accelerating. According to a

recent study, North America lost 39 species and 18 subspecies between 1898 and 2006. Based on current trends in threatened and endangered fish species, it is estimated that an additional 53 to 86 species of freshwater fish may be extinct by the year 2050. Furthermore, since the first assessment of extinct North American freshwater fishes in 1989, the number of extinct fishes increased by 25 percent (USGS 2012). At least two federally listed species, the palezone shiner and snail darter, (further described below) are found in the Paint Rock River watershed.

Palezone Shiner

The endangered palezone shiner (*Notropis albizonatus*) usually occurs in moderately large, high-gradient, clear streams flowing over bedrock, cobble, or gravel mixed with clean sand; it prefers pools and pool runs below riffles. It is highly restricted in distribution, found only in the Tennessee River drainage in Alabama and Tennessee and to the north in the Cumberland River drainage in Kentucky. It is uncommon and localized throughout its range. In Alabama, it occurs only in the upper Paint Rock River system. This species was historically known from only four rivers and/or creeks. Because much of the species' presumed historic habitat has been impounded or altered by other factors, it is unlikely that the species can be recovered to the point of delisting. However, the Recovery Plan (USFWS 1997a) states that the palezone shiner would be considered for reclassification from endangered to threatened and eventual removal from the federal list when the likelihood of the species becoming extinct in the foreseeable future has been eliminated by achievement of: (1) Protection and enhancement of the existing populations in the Paint Rock River and the Little South Fork of the Cumberland River (LSFCR); (2) studies of the biological and ecological requirements have been completed, and the implementation of management strategies developed from these studies have been successful in increasing the number and range of the palezone shiner in the Paint Rock River and LSFCR, and; (3) no foreseeable threats exist that would likely threaten the survival of a significant portion of the species' range in either the Paint Rock River or LSFCR. Establishment of this refuge could aid in protection and enhancement of the existing Paint Rock River population, and ultimately contribute to the downlisting and eventual delisting of the palezone shiner.

Snail Darter

The threatened snail darter (*Percina tanasi*) is found over gravel and sand shoals with moderate current in large tributaries and free-flowing rivers. Snail darters were originally thought to occur only in the lower Little Tennessee River and adjacent Tennessee River. However, sampling confirmed their presence in the lower Paint Rock River. Introduction and subsequent sampling expanded their range into Chickamauga Creek, a downstream segment of the Tennessee River, and the Sequatchie, Hiwassee, Holston, and Elk Rivers' systems. The ultimate goal of the Recovery Plan (USFWS 1983b) is to protect and recover this species to the point where it can be removed from the federal list. The species would be considered recovered when one of three alternatives is met and no present or foreseeable threats exist which could cause the species to become in danger of extinction. These three alternatives are: (1) Suitable habitat areas are inhabited by snail darter populations which can survive and reproduce independently of tributary rivers; (2) more populations are discovered and existing populations are not lost, and; (3) through maintenance of existing populations and/or expansion of these populations, there exist viable populations of snail darters in five separate streams such as Sewee Creek, Hiwassee River, South Chickamauga Creek, Sequatchie River, and Paint Rock River. The area that this refuge would encompass contains essential habitat for recovery of the snail darter. As mentioned in the Recovery Plan, adequate protection of populations in this watershed meets a portion of the criteria for ultimate delisting.

Invertebrates

The region's mussel and aquatic snail diversity is likely the highest in the world, and is the highest in North America. Alabama has over 60 percent of all mussel species and 43 percent of aquatic snails of all North American species (Lydeard and Mayden 1995). As a group, mussels are among the most imperiled in the nation. At least 6 percent have already become extinct within the United States, and over 25 percent are listed as threatened or endangered, the majority of which are located in the southeast (Williams et al. 2008). The AOI provides habitat for at least seven listed mussel species, as further described below.

Alabama Lampmussel

The endangered Alabama lampmussel (Lampsilis virescens) typically inhabits sand and gravel substrates in small- to medium-sized streams. A viable population of Alabama lampmussel exists in the Paint Rock River above the impounded portion in Wheeler Reservoir up to and including Larkin Fork, Estill Fork, Hurricane Creek and their tributaries, and is found in only one other watershed, the Emory River, located in north-central Tennessee. The Recovery Plan (USFWS 1985a) provides that this population should be distributed within the upper reaches of these streams that occur in Tennessee, such that it is unlikely a single adverse event would result in the total loss of the population. Establishment of this refuge could aid in protection of essential habitat, set aside areas for future propagation efforts and reintroduction, and ultimately contribute to the delisting of the Alabama lampmussel.

Fine-rayed Pigtoe

The endangered fine-rayed pigtoe (Fusconaia cuneolus) has been collected in 16 different river systems including the Paint Rock River. The ultimate goal of the Recovery Plan (USFWS 1984a) is to maintain and restore viable populations of this species to a significant portion of its historic range and remove it from the federal list. This would be accomplished when: (1) Populations, with evidence of recent recruitment (specimens age 5 or younger), exists in portions of six river systems in four southeastern states. These populations are distributed widely enough within their rivers such that a single adverse event in a river would be unlikely to result in the loss of that population; and (2) through reestablishment and/or discoveries of new populations, a viable population exists in one additional stream or river reach that historically maintained the species. The viable population would contain at least two locations which are dispersed to the extent that a single adverse event would be unlikely to eliminate the fine-rayed pigtoe from these locations. Mussel surveys would document that three year-classes, including one year-class of age 10 or older, has been naturally produced within each of the locations. All of the populations and their habitats should be protected from present and foreseeable human-related and natural threats that may interfere with the survival of any of the populations. Establishment of this refuge would protect essential habitats, provide for the discovery of new populations, and allow opportunities for reintroduction that could contribute to downlisting and eventual delisting of the fine-rayed pigtoe.

Pale Lilliput

The endangered pale lilliput (Toxolasma cylindrellus) is typically found in small rivers and streams in shallow fast-flowing water with stable, clean substrate. A viable population of pale lilliput exists in the Paint Rock River, Estill Fork and Hurricane Creek, and is found nowhere else in the world. A survey of the upper 40 miles of the Paint Rock River above Walker Mill Ford is needed to determine the extent of the populations discovered by TVA biologists in 1980. Only two live specimens were found. The Recovery Plan (USFWS 1984b) recommends intensive freshwater mussel surveys for Hurricane Creek and Estill Fork and their tributaries where freshly dead specimens were found in 1978. Additional freshwater mussel surveys should be conducted in Larkin Fork where 26 dead specimens of pale lilliput were collected from a muskrat midden in 1966. The greatest known concentrations of

this species occur in the Paint Rock River, Estill Fork, and Hurricane Creek. Establishment of this refuge would help to conserve these mussel populations and their habitat.

Pink Mucket

The endangered pink mucket (Lampsilis abrupta) is found in mud and sand and in shallow riffles and shoals swept free of silt in major rivers and tributaries. This mussel buries itself in sand or gravel, with only the edge of its shell and its feeding siphons exposed. The ultimate goal of the Recovery Plan (USFWS 1985b) is to maintain and restore viable populations of this species to a significant portion of its historic range and remove it from the federal list. This would be accomplished when: (1) Two additional viable populations are found in any two rivers except the Tennessee, Cumberland, and Mermec Rivers. Both of these rivers would contain viable populations that are distributed such that a single event would unlikely eliminate the pink mucket from the river system. Survey data must show at least five viable populations with each population having a minimum of two year-classes between four and 10 years of age as evidence of reproduction; (2) additional mussel sanctuaries are established or expanded in river systems which contain known concentrations of the species; and (3) the species and its habitat are protected from present and foreseeable human-related and natural threats that may interfere with the survival of any of the populations. The biodiversity of the Paint Rock River system would lead to the belief that habitat exists for this species and the establishment of this refuge along with surveys could verify its existence. Repatriation could be accomplished if suitable habitat is discovered, and could therefore lead to the downlisting and eventual delisting of the pink mucket.

Rough Pigtoe

The endangered rough pigtoe (Pleurobema plenum) is found in medium to large rivers in sand and gravel substrates. Historically, this species was widely distributed in 22 major rivers. Decline of this species, as with most mussels, is due to impoundment, siltation, and pollution. The ultimate goal of the Recovery Plan (USFWS 1984c) is to maintain and restore viable populations of this species to a significant portion of its historic range and remove it from the federal list. This can be accomplished by protecting and enhancing habitat containing the species' populations, establishing populations in rivers and river corridors that historically contained the species, and its habitat is protected from present and foreseeable human-related and natural threats that may interfere with the survival of any of the populations. If suitable habitat is found in the proposed refuge, discovery and/or repatriation of this species could be a feasible way of reaching the recovery goal and contributing to downlisting and eventual delisting of the rough pigtoe.

Shiny Pigtoe

The endangered shiny pigtoe (Fusconaia cor) was discovered in the mid-1960s in the Paint Rock River and historically occurred in five other river systems. The present range includes the Paint Rock, North Fork Holston, Clinch, Powell, and Elk Rivers. In 1980, this species was observed at seven sites in Alabama along the Paint Rock River between Paint Rock River Miles 44.8 and 58.5. The ultimate goal of the Recovery Plan (USFWS 1983a) is to maintain and restore viable populations of this species to a significant portion of its historic range and remove it from the federal list. This can be accomplished by protecting and enhancing habitat containing the species' populations, establishing populations in rivers and river corridors that historically contained the species and its habitat, and protecting the shiny pigtoe from present and foreseeable human-related and natural threats that may interfere with the survival of any of the populations. Establishment of this refuge would afford the opportunity to locate suitable sites for habitation, and develop successful methods for repatriation and monitoring of the reintroductions. This could contribute to downlisting and eventual delisting of the shiny pigtoe.

Slabside Pearlymussel
The slabside pearlymussel (Lexingtonia dolabelloides) is a candidate species that primarily inhabits sand, fine gravel, and cobble substrates in relatively shallow riffles and shoals with moderate current (Parmalee and Bogan 1998). Currently, it is limited to 10 populations in the Tennessee River system, having been extirpated (eliminated) from the Cumberland River system and from the Tennessee River main stem. The Paint Rock River system (including Larkin Fork, Estill Fork, and Hurricane Creek) is considered a single population segment, but it occurs only in the lower mile or so of the three tributary streams. The slabside pearlymussel has been eliminated from about three-fifths of the total number of streams from which it was historically known. Only two populations are recruiting as evidenced by finding juveniles (i.e., Duck and Paint Rock Rivers). The slabside pearlymussel is found at numerous sites in the Duck River within a 40-mile reach, and is found at numerous sites within a 45-mile reach of the Paint Rock River (Fobian et al. 2008).

Snuffbox
The endangered snuffbox (Epioblasma triquetra) is a small- to medium-sized freshwater mussel found in areas with a swift current, although it is also found in Lake Erie and some larger rivers. Adults often burrow deep in sand, gravel, or cobble substrates, except when they are spawning or the females are attempting to attract host fish. It once occurred in the Tennessee River and some of its tributaries; however, the snuffbox is now known only to persist in approximately 30 miles of the Paint Rock River and its tributaries. The Paint Rock River is considered a stronghold for the snuffbox with documented recruitment occurring, population trends improving, and its potential viability considered high. Establishment of this refuge would help to conserve these mussel populations and their habitats.

Rabbitsfoot
The rabbitsfoot (*Quadrula cylindrica cylindrica*) is a candidate species and described as a medium- to large-sized mussel that reaches about 6 inches in length, primarily inhabiting small- to medium-sized streams and some larger rivers. It usually occurs in shallow areas along the bank and adjacent runs and shoals where the water velocity is reduced. Specimens may also occupy deep water runs, having been reported in 9 to 12 feet of water. Bottom substrates generally include sand and gravel. Within the Paint Rock River, the rabbitsfoot is extant in approximately 56 river miles. Establishment of this refuge would help protect habitat for this imperiled mussel.

Anthony's Riversnail
Anthony's riversnail (*Athearnia anthonyi*) is an endangered species known from only three disjunct populations in the Tennessee River system: the Tennessee River, Sequatchie River, and Limestone Creek. Although much of its life history remains unknown, this species prefers medium to large river habitats with cobble/boulder substrates in the vicinity of riffles with strong current. Population demographics are only available for the Limestone Creek population, which appears to be a viable population (USFWS 1997b). This species has not been recently found in the Paint Rock River.

Plants

American Hart's-tongue Fern
The threatened American Hart's-tongue Fern (*Asplenium scolopendrium* var. *americanum*) occurs in the Paint Rock River Watershed at Fern Cave NWR. The ultimate goals of the Recovery Plan (USFWS 1993a) are to protect and recover this species to the point where it can be removed from the federal list. The first step toward recovery would be protection and management of all extant populations to ensure their continued survival. Little is known about the specific biological and habitat requirements of this species. Therefore, it would be necessary to conduct detailed genetic and demographic studies and ecological research to gain understanding needed to develop appropriate

protection and management strategies. The ultimate effects of various kinds of habitat disruption must be determined and, if necessary, prevented. Active management may be required to ensure continued survival and vigor. American Hart's-tongue fern would be considered for removal from the federal list when the following criteria are met: (1) At least 15 populations in the United States (two in Alabama, two in Tennessee, four in Michigan, and seven in New York) are self sustaining and occur on sufficiently large tracts to ensure their perpetuation with a minimal amount of active management; and (2) all of the populations and their habitat are protected from present and foreseeable human-related and natural threats that may interfere with the survival of any of the populations. Although this plant is found over a very wide area, from Alabama to Canada, its populations tend to be very small and isolated due to its unique habitat. Many activities threaten the American Hart's-tongue fern, and because of its natural rarity, it is particularly vulnerable to disturbance. Additional surveys for this plant on this refuge could provide valuable information regarding presence of suitable habitat for protection and possible propagation of the American Hart's-tongue fern.

Morefield's Leather-flower

The Morefield's Leather-flower Recovery Plan (USFWS 1994) states that the endangered Morefield's leather-flower (*Clematis morefieldii*) will be reclassified to threatened, when at least 10 viable populations are protected from any foreseeable threats. Limited surveys have been conducted for this plant. A thorough systematic survey for new populations is needed. Suitable habitat should be identified through an analysis of supporting habitat. Particular attention should be focused on sites with the American smoke tree (*Cotinus obovatus*), which appears to be a principal indicator species for Morefield's leather-flower. The location of other populations will perhaps yield important information on this species' habitat requirements. In addition, documentation of apparently suitable habitat, which lacks the plants, will be important to any future plans to establish additional populations. Establishment of this refuge would allow further exploration for the existence of this species within the proposed refuge boundaries, and expand the limited and dwindling populations known on Huntsville, Keel, and Monte Sano Mountains in Alabama.

Price's Potato-bean

The threatened Price's potato-bean (*Apios priceana)* is known from Alabama, Kentucky, Mississippi, and Tennessee. It thrives in open, wooded areas, often in forest gaps or along forest edges. It seems to prefer mesic sites and is often found in open, low areas near a stream or along the banks of streams and rivers. The species does not flower every year and is difficult to identify without flowers. Consequently, it may be over-looked during surveys, when not flowering. It has been documented in the lower Paint Rock River watershed and may occur elsewhere along the Paint Rock River. The Recovery Plan (USFWS 1993b) provides that Price's potato-bean would be considered for delisting when 25 geographically distinct, self-sustaining populations are adequately protected and maintained for 10 years. A population will be considered to be self-sustaining if it successfully reproduces and the size is stable or increasing. Additional surveys for this plant on this proposed refuge could provide valuable information regarding presence of the species and its suitable habitat and could contribute to delisting of the species.

White Fringeless Orchid

The white fringeless orchid (*Platanthera integrilabia*) is a candidate species that grows in wet, boggy areas at the heads of streams and on seepage slopes. It is often associated with Sphagnum in partially, but not fully shaded areas. This species was originally known from Alabama, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia. It has been extirpated from North Carolina (Henderson and Cherokee Counties) and Virginia (Lee County) (NatureServe 2009).

State-listed Species

Tennessee Department of Environment and Conservation's (TDEC) Natural Heritage Division has identified numerous rare and imperiled species in Franklin County, many of which are likely to be found in the AOI. Over 50 state-listed threatened and endangered species are found in the county (Table 8). These are species that are likely to become extirpated in the state in the foreseeable future. For the purposes of this Draft LPP/EA, only state-listed species that have a legal ranking are reported.

Table 8. Tennessee-listed species likely found in the AOI

Common Name	Scientific Name	Status
Mammals		
Gray Bat	*Myotis grisescens*	E
Indiana Bat	*Myotis sodalis*	E
Birds		
Bachman's Sparrow	*Aimophila aestivalis*	E
Amphibians and Reptiles		
Northern Pinesnake	*Pituophis melanoleucus melanoleucus*	T
Tennessee Cave Salamander	*Gyrinophilus palleucus*	T
Fish		
Palezone Shiner	*Notropis albizonatus*	E
Snail Darter	*Percina tanasi*	T
Invertebrates		
Alabama Lampmussel	*Lampsilis virescens*	E
Fine-rayed Pigtoe	*Fusconaia cuneolus*	E
Pale Lilliput	*Toxolasma cylindrellus*	E
Pink Mucket	*Lampsilis abrupta*	E
Rough Pigtoe	*Pleurobema plenum*	E
Shiny Pigtoe	*Fusconaia cor*	E
Anthony's Riversnail	*Athearnia anthonyi*	E
Plants		
Sharp's Lejeunea	*Lejeunea sharpii*	E
Ridge-stem False-foxglove	*Agalinis oligophylla*	E
White-leaved Leatherflower	*Clematis glaucophylla*	E
Southern Lady's-slipper	*Cypripedium kentuckiense*	E
Small's Stonecrop	*Diamorpha smallii*	E

Common Name	Scientific Name	Status
Short-leaved Panic Grass	*Dichanthelium ensifolium ssp. curtifolium*	E
Dwarf Sundew	*Drosera brevifolia*	T
Horse-tail Spike-rush	*Eleocharis equisetoides*	E
Wolf Spike-rush	*Eleocharis wolfii*	E
Tawny Cotton-grass	*Eriophorum virginicum*	E
Harper's Fimbristylis	*Fimbristylis perpusilla*	E
Dwarf Huckleberry	*Gaylussacia dumosa*	T
Florida Hedge-hyssop	*Gratiola floridana*	T
Slender Blue Flag	*Iris prismatica*	T
Butternut	*Juglans cinerea*	T
Slender Blazing-star	*Liatris cylindracea*	T
Canada Lily	*Lilium canadense*	T
Canby's Lobelia	*Lobelia canbyi*	T
Yellow Honeysuckle	*Lonicera flava*	T
Globe-fruited False-loosestrife	*Ludwigia sphaerocarpa*	T
Broad-leaved Barbara's-buttons	*Marshallia trinervia*	T
Ozark Bunchflower	*Melanthium woodii*	E
Cutleaf Water-milfoil	*Myriophyllum pinnatum*	T
Alabama Snow-wreath	*Neviusia alabamensis*	T
Smooth False Gromwell	*Onosmodium molle ssp.subsetosum*	E
Heart-leaved Plantain	*Plantago cordata*	E
Shadow-witch	*Ponthieva racemosa*	E
Rough Rattlesnake-root	*Prenanthes aspera*	E
Sand Cherry	*Prunus pumila*	E
Yellow Water-crowfoot	*Ranunculus flabellaris*	T
Obscure Beak-rush	*Rhynchospora perplexa*	T
Cumberland Rosinweed	*Silphium brachiatum*	E
Southern Prairie-dock	*Silphium pinnatifidum*	T
Eared Goldenrod	*Solidago auriculata*	T
Prairie Goldenrod	*Solidago ptarmicoides*	E
Shining Ladies'-tresses	*Spiranthes lucida*	T
Roundleaf Fameflower	*Talinum teretifolium*	T

Common Name	Scientific Name	Status
Bristle-fern	*Trichomanes boschianum*	T
Dwarf Filmy-fern	*Trichomanes petersii*	T
Least Trillium	*Trillium pusillum*	E
Limerock Arrowwood	*Viburnum bracteatum*	E
Wide-leaved Yellow-eyed Grass	*Xyris laxifolia var. iridifolia*	T
Death-camas	*Zigadenus leimanthoides*	T

E = Endangered – a species whose prospects of survival or recruitment within the state are in jeopardy or are likely to become so within the foreseeable future.
T = Threatened – a species that is likely to become endangered within the foreseeable future.
Source: Tennessee Department of Environment and Conservation 2009

State and Globally Ranked Species

TDEC also uses a non-legal ranking system indicating rarity and vulnerability at the state level. The AOI likely includes over 100 species that are ranked either S1 - Extremely rare and critically imperiled, S2 - Very rare and imperiled, or S3 - Rare and uncommon (TDEC 2009).

Global conservation rankings are primarily developed by NatureServe and describe species' conservation status world-wide. Within the AOI, at least 17 species are found with rankings of G1 (critically imperiled – at high risk of extinction due to extreme rarity) to G3 (vulnerable – at moderate risk of extinction due to small population size and ongoing threats). These include endemic species, meaning they are found nowhere else on Earth. Examples include several cave-dwelling invertebrates: roundworm (*Eremidrilus allegheniensis*), beetle (*Ptomaphagus chromolithus*), and pseudoscorpion (*Tyrannochthonius fiskei*) (Tennessee Department of Environment and Conservation 2009).

RELATED RESOURCES

Sections B and C of Chapter II in the Draft LPP provide an overview of related resources in this landscape, including landscape conservation goals and objectives, as well as partner efforts. The proposed refuge would contribute to many of these, including the Appalachian Landscape Conservation Cooperative (USFWS 2011x); conservation easements (e.g., Wetlands Reserve Program lands); non-governmental conservation lands; and international, national, and regional conservation plans and initiatives. Several of these are listed below.

International

- Partners-in-Flight (PIF) North American Landbird Conservation Plan (Rich et al. 2004)

National

- America's Great Outdoors Initiative (AGO 2011)
- Wetlands Reserve Program (WRP) of the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture (USDA) (USDA 2011)
- Partners for Fish and Wildlife (USFWS 2012x)
- Forest Stewardship Program (USDA 2011)

Regional

- PIF Southern Ridge and Valley conservation recommendations (PIF 2011)
- South Cumberland Conservation Action Plan/Jackson Mountains Conservation Area (Land Trust for Tennessee and Sewanee Environmental Institute 2011)
- Threatened and Endangered Species Recovery Plans (USFWS 2011)
- Tennessee River Basin Watershed Management Plan (TVA

State-level

- Tennessee Wildlife Resources Agency (TWRA) Farm Wildlife Habitat Program (TWRA 2011)
- Tennessee Stream Mitigation Program (TWRA 2011)
- Tennessee's Comprehensive Wildlife Conservation Strategy (TWRA 2005)

Several state and federal agencies serve as key partners in this landscape, including state wildlife agencies and USDA's Natural Resources Conservation Service. The Service also works closely with various non-profit conservation organizations

Currently, TSNA and TWRA have protected over 3,901 acres (about 10 percent) of the AOI (Figure 1). These sites include Bear Hollow Wildlife Management Area and Walls of Jericho State Natural Area. These land conservation efforts have aided the protection of imperiled species, hardwood forests, and recreational areas that contribute to the long-term ecological health, economy, and way of life of the region.

SOCIOECONOMIC ENVIRONMENT

This section summarizes population, employment, income, tourism, and wildlife-oriented recreation data and trends for counties in the AOI and, where applicable, state and national levels. As stated earlier, the affected area within which socioeconomic impacts would be analyzed is the AOI and comprises Franklin County, Tennessee.

REGIONAL ECONOMIC SETTING

The AOI comprises a landscape that is largely rural, with agriculture, forestry, and outdoor recreation/tourism being among the more important economic drivers of the area of interest. Over 2 million people are located within a 1- to 2-hour drive of the AOI (U.S. Census Bureau 2012). For the purposes of this Draft LPP/EA, selected demographic and economic data for Franklin County, Tennessee, were summarized.

POPULATION

Recent Population Trends: 2000-2010

Human population characteristics for the AOI are shown in Table 9. Data from 2000 are compared to 2010, and the general trend is that population has continued to rise. The population of Tennessee grew by over 11 percent during the past 10 years. Franklin County's population growth rate was less than half of that, at 4.5 percent.

The population densities (persons' per-square-mile) increased in by 11.5 percent between 2000 and 2010 (Table 9). Franklin County's growth rate was slightly less than half that rate during the same timeframe (U.S. Census Bureau 2012).

Table 9. State and county population estimates, characteristics, and trends (2000 - 2010)

Demographic Unit	Population Characteristics in 2000		Population Characteristics in 2010		Population Change (2000 to 2010)
	Residents	Persons per Square Mile	Residents	Persons per Square Mile	
Tennessee	5,689,283	135	6,346,105	151	+11.5%
Franklin County	39,270	68	41,052	71	+4.5%

Source: U.S. Census Bureau 2012

Projected Population Trends: 2000-2030

As was discussed above, the population of Tennessee rose between 2000 and 2010 and is expected to do so for the next 20 years. With a growth rate similar to the national rate or change, it is estimated that Tennessee's population will reach over 7.3 million by 2030, a rise of almost 30 percent compared to 2000 (Table 10; U.S. Census Bureau 2004). However, the projections for Tennessee may underestimate future growth. Data from 2004 projected Tennessee's population to rise to 5,965,317 by 2010, but actual data from the Census that year estimated 6,346,105 individuals in the state, a 6 percent difference. The future growth rate for Franklin County is substantially less, and is projected to be almost 8 percent, with a county-wide population of 42,363 by 2030 (University of Tennessee 2012) (Table 10).

Table 10. National and state population trends (2000–2030)

Demographic Unit	2000[1]	2010[1]	2020[2, 3]	2030[2, 3]	Percent Population Change (2000 to 2030)
United States	281,421,906	308,745,538	335,804,546	363,584,435	29.1%
Tennessee	5,689,283	6,346,105	6,887,930	7,380,634	29.7%
Franklin County	39,270	41,052	41,522	42,363	7.8%

Sources: [1] U.S. Census Bureau 2012; [2] US Census Bureau 2004; [3] University of Tennessee

EMPLOYMENT AND INCOME

Employment and income data was summarized for Tennessee and Franklin County (Tables 11 and 12).

Franklin County employment data for various industry categories were summarized for 2000 and 2009 in Table 11. In 2000, land-based jobs associated with agriculture, forestry, and others comprised a small part of the total number of jobs. Manufacturing and retail, both relatively large

component of the overall job pool, grew slightly. Also a major employment category, educational services and health/social care, declined. Professional/scientific/management services also dropped (U.S. Census Bureau 2000 and 2009).

Table 11. Percent full-time and part-time employment for Franklin County (2000-2009)

Industry	2000	2009
Agriculture, forestry, fishing and hunting, and mining	2.2	ND
Construction	7.6	ND
Manufacturing	25.9	31.7
Wholesale trade	2.8	ND
Retail trade	11.9	14.1
Transportation and warehousing, and utilities	4.0	ND
Information	0.9	ND
Finance and insurance, real estate, and rental and leasing	3.9	3.1
Professional, scientific, and management, and administrative and waste management services	7.2	1.6
Educational services, and health care and social assistance	20.1	14.6
Arts, entertainment, and recreation, and accommodation and food services	4.9	7.8
Other services, except public administration	5.0	3.2
Public administration	3.6	ND

ND – no data

Source: U.S. Census Bureau 2000 and 2009

National, state, and county income, unemployment and poverty estimates for 2000 and more recent data are shown in Table 12. Average annual incomes rose in all four counties included in the area of interest, following patterns seen at state and national levels. The effects of the economic downturn in recent years can be seen in the comparison between 2000 and 2010 unemployment and poverty data. In all counties, unemployment levels approximately tripled between 2000 and 2010. As can be expected, county poverty rates also increased during the 2000-2010 period, as a result of rising unemployment levels. Generally, poverty rates increased several percentage points during the 2000-2010 timeframe.

Table 12. Income, unemployment, and poverty estimates

Demographic Unit	Average Annual Pay (US Dollars)		Percent* Unemployment		Percent of Persons Below Poverty Line	
	2001	2010	2000	2010	2000	2010
United States	$41,994	$51,425	3.7	9.0	12.4	15.3
Tennessee	$31,520	$41,572	3.5	9.7	13.5	17.8
Franklin County	$23,605	$30,117	4.0	10.2	13.2	14.8

**Annual averages*
Sources: U.S. Census Bureau 2010, U.S. Department of Labor 2012x and 2012X

TOURISM

Tourism is an important part of Tennessee's economy, contributing $23.1 billion in revenue in 2010. State-wide domestic and international traveler expenditures supported 278,400 jobs that year. In 2010, tourism expenditures for Franklin County totaled approximately $17.8 million and supported 110 jobs (Tennessee Department of Tourism Development 2011).

WILDLIFE-DEPENDENT RECREATION

Fish and wildlife are economically important nationwide. According to the report, "Banking on Nature 2006: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation," approximately 34.8 million people visited national wildlife refuges in Fiscal Year 2006, generating almost $1.7 billion in total economic activity and creating almost 27,000 private sector jobs, producing about $542.8 million in employment income. Additionally, recreational spending on refuges generated nearly $185.3 million in tax revenue at the local, county, state, and federal levels (Carver and Caudill 2007). In 2006, nearly 71 million people 16 years and older spent $45.7 billion and generated $122.6 billion while fishing, hunting, or observing wildlife (Leonard 2008). Since then, Refuge System visitation has grown with over 45.7 million visitors in 2011. According to a Department of the Interior Economic Contributions 2011 report, in 2010 national wildlife refuges generated more than $3.98 billion in economic activity and created more than 32,000 private sector jobs nationwide (U.S. Department of the Interior 2011). As land development continues and the number of places left to enjoy wildlife decreases, refuge lands may become even more important to the local community. It can benefit the community directly by providing recreational and employment opportunities for the local population and indirectly by attracting tourists from outside the area to generate additional dollars for the local economy.

Throughout Tennessee, over 3.5 million participants engaged in one or more of three wildlife-related recreation activities (fishing, hunting, wildlife watching) during 2006, as shown Table 13 (USFWS and U.S. Census Bureau 2006). The majority of participants, over 2.3 million, engaged in wildlife watching, followed by fishing (about 871,000), and hunting (approximately 329,000). Expenditures were the highest for wildlife watchers (almost $1 billion), followed by anglers (approximately $600 million), and hunters (about $500 million). Together, participants engaged in wildlife-dependent recreation spent over $2 billion in Tennessee during 2006. The average expenditures per participant were the highest for hunting ($867), followed by fishing ($623), and wildlife watching ($400).

Table 13. Economics of wildlife-dependent recreation in Tennessee during 2006

Activity	Number of Participants	Expenditures			
		Trip-related	Equipment and Supplies	Total	Average Per Participant
Fishing	871,000	$290,424,000	$309,259,000	$599,683,000	$623
Hunting	329,000	$109,447,000	$378,973,000	$488,420,000	$867
Wildlife Watching	2,362,000	$327,240,000	$665,126,000	$992,365,000	$400
Total	3,562,000	$727,111,000	$1,353,358,000	$2,080,468,000	

Source: USFWS and U.S. Census Bureau 2006

RECREATIONAL ACTIVITIES AND TRENDS

Still largely rural, the AOI provides a variety of opportunities for outdoor recreation, including hunting, fishing, wildlife viewing, hiking, biking, horseback riding, camping, and off-roading. For the purposes of this Draft LPP/EA, the focus of our discussion on recreational opportunities will be on those that are wildlife-dependent.

In the AOI, currently only state (TSNA and TWRA) managed lands are accessible to the public for a variety of recreational activities. Combined, they cover about 3,901 acres, about one-tenth of the AOI. Refer to Figure 1 for a map of the TSNA and TWRA lands within the AOI.

- Bear Hollow Mountain WMA – North
- Bear Hollow Mountain WMA – South
- Walls of Jericho State Natural Area

Hunting

The variety of upland and wetland habitat found in the AOI support a diversity of game species, including bear, deer, wild hog, turkey, waterfowl, dove, quail, and a variety of small game. Bears are hunted in Tennessee, but currently only in several eastern counties. Many of these species attract sport and game enthusiasts to the area. Several of the game species hunted in the AOI are further discussed below. The TWRA wildlife management area systems have been highly instrumental in providing quality hunting opportunities to Tennessee. In Tennessee, there are nearly 100 WMAs managed by TWRA. They vary in size from 53 to 625,120 acres, and all WMAs are available to the public for hunting and trapping, although certain regulations do apply. Currently, WMAs in Tennessee total more than 1,250,000 acres.

Deer
White-tailed deer are the most popular game animal in Tennessee, and based on surveys collected in 2006, approximately 615,000 hunters (or 85 percent of all hunters) targeted this species (USFWS and U.S. Census Bureau 2006). In Tennessee, deer restoration activities between 1940 and 1985 resulted in the successful establishment of this game species statewide. In 2005, there were an estimated 900,000 deer in Tennessee. To date, the majority of the herd exists in middle and western Tennessee, while densities in the Mississippi River Counties, the Cumberland Plateau, and far eastern portions of the state remain below desired levels. The increasing deer population has been reflected in an increasing harvest, which was a record 179,542 deer during the 2004/05 season. Hunter success has grown with the increasing harvests, reaching a record in 2004, with 46 percent of deer hunters harvesting at least one deer. Although hunter numbers have declined slightly since their peak of 242,000 in 1999, they have remained relatively stable since the turn of the century, averaging 217,400 deer hunters per year (Tennessee Wildlife Resources Agency 2011a). Recent deer harvest data for two WMAs in the AOI are shown in Table 14.

Wild Hog
Wild or feral hogs are found in Tennessee. In just over a decade, the distribution of the state's wild hog population has spread at an accelerated rate. Although first confined to local areas in east Tennessee and the Cumberland Plateau, it is believed that viable hog populations can be found in close to a third of Tennessee's counties. On WMAs, wild hogs can be taken without limit during scheduled hunts. On private lands, the season is open year-round with no bag limits (Tennessee Wildlife Resources Agency 2011b).

Wild Turkey
Wild turkey is a highly popular game bird in Tennessee. Uncontrolled hunting and habitat loss, combined with several years of extreme weather during the poult rearing season resulted in the near-extirpation of the species in Tennessee. The State of Tennessee and partners have been actively restoring wild turkey populations. Due to the success of wild turkey management efforts, the state re-opened all portions of all 95 counties to turkey hunting in 2000. During the 2009-2010 hunting season, 33,263 birds were harvested state-wide, more than double than what was taken in 1998 (Tennessee Wildlife Resources Agency 2010). Recent turkey harvest data for two WMAs in the AOI are shown in Table 14.

Waterfowl
Waterfowl comprise an important part of migratory birds hunted in the United States, and according to national survey data, approximately 1.8 million hunters targeted ducks and geese in 2006 (USFWS and U.S. Census Bureau 2006). Preliminary state-wide waterfowl survey results estimated 1,521,010 ducks and 175,092 geese, with the vast majority being observed in Region 1 (TWRA 2012).

Quail
Northern bobwhite quail populations are declining in Tennessee, largely a result of changes in land use that cause declines in available habitat. This is a trend mirrored across the eastern United States. Quail utilize open, successional habitats, which are typically not found on intensively managed, highly mechanized farms that dominate the landscape. Quail surveys show annual reductions of approximately 4 percent (Tennessee Wildlife Resources Agency 2011). In general, the AOI contains large tracts of hardwoods, habitat not favored by quail and consequently opportunities for hunting this species in the area are likely limited.

Dove
The mourning dove (*Zenaida macroura*) is the leading migratory game bird in the United States and more doves are harvested annually than all other migratory game birds combined (Dolton et al. 2007). In 2008, over 17 million doves were harvested in the United States, with approximately 798,200 taken in Tennessee (Sanders and Parker 2010). This game species prefers open and edge habitat and opportunities for hunting this species are likely somewhat limited in the heavily forested portions of the AOI.

Other Small Game
In addition to quail and dove, other small game hunted in Tennessee include snipe, woodcock, rabbit, opossum, raccoon, fox, and squirrel. Of these, squirrels are among the most targeted, with over 78,000 hunters seeking this species in Tennessee during 2006. Rabbits were also a popular, with 66,000 hunters pursuing this species (USFWS and U.S. Census Bureau 2006).

Table 14. Game harvest data for Bear Hollow WMA between 2006 and 2011

Game Species	Bear Hollow WMA, Tennessee				
	2006-07	2007-08	2008-09	2009-10	2010-11
Deer	72	60	42	90	104
Turkey	1	2	2	4	4

Source: TWRA 2012

Fishing

The vast and varied water resources of Tennessee provide numerous opportunities for freshwater fishing. Water resources of Tennessee include 60,000 miles of rivers and streams and approximately 536,000 acres of ponds, lakes, and reservoirs. According to a 2006 survey, over 8.7 million resident and visiting freshwater anglers fished in Tennessee. Major species fished include crappie, sunfish, white/striped bass, black bass, walleye, northern pike, trout, and various catfish (USFWS and U.S. Census Bureau 2006).

Wildlife Viewing

Wildlife viewing comprises the largest group of people engaged in wildlife-dependent recreational activities. During 2006, over 2.3 million participants engaged in wildlife watching in Tennessee, more than hunters and anglers combined (USFWS and U.S. Census Bureau 2006). Although hunting and fishing have seen declines in participation rates in recent years (Aiken 2009), wildlife watching continued to grow in popularity nationally and in Tennessee between 1991 and 2006, based on survey data (Aiken 2009). In the AOI, opportunities for wildlife watching in the AOI are provided by trails on state lands.

VISUAL RESOURCES

The visual resources of the AOI have been relatively undisturbed. The area remains largely rural in character, with few large, tall structures or major highways affecting the landscape.

LAND USE

Understanding land use and ownership is important for assessing the social and economic impacts of conservation actions, including the potential establishment of a refuge. For the purposes of this Draft LPP/EA, the National Land Cover Dataset (NLCD) (Fry et al. 2011) was used to portray land use. The majority of the lands in the AOI is considered to be in "open" or undeveloped land uses and most parcels are in private ownership, including estates, land investment companies, commercial timber plantations, and family farms (Table 15). The AOI currently contains several large tracts (over 1,000 acres) of mostly forested land. Several of these tracts are owned by forestry investment companies, and some of the parcels are being used for commercial timber. Farmland is typically found along the floodplains, where the land is more level and water more accessible. About 10 percent of the AOI is in public ownership and consists of state lands, including Bear Hollow Wildlife Management Area and Walls of Jericho State Natural Area.

Table 15. Land use in the AOI

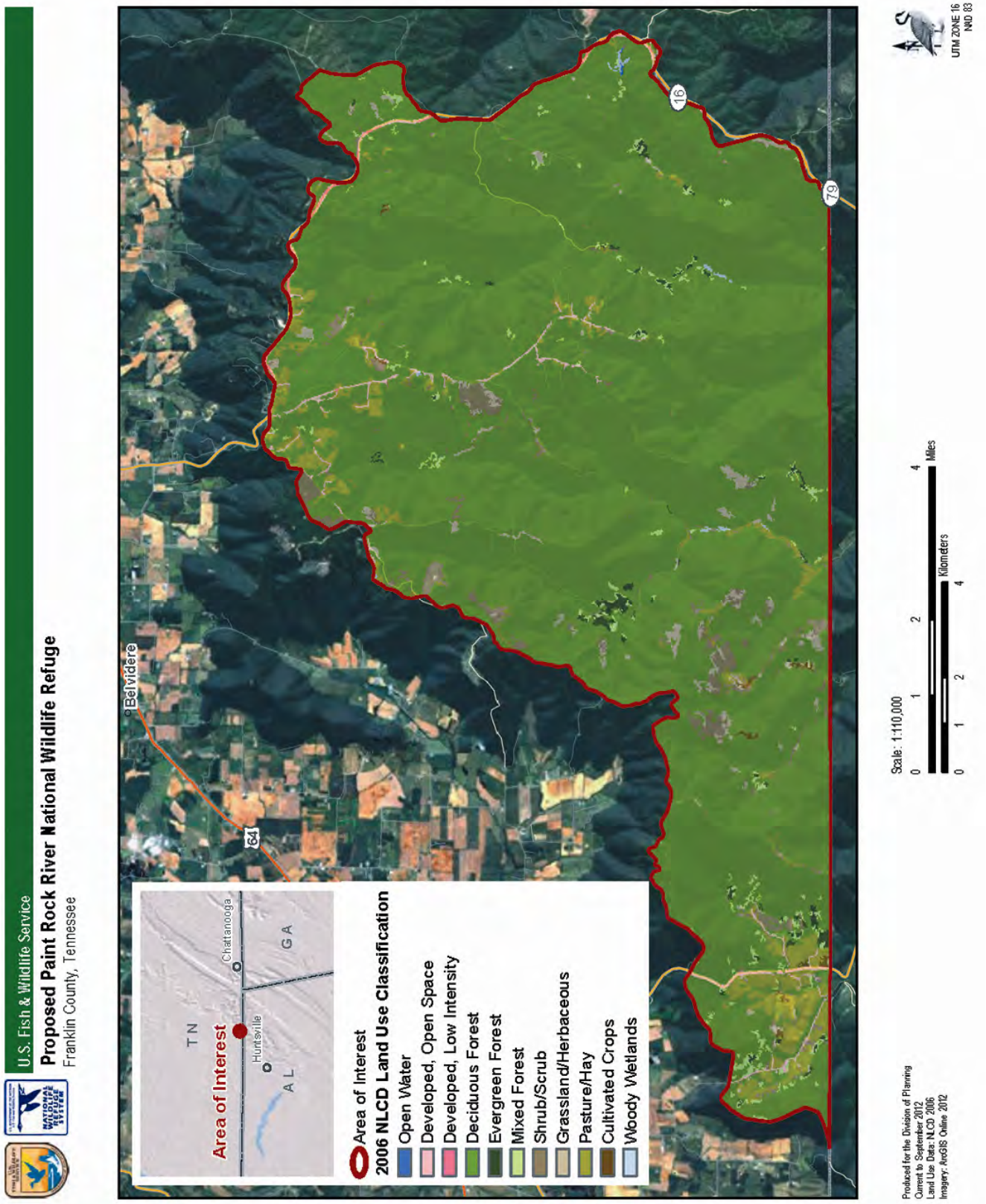
Land Use Class	Total Acres
Deciduous Forest	36,265
Planted/Cultivated	1,601
Scrub/Shrub	1,008
Grassland/Herbaceous	508
Mixed Forest	437
Developed	417
Evergreen Forest	229
Woody Wetlands	36
Open Water	4
Total	***40,505***

Source: Fry et al. 2011

[1]Includes "Barren Areas"

Key: *Deciduous Forest - dominated by trees > 25 ft tall, > 20% of total cover, and where 75% of the trees are hardwoods. Planted/Cultivated – hay, pasture, row crops. Evergreen Forest - dominated by trees > 25 ft tall, > 20% of total cover, and where 75% of the trees keep their leaves. Developed - characterized by a high percentage (30% or greater) of constructed materials (e.g. asphalt, concrete, buildings, etc.). Mixed Forest - dominated by trees > 25 ft tall, > 20% of total cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover. Scrub/Shrub - dominated by shrubs; < 25 ft tall with shrub canopy typically greater than 20% of cover, includes true shrubs, includes young or stunted trees. Grassland/Herbaceous - dominated by gramanoid/herbaceous vegetation, > 80% of total vegetation. Woody Wetlands - forest or shrubland vegetation comprise > 20% of cover and the soil/substrate is periodically saturated/covered with water. Open Water – lakes/ rivers, with < 25% covered by ground or vegetation.*

Figure 6. Land use within the AOI based on 2006 National Land Cover Data **(Fry et al. 2011)**



CULTURAL RESOURCES

Section 106 of the National Historic Preservation Act of 1966, as amended, and Section 14 of the Archaeological Resources Protection Act require the Service to evaluate the effects of any of its actions on cultural resources (e.g., historical, architectural, and archaeological) that are listed or eligible for listing in the National Register of Historic Places (NRHP)). In accordance with these regulations, the Service has coordinated the review of this proposal with the Tennessee State Historic Preservation Office.

The body of federal historic preservation laws has grown dramatically since the enactment of the Antiquities Act of 1906. Several themes recur in these laws, their promulgating regulations, and more recent executive orders. They include: (1) Each agency is to systematically inventory the historic properties on their holdings and to scientifically assess each property's eligibility for the National Register of Historic Places; (2) federal agencies are to consider the impacts to cultural resources during the agencies' management activities and seek to avoid or mitigate adverse impacts; (3) the protection of cultural resources from looting and vandalism are to be accomplished through a mix of informed management, law enforcement efforts, and public education; and (4) the increasing role of consultation with groups, such as Native American tribes, in addressing how a project or management activity may impact specific archaeological sites and landscapes deemed important to those groups. The Service, like other federal agencies, is legally mandated to inventory, assess, and protect cultural resources located on those lands that the agency owns, manages, or controls. The Service's cultural resource policy is delineated in 614 FW 1-5 and 126 FW 1-3. In the Service's Southeast Region, the cultural resource review and compliance process is initiated by contacting the Regional Historic Preservation Officer/Regional Archaeologist (RHPO/RA). The RHPO/RA would determine whether the proposed undertaking has the potential to impact cultural resources, identify the "area of potential effect," determine the appropriate level of scientific investigation necessary to ensure legal compliance, and initiate consultation with the pertinent State Historic Preservation Office and federally recognized tribes. The Service believes that the proposed acquisition of lands would have no adverse effect on any known or yet-to-be identified NRHP-eligible cultural resources. However, in the future, if the Service plans or permits any actions that might affect eligible cultural resources, it would carry out appropriate site identifications, evaluations, and protection measures as specified in the regulations and in Service directives and manuals.

OVERVIEW OF CULTURAL RESOURCES

The following section summarizes the prehistoric (pre-European) time, which spans approximately 11,500 B.C. to 1600 A.D. and historic (1600 A.D. until present) cultural resources in the AOI.

Prehistory

Humans are believed to have inhabited the AOI as early as 11,500 B.C., having migrated from Asia via the Bering Strait during the last ice age, when sea levels were substantially lower than today. The region's prehistoric times have been separated into the following stages: Paleoindian, Archaic, Woodland, and Mississippian.

Paleoindian Stage (11,500 to 8,500 B.C.)

Paleoindians were highly mobile hunter-gatherers who utilized resources opportunistically during a time when the region had a much colder climate, with harsh winters and shorter summers. The landscape consisted of a mosaic of grasslands with patchy conifer stands, and deciduous tree species made up a relatively small component of the forest types. In addition to large game (mammoth, mastodon, ground sloth, bison, etc.), they hunted smaller wildlife, fished, and collected snails and clams. They gathered seasonally available fruits, nuts, tubers, and other plant materials.

They utilized a variety of implements, which they fashioned from various stones and rocks, and these tools were often used diagnostically and include Clovis, Cumberland, and Redstone type artifacts (Gage and Herrmann 2009).

Archaic Stage (8,500 to 900 B.C.)
The Archaic stage is marked by a shift in climate and forest types, with a transition from a boreal, more open landscape to mixed hardwood forests and a loss of most of the grasslands. The remaining North American megafauna became extinct. Humans adapted to the change in exploitable faunal and floral resources, and there was a shift in material culture and settlement patterns. During this stage, people became slightly more sedentary, as is evidenced in the archaeological record by larger, more densely occupied sites. Faunal remains from archaeological sites indicate that white-tailed deer, turkey, squirrel, raccoon, and box turtle became the most common sources of meat. Meanwhile, hickory and acorn nuts were common plant foods. Atlatl weights appeared for the first time and stone net sinkers have been found in the archaeological record and suggested new technologies for fishing. In addition, container technology included the advent of soapstone bowls. Other tool advances included grooved axes and limestone digging implements. Burial practices also became more elaborate. Evidence of long distance trade is seen in the archaeological record by the presence of non-local artifacts, such as marine shell, copper, and greenstone (Gage and Herrmann 2009).

Woodland Stage (900 B.C. to 600 A.D.)
Regionally, the Woodland Stage is marked by the advent of pottery. Temporal indicators throughout the Woodland Stage include tempering agents, surface treatments, and vessel forms. People became increasingly sedentary, as evidenced by larger, more permanent communities. Settlements were typically along rivers, with temporary sites found in upland areas, likely to take advantage of seasonal hunting opportunities. Horticulture became more important during this stage, but initially it remained on a smaller scale than hunting, fishing, and gathering. Woodland subsistence was largely based on white-tailed deer, elk, bear, turkey, raccoon, beaver, and squirrel, accompanied by turtles and fish. Shellfish procurement became increasingly important, as people utilized the diverse and abundant populations of freshwater snails, mussels, and crayfish. Nut crops such as acorn, hickory, and walnut were widely exploited. Towards the end of the Woodland Stage, cultivation of small grains contributed a major component of the diet. The move to a more agrarian way of life also led to the development of numerous new tools, including drills, scrapers, knife blades, pecked celts, grooved axes, hammerstones, whetstones, mortars, pestles, teatite bowls, and gorgets (Gage and Herrmann 2009).

Mississippian Stage (900 to 1600 A.D.)
The Mississippian stage is marked by a shift in political, social, and overall cultural conditions in the southeast. The foundation for Mississippian society was believed to have its source in the Mississippi Valley, but quickly spread east and incorporated local variations. Pottery with shell tempering appeared, with small, triangular points. (Hamilton and Madison types) were prevalent; and floodplain horticulture, focused on maize, beans, and squash, was practiced. The construction of massive ceremonial centers, such as Cahokia and Moundville, occurred and ceremonialism, incorporating aspects of horticulturalism, was practiced. Dwellings became more elaborate and building materials and designs improved, making structures more durable and offering better protection against the elements. Public buildings also became more common. Towards the end of this stage, economies were primarily maize-based, supplemented with several lesser crops, nuts, deer, turkey, turtle, and fish.

Historic (~1600 A.D to Present)
By 1600, dramatic shifts in the regional population marked the decline of the Mississippian occupations. Floodplain horticultural and earth mound construction continued among the Crow Creek phase and the Dallas cultures to the north. The Cherokee and Chickasaw Tribes followed this phase, with the first Europeans appearing with Desoto in 1539. About 23 years later, Spanish soldiers from the Alabama River area entered the area of the eastern portion of the middle Tennessee Valley. Tribes occupying this region at the time included the Chickasaw, Creek, Shawnee, Natchez, and the Cherokee. The Chickasaw aligned with the British during the French and Indian War, but remained neutral during the American Revolution. In 1786, the Treaty of Hopewell established the northern boundary of the Chickasaw lands as the divide between the Cumberland and Tennessee Rivers west to the Ohio. Pressure from American settlers produced another treaty in 1832, which resulted in the Chickasaw giving up all lands east of the Mississippi. Soon after, the majority of the tribe moved west to Indian Territory.

The Natchez may have occupied the Middle Tennessee Valley in small numbers having been given refuge by the Cherokee and Upper Creek. The Creek occupied the south side of the Tennessee River which formed their northern boundary.

The Cherokee occupied both sides of the Appalachians at the time Europeans arrived to the area. This interaction brought many changes to the Cherokee culture. The large amount of European trade goods found at archaeological sites indicates a high degree of trade between Euro-American and the Cherokee. A close alliance with the British continued through the beginning of the American Revolution. The Cherokee sued for peace with the Americans after several area towns were destroyed. Settlers soon moved into Cherokee Territory, forcing them south of the Little Tennessee River in 1794. By 1835, the tribes had migrated onto reservations to the west or into areas of the Appalachian Mountains.

Land use substantially changed with the arrival of the settlers. More of the floodplains began to be farmed, and larger tracts of forests were cleared. Forests in the AOI are likely to have been cut-over at least several times over the past few hundred years. Railroads, roads, and communities were built, mainly in the mid and lower portions of the watershed. Over the last decade, second homes and housing developments have been built. Additionally, commercial forestry interests are purchasing lands, and in some areas are converting hardwood stands to pine plantations. These changes in land use continue, and are accelerating in some parts of the AOI, as previously discussed under the section on socioeconomics.