Chapter 3:
Affected Environment

CHAPTER 3: AFFECTED ENVIRONMENT

INTRODUCTION

This "Affected Environment" chapter describes existing conditions for those elements of the natural and cultural environments at Big South Fork National River and Recreation Area (NRRA) and Obed Wild and Scenic River (Obed WSR) that would be affected by implementing the actions considered in this Oil and Gas Management Plan / Environmental Impact Statement (plan/EIS). The natural environment components that are addressed include air quality, geology and soils, water resources (surface and ground water), vegetation, wildlife and wildlife habitat, federally listed threatened and endangered species, species of special concern, and soundscapes. The cultural components include archeological, historic, and ethnographic resources, as well as cultural landscapes. Visitor use and experience and park operations and management are also addressed.

GEOLOGY AND SOILS

Both the Big South Fork NRRA and Obed WSR are located on the Cumberland Plateau. The U.S. Geological Survey (USGS) categorizes physiographic divisions based on Fenneman and Johnson's (1946) *Physical Divisions of the United States*, which is based on eight major divisions, 25 provinces, and 86 sections representing distinctive areas having common topography, rock types and structure, and geologic and geomorphic history. Within this classification system, the Cumberland Plateau is a physiographic section of the larger Appalachian Plateau province, which in turn is part of the larger Appalachian physiographic division (USGS 2009a). The following description of general geologic features in the region is taken from Harris (pers. comm., 2009) unless otherwise noted.

GEOLOGY OF THE CUMBERLAND PLATEAU

The Cumberland Plateau is characterized by flat or rolling upland areas, deeply incised river gorges, and a long line of cliffs that separate it from the lower elevations of the Ridge and Valley Province, which begins at the Cumberland Plateau's eastern escarpment (NPS 1998b). It is along this eastern escarpment, particularly in northern Tennessee and southern Kentucky, where the development of several structural folds and fault systems has had a pronounced effect on local topography. In this region, a great block fault forms the structural basis for the Cumberland Mountains, an area of pronounced elevation and relief. Major drainage systems of the Plateau may be divided into two principal groups, consisting of those that are tributary to the Cumberland River system and those that are tributary to the Tennessee. The Big South Fork is tributary to the Cumberland River system. The Obed River becomes the Emory River which empties into the Clinch River which is part of the Upper Tennessee River Basin.

The sedimentary rocks that comprise the Cumberland Plateau are of the Pennsylvanian (280 to 320 million years ago) and Mississippian periods (320 to 360 million years ago), which together comprise the Carboniferous period. These rocks are composed of near shore sediments transported westward from the old Appalachian Mountains. The Pennsylvanian rocks consist of shale, siltstone, and sandstone and are coal-bearing (NPS 2005a). Some rock layers, including bituminous coal seams, were laid down in swampy environments. These are interlaced with delta deposits of cross-bedded sandstones and occasional conglomerates.

Big South Fork National River and Recreation Area

Big South Fork NRRA encompasses approximately 125,000 acres (including deferred properties) of rugged terrain on the Cumberland Plateau in northeastern Tennessee and southeastern Kentucky, consisting of prominent rock formations, as well as the massive gorge and accompanying bluffs. The topography at Big South Fork NRRA is characterized by a dendritic drainage pattern and narrow, V-shaped gorges. Valleys are dotted with huge boulders that have broken off from the rock face. Prominent rock formations, as well as the massive gorge and accompanying bluffs, form the basis for the Sensitive Geomorphic Features (Special Management Area) described for alternative C in chapter 2 and illustrated in figure 11.

The specific geologic units found at Big South Fork NRRA are summarized in table 11 and shown on figure 11.

TABLE 11. GEOLOGIC UNITS OF BIG SOUTH FORK NATIONAL RIVER AND RECREATION AREA

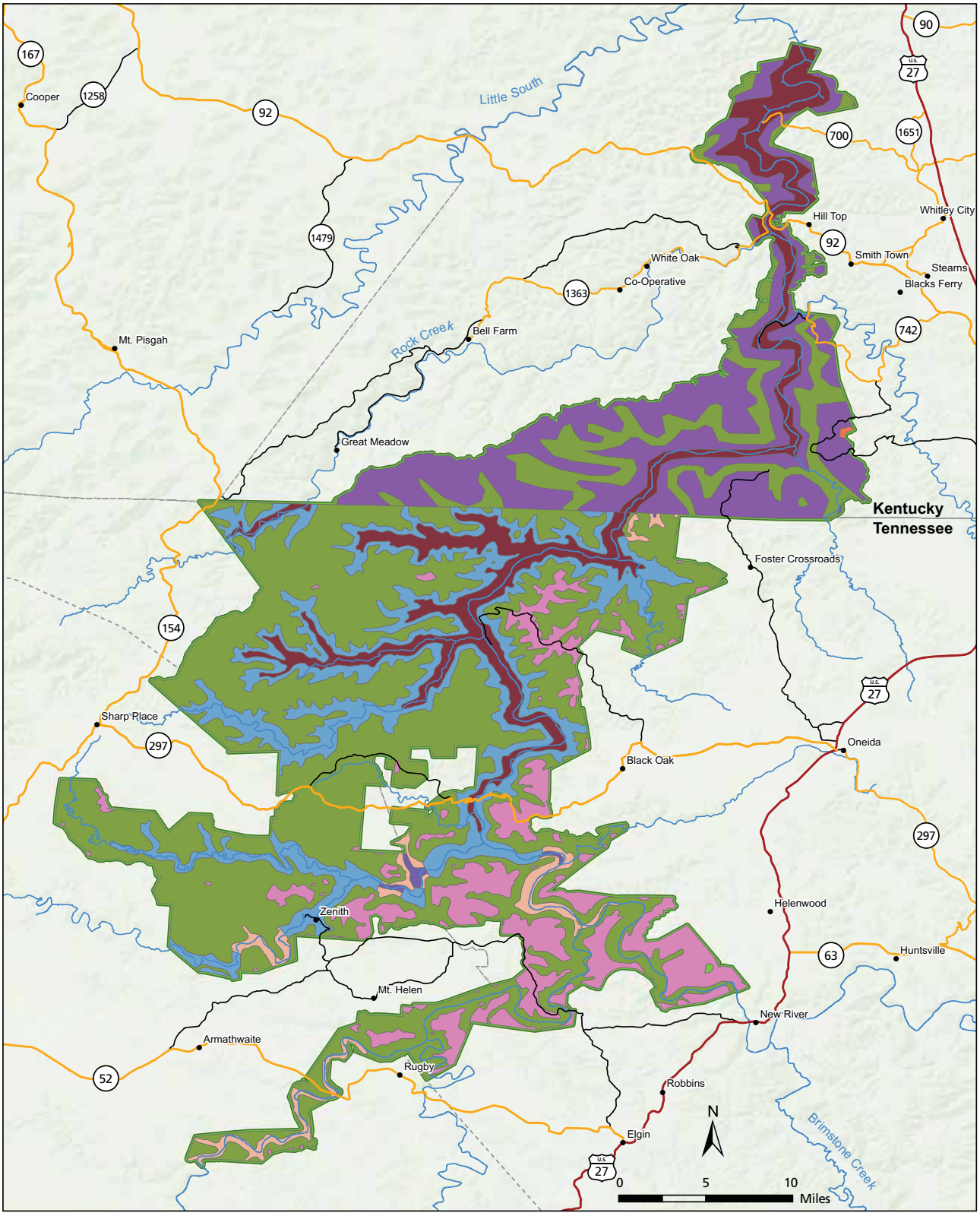
Name	Age	Rock Types
Tennessee		
Crooked Fork Group	Pennsylvanian	Shale, sandstone, siltstone, and thin coal beds; thickness 200 to 450 feet
Crab Orchard Mountain Group	Pennsylvanian	Conglomerate sandstone with thin zone of quartz and shale-pebble conglomerate at base; maximum preserved thickness 35 feet.
Gizzard Group	Pennsylvanian	Sandstone, conglomeratic sandstone, siltstone, shale, and minor coal; thickness 100 to 200 feet.
Pennington Formation	Mississippian	Highly variegated clay shale contains siltstone and locally fine-grained sandstone; thickness 400 to 700 feet.
Kentucky		
Breathitt Formation, lower part	Pennsylvanian	Shale, siltstone, sandstone; coal; conglomerate.
Lee (and Breathitt) Formation (Corbin Sandstone)	Pennsylvanian	Sandstone, conglomerate.
Lee Formation (Rockcastle Conglomerate)	Mississippian to Pennsylvanian	Conglomerate, sandstone, siltstone; shale; coal.
Pennington (Paragon) Formation	Mississippian	Limestone, shale, sandstone.

Source: Nicholson et al. 2007.

Obed Wild and Scenic River

Obed WSR encompasses approximately 5,195 acres of rolling uplands underlain by Pennsylvanian sandstones, siltstones, shales, some conglomerates, and coals. These rocks have a thickness of about 1,500 feet. The resistant nature of the capping sandstone that underlies and maintains the flat to rolling plateau topography is important in determining the landforms that characterize much of the Obed WSR drainage area. Where rivers have eroded through the sandstone caprock, continued erosion of the Pennsylvanian shales has produced the long narrow gorges of the Obed River and its tributaries (Schmalzer et al. 1985).

The specific geologic units found in Obed WSR are the Crooked Fork Group, Crab Orchard Mountains Group, and Rockcastle Conglomerate, which are summarized in table 11 for Big South Fork NRRA, and shown on figure 12.



Legend

Figure 11. Bedrock Geology of Big South Fork National River and Recreation Area

Legend

- U.S. Highway
- State Highway
- Roads
- Park Unit Boundary
- Rivers / Streams
- County Boundary

Geology

Tennessee

- Crooked Fork Group
- Rockcastle Conglomerate
- Crab Orchard Mountain Group
- Fentress Formation
- Grizzard Group (incl. Warren Pt. Sandstone and Raccon Mt. Formation)
- Pennington Formation

Kentucky

- Breathitt Formation, lower part (incl. Livingston Cgl)
- Lee (& Breathitt) Formation (Corbin Sandstone)
- Lee Formation (Rockcastle Conglomerate)
- Pennington Formation, Bangor Ls, Hartselle Fm, and Monteagle Limestone (Kidder Mbr)

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Big South Fork National River and Recreation Area and
Obed Wild and Scenic River
Kentucky and Tennessee

National Park Service
U.S. Department of the Interior

Legend

Figure 12. Bedrock Geology of OBED Wild and Scenic River

Legend

- US Highway
- State Highway
- Paved or Unpaved Roads
- Park Unit Boundary
- County Boundary
- Rivers / Creeks

Geology

- Crooked Fork Group
- Crab Orchard Mountain Group
- Rockcastle Conglomerate

N

0 5 10 Miles

For Illustrative Purposes Only

SOILS

The soils of the Cumberland Plateau, which are predominantly loamy with moderate infiltration rates, are weathered from the broad area of sandstone caprock. Some soils are also formed with additions from acidic shales and siltstone, or combinations of these rock types. The depth of the soil to bedrock ranges from about one foot on steep hillsides to about four to five feet on broad, smooth interstream divides. The soil characteristics for both Big South Fork NRRA and Obed WSR are described in detail in the following sections.

Big South Fork National River and Recreation Area

Big South Fork NRRA is located within the Tennessee counties of Scott, Morgan, Fentress, and Pickett, and the Kentucky county of McCreary. A soil survey of the Big South Fork NRRA categorized soils into 19 map units (see figure 13). These soils identified within the recreation area and, where available, the hydrologic soil groups associated with them (described later in this section) are provided in table 12.

TABLE 12. SOIL ASSOCIATIONS WITHIN BIG SOUTH FORK NATIONAL RIVER AND RECREATION AREA

Soil Map Unit	Hydrologic Soil Group[1]
Atkins loam	—
Atkins-Lily complex	B
Atkins-Skidmore complex	B
Gilpin silt loam	C
Gilpin-Bouldin complex	B
Gilpin-Bouldin-Petros complex	B/D
Gilpin-Petros complex	D
Gilpin-Sequoia complex	C
Itmann very parachannery loam	C
Lily loam	B
Lily-Gilpin complex	B
Lily-Ramsey complex	B
Lonewood silt loam	B
Pope-Skidmore complex	B
Ramsey-Rock outcrop complex	D
Shelocta silt loam	B
Shelocta-Bouldin complex	B
Skidmore very gravelly sandy loam	—
Wernock silt loam	B

Source: USDA 2009a, 2009b.

[1]Classifications are based on the hydrologic soil groups as assigned by the Natural Resources Conservation Service and are provided where available for specific soils contained in the map unit.

For purposes of describing the hydrologic characteristics of the soil and evaluating the potential impacts of oil and gas operations, soil associations within the recreation area have been combined into four major classifications based on their infiltration/runoff potential or hydrologic group. Hydrologic group refers to a group of soils having similar runoff potential under similar storm and cover conditions. These

classifications are assigned by the Natural Resources Conservation Service (NRCS). The four hydrologic soil groups are A, B, C, and D, where soils in group A generally have the smallest runoff potential, while those in group D have the greatest runoff potential. Table 13 describes common characteristics of these hydrologic groups.

TABLE 13. COMMON CHARACTERISTICS OF HYDROLOGIC SOIL GROUPS

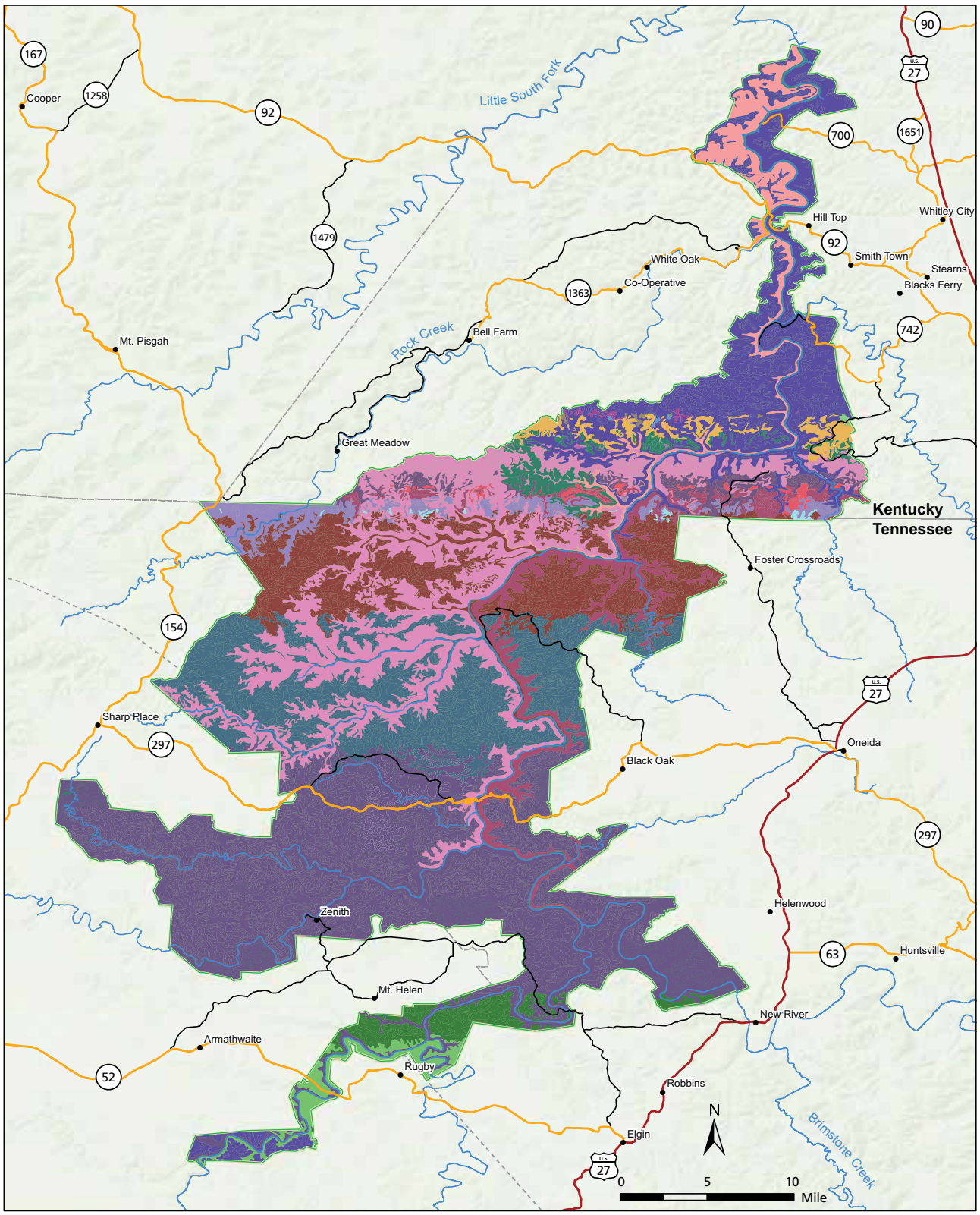
Hydrologic Soil Group	A Soils	B Soils	C Soils	D Soils
Composition	Thick, well to excessively drained, moderately coarse textures (sands, loamy sands, and sandy loams)	Moderately thick, well to excessively drained, moderately fine to moderately coarse textured (silt loams and loams)	High clay content, water retardant layer, moderately fine to fine textured (sandy clay loams)	Fine textured, thin clayey soils with claypan or clay layer near surface
Location	Generally found in upland areas	Generally found in upland areas	Generally found in wetlands and floodplains	Generally found in wetlands and floodplains
Permeability	High	Moderate	Low	Very Low
Erodibility	Low to Moderate	Low to Moderate	Moderate to High	Moderate to High
Compaction	Low	Low	Moderate	High
Shrink/Swell Potential	Low	Low	Moderate	High
Runoff Potential	Low	Low	Moderate	High
Infiltration Rate	High	Moderate	Low	Low

Source: USDA 2009b; NPS 2005d.

Soil characteristics that are important in assessing the potential impacts of oil and gas operations include the following:

Soil Erodibility—Most of the soils in classes A and B are low to moderately erodible, while soils in classes C and D are moderately to highly erodible. Erosion also depends on the rainfall energy, slope length, vegetative cover, and site conservation or management practices. Slopes within Big South Fork NRRA are variable, and soil erosion control may be necessary whenever vegetative cover is removed or when water is concentrated and flow velocities are high.

Soil Compaction—Typically, soils with a high clay content are most subject to compaction. Soil compaction resulting from foot travel or vehicle use reduces the pore spaces in the soil and impedes the penetration of rainfall and plant roots (Meek et al. 1992). Even though drying and shrinking of the soils and subsequent wetting and expansion will tend to negate some of the adverse impacts over time, clayey soils should not be traversed when saturated. Vehicular travel on clayey soils under saturated conditions will form compacted tracks. These tracks will have the effect in flat topography of changing surface drainage patterns by forming small drainage channels that can locally affect the hydroperiod (frequency and duration of saturation) of a site. Compaction will also tend to severely reduce the permeability of the soil. Soils within class D are most prone to compaction.



Legend

Figure 13. Soils of Big South Fork National River and Recreation Area

- U.S. Highway
- State Highway
- Roads
- Rivers / Streams
- County Boundary

Legend

- Atkins loam, ponded
- Atkins-Lily complex
- Atkins-Skidmore complex
- Gilpin silt loam
- Gilpin-Bouldin complex
- Gilpin-Bouldin-Petros complex
- Gilpin-Petros complex
- Gilpin-Sequoia complex
- Itmann very parachannery loam
- Lily loam
- Lily-Gilpin complex
- Lily-Ramsey complex
- Lonewood silt loam
- Pope-Skidmore complex
- Rock outcrop-Ramsey complex
- Shelocta silt loam
- Shelocta-Bouldin complex
- Skidmore very gravelly sandy loam
- Water
- Wernock silt loam

Shrink/Swell Potential—Clayey soils that are composed of expansive clays will tend to expand and contract with seasonal moisture variations. The combined effects of shrink/swell and compaction make road construction difficult in areas where there are clayey soils. Typically, soils in class D are more prone to shrink and swell.

Prime or Unique Farmland Soils—The Farmland Protection Policy Act was passed in order to minimize the amount of land irreversibly converted from farmland due to federal actions. Prime farmland, as defined by the U.S. Department of Agriculture (USDA) National Resources Conservation Service, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is available for these uses. It could be cultivated land, pastureland, forestland, or other land, but it is not urban or built-up land or water areas. Big South Fork NRRA contains seven soil associations that have been identified as prime farmland soils. They are: Allegheny-Grigsby, Lily Loam, Lonewood Clarkrange, Sequoia Silt Loam, Sequoia-Wernock, Sewanee Loam, Wernock Silt Loam (USDA 2009b).

Obed Wild and Scenic River

The Obed WSR is located within Cumberland and Morgan counties. Soil composition characteristics for the Obed WSR are representative of the Cumberland Plateau and similar to those of Big South Fork NRRA. The 18 soils found within the recreation area and the hydrologic soil classes associated with them are illustrated in figure 14 and listed in table 14.

TABLE 14. SOIL ASSOCIATIONS WITHIN OBED WILD AND SCENIC RIVER

Soil Map Unit	Hydrologic Soil Group
Bethesda-mines pit complex	C
Ealy-Craigsville complex	B
Gilpin silt loam	C
Gilpin-Bouldin-Petros complex	C
Gilpin-Petros complex	C
Jefferson-Varilla-Shelocta complex	B
Lily Loam	B
Lily-Gilpin complex	B
Lily-Ramsey complex	B
Lonewood Silt Loam	B
Pope-Philo complex	B
Ramsey-Rock outcrop complex	D
Shelocta Silt Loam	B
Wernock Silt Loam	B

Source: USDA 2009a; 2009b.

Prime or Unique Farmland Soils—Obed WSR contains five soil types that have been identified as prime farmland soils. These are: Lily Loam, Lonewood Loam, Lonewood Silt Loam, Pope Philo, and Wernock Silt Loam (USDA 2009b).

WATER RESOURCES

BIG SOUTH FORK NATIONAL RIVER AND RECREATION AREA

One of the primary reasons the Big South Fork NRRA was established was to preserve the Big South Fork of the Cumberland River as a natural, free-flowing stream for the benefit and enjoyment of present and future generations. The Big South Fork River is formed by the New River and the Clear Fork, and drains the northern portion of the Cumberland Plateau in Tennessee. As the Big South Fork flows from south to north, it is fed by a variety of sources ranging from perennial streams, such as North White Oak Creek, to many ephemeral creeks. Flooding is common during the winter months (December – March) when soils are saturated, frozen, or covered with snow. Springs and ponds can be found scattered throughout the Big South Fork NRRA. Enhancing the water quality of the Big South Fork is an important management concern. The following sections generally describe surface and ground water at the park unit. A complete overview of the management of the water resources is contained in the Big South Fork NRRA Water Resources Management Plan (NPS 1997).

Surface Water

The Big South Fork (also known as the Big South Fork of the Cumberland) River originates at the confluence of the Clear Fork and New River in the southern portion of the Big South Fork NRRA. Other major tributaries include North White Oak Creek, Pine Creek, Bear Creek, Station Camp Creek, Williams Creek, Roaring Paunch Creek, and Rock Creek. Major tributaries to the Big South Fork are shown on figures 15, 16, and 17. Table 15 provides the area drained by these major tributaries as well as several smaller tributaries to the river.

TABLE 15. SUB-WATERSHEDS IN THE BIG SOUTH FORK NATIONAL RIVER AND RECREATION AREA

Sub-watershed River	Sub-watershed Area mi^2	Location Counties
New River	396	Scott, Anderson, Campbell, Morgan
Clear Fork River	283	Scott, Fentress, Morgan
North White Oak Creek	88	Scott, Fentress
Pine Creek	27	Scott
Station Camp Creek	132	Scott, Pickett, Fentress
Bear Creek	23	Scott, McCreary
Williams Creek	24	Scott
Roaring Paunch Creek	50	Scott, McCreary
Rock Creek	163	Scott, Pickett, McCreary

Source: NPS 1997.

Big South Fork National River and Recreation Area and
Obed Wild and Scenic River
Kentucky and Tennessee

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U.S. Department of the Interior

Legend

Figure 14. Soils at Obed Wild and Scenic River

Legend

- Bethesda-mines pit complex
- Ealy-Craigsville complex
- Gilpin silt loam
- Gilpin-Bouldin-Petros complex
- Gilpin-Petros complex
- Jefferson-Varilla-Shelocta complex
- Lily loam
- Lily-Gilpin complex
- Lily-Ramsey complex
- Lonewood silt loam
- Pope-Philo complex, frequently flooded
- Ramsey-Rock outcrop complex
- Shelocta silt loam
- Water
- Wernock silt loam
- Park Unit Boundary
- US Highway
- County Boundary
- State Highway
- Paved or Unpaved Roads
- Rivers / Creeks

N

0 5 10 Miles

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Big South Fork National River and Recreation Area
Kentucky and Tennessee

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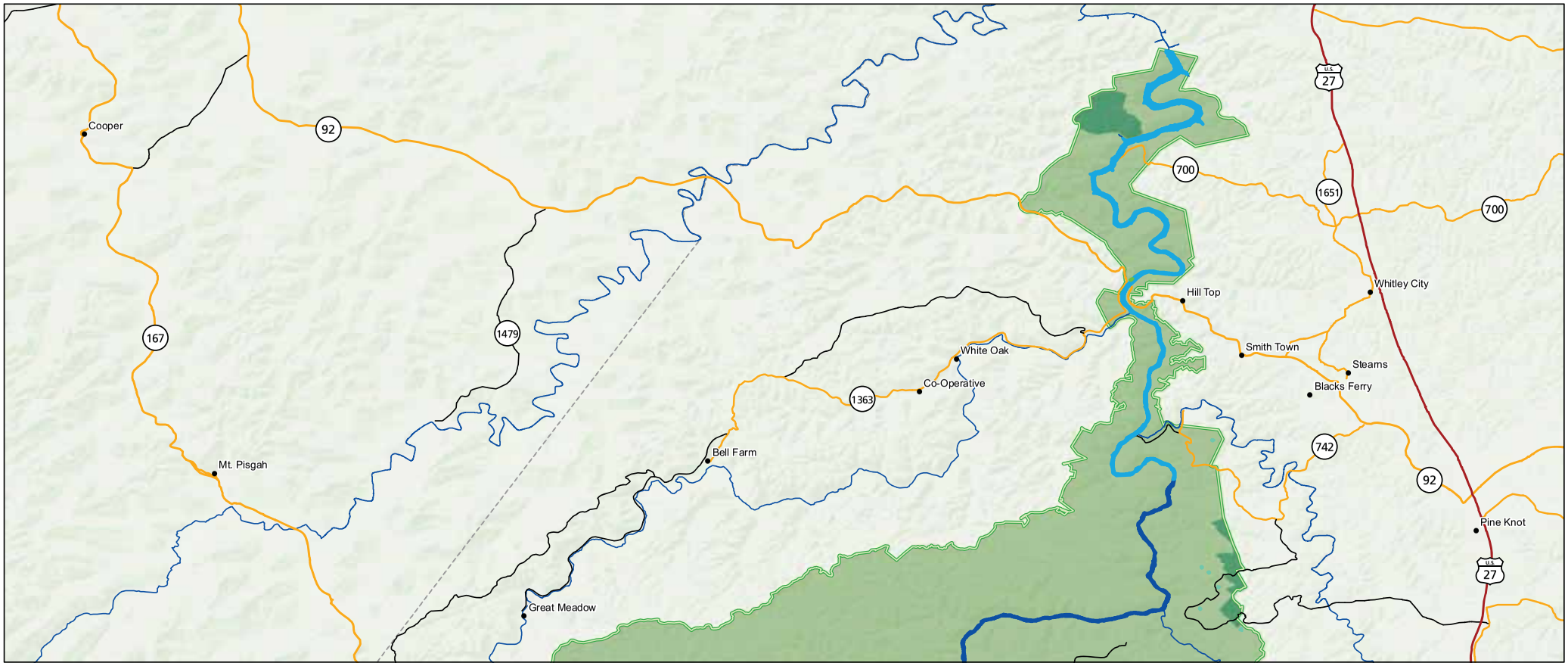


Legend

Figure 15. Wetlands and Surface Water of Big South Fork National River and Recreation Area (Map 1)

Legend

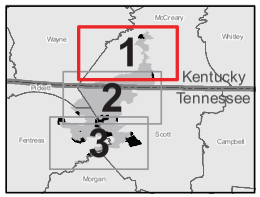
- U.S. Highway
- State Highway
- Roads
- Park Unit Boundary
- Rivers / Streams
- County Boundary

Wetlands and Surface Water

- Freshwater Forested / Shrub Wetland
- Freshwater Pond
- Lake
- Riverine
- Reservoirs and Impoundments

N

0 2 4 Mi.



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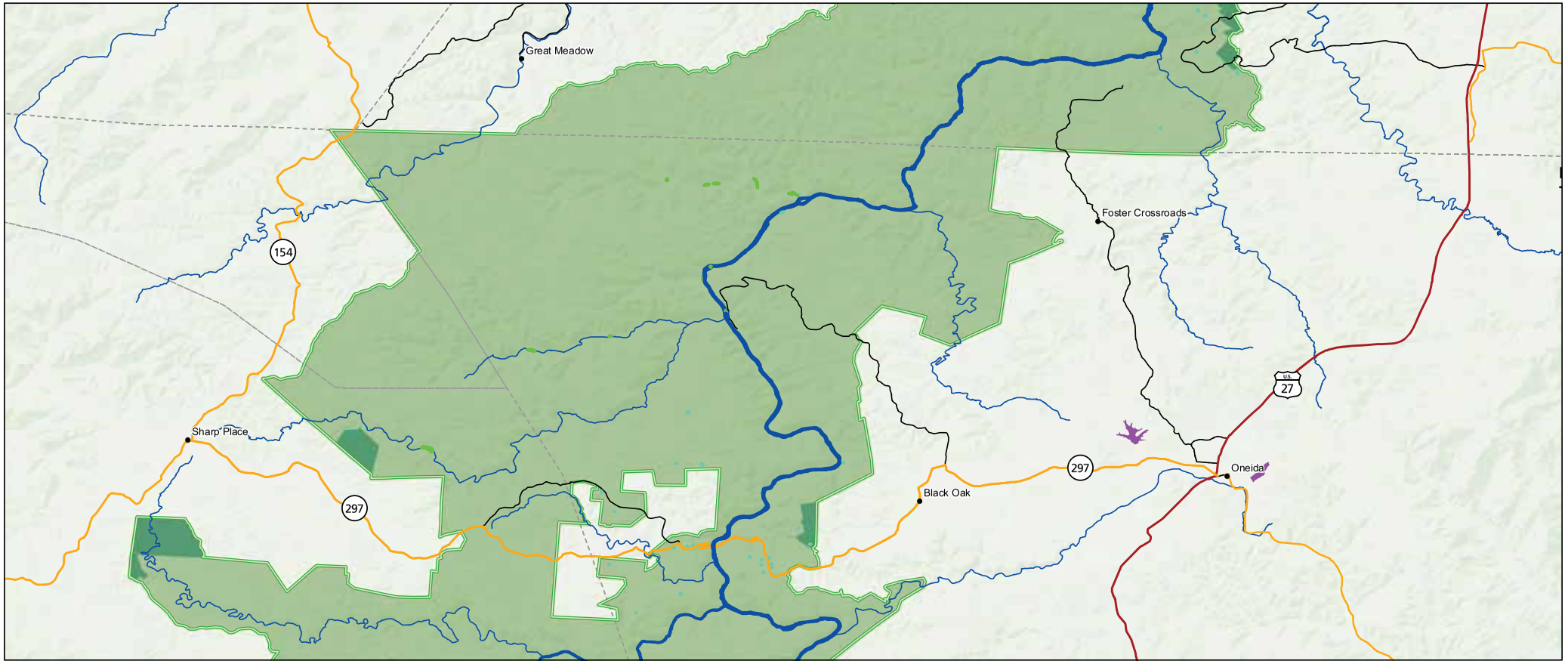

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Figure 16. Wetlands and Surface Water of Big South Fork National River and Recreation Area (Map 2)

Legend

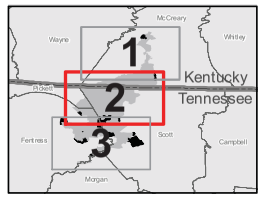
- U.S. Highway
- State Highway
- Roads
- Park Unit Boundary
- Rivers / Streams
- County Boundary

Wetlands and Surface Water

- Freshwater Forested / Shrub Wetland
- Freshwater Pond
- Lake
- Riverine
- Reservoirs and Impoundments

N

0 2 4 Mi.



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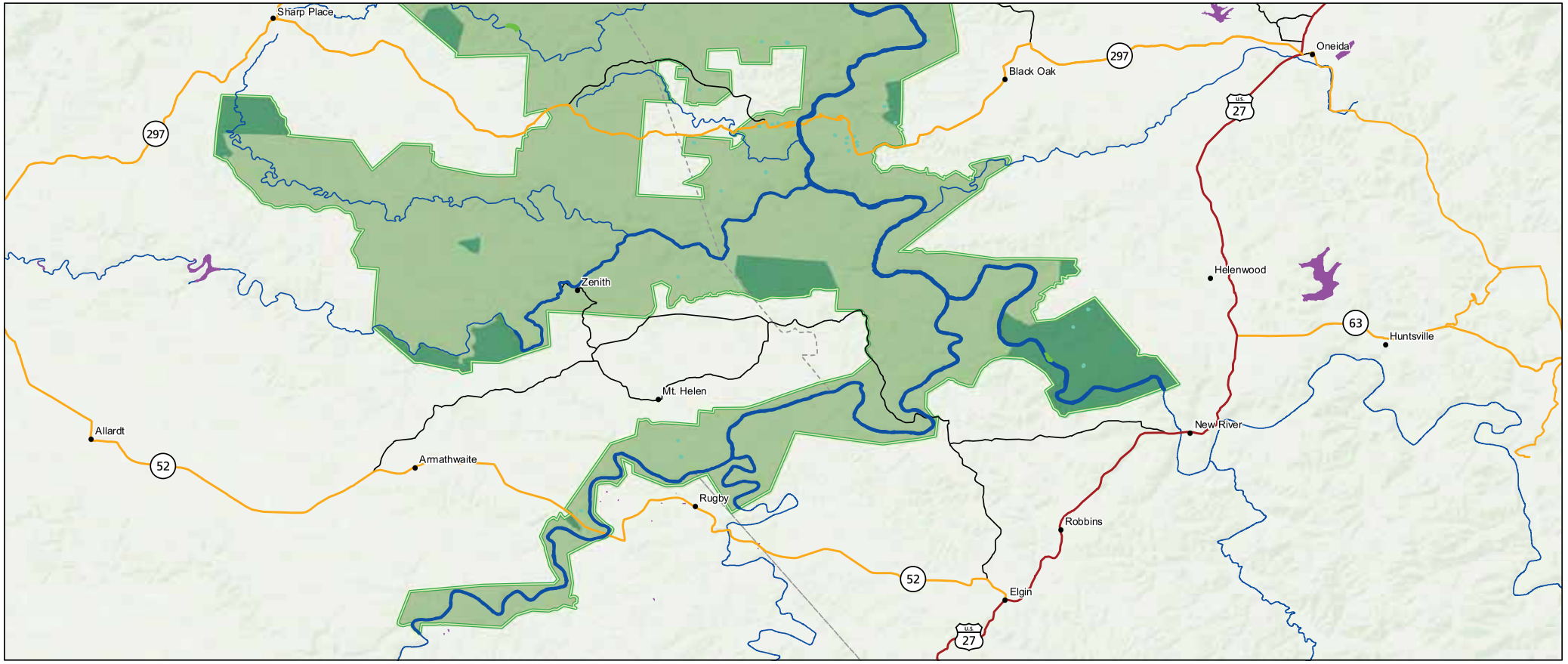


Legend

Figure 17. Wetlands and Surface Water of Big South Fork National River and Recreation Area (Map 3)

Legend

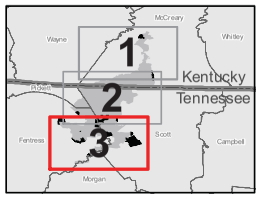
- U.S. Highway
- State Highway
- Roads
- Park Unit Boundary
- Rivers / Streams
- County Boundary

Wetlands and Surface Water

- Freshwater Forested / Shrub Wetland
- Freshwater Pond
- Lake
- Riverine
- Reservoirs and Impoundments

N

0 2 4 Mi.



The Big South Fork River flows northward through the Big South Fork NRRA for approximately 49 miles and joins the Cumberland River 28 miles north of the Big South Fork NRRA's northern boundary at Burnside, KY (NPS 1997). The Big South Fork River watershed, combined with the New River and Clear Fork watersheds, drain approximately 1,123 square miles within the Cumberland Plateau (NPS 2009a). Roughly six miles of the Big South Fork River within the Big South Fork NRRA boundaries are part of Lake Cumberland at normal pool levels.

A unique feature of surface waters in the Big South Fork NRRA is their low ionic strength. Ion content of streams and rivers is related to several other potential stressors, including temperature, sediment, pH, metals, other toxic chemicals, and flow alteration. Insofar as conductivity may be taken as an indicator of ionic strength, clean streams in the Big South Fork NRRA would have an electrical conductivity of 60 microSiemens per centimeter (µS/cm) or less in watersheds with limestone, or 30 µS/cm or less in watersheds without limestone. When conductivity exceeds 60 µS/cm, this is an indication that the stream is polluted (Rikard et al. 1986). For this reason, brine discharges associated with oil and gas activities should not be allowed to raise the conductivity of the surface water above these acceptable levels. While some surface waters of the Big South Fork River system are contaminated by oil and gas activities (as detailed below), overall surface water quality, as measured by ionic strength, is good.

Streamflow—There are three USGS stream gauge stations within the Big South Fork NRRA. One is on the Big South Fork River in Kentucky (station no. 03410500), one is on the Clear Fork near Burnt Mill Bridge (station no. 03409500), and the other is on the Big South Fork River in Tennessee (station no. 03410210).

The Adams Bridge Stream Gage located on the Obed River.

Data is available for streamflow measurements reported for 2004 at station no. 03410600 on the Big South Fork Cumberland River at Yamacraw in Kentucky. Statistics from this reporting year indicate that average daily flow, measured in cubic feet per second (cfs), ranges from 222 to more than 43,500 cfs. Flows are highest during the months from January through April, with peak flows occurring somewhere during this period. Flows during this period average approximately 3,940 cfs. During the May through December period, flows are lower, and average approximately 1,970 cfs (USGS 2004).

Streamflow measurements from the station no. 03409500 on the Clear Fork near Robbins in Tennessee indicate that average flow is from 2 to 3,420 cfs. Flows are highest during the months of January, February, March, and April. During this period, flows average approximately 900 cfs. During the period from May through December, flows are lower and average approximately 260 cfs (USGS 2009b).

Streamflow measurements from the station no. 03410210 on the Big South Fork Cumberland River at Leatherwood Ford in Tennessee indicate that average flow is from 26 to 6,370 cfs. Flows are highest during the months of January, February, March, and April. During this period, flows average approximately 2,300 cfs. During the period from May through December, flows are lower and average approximately 800 cfs (USGS 2009b).

Intakes—There are four public water supply intakes that withdraw water from streams that fall within the Big South Fork River watershed (table 16). The McCreary County intake is located within the Big South Fork NRRA boundary; the other three intakes are outside of the park (NPS 2005a).

TABLE 16. INTAKES IN THE BIG SOUTH FORK NATIONAL RIVER AND RECREATION AREA

Public Water Supply	Year Operation Began	Source	Average Pumpage (10^6 gal/day)	Population Served
McCreary County Water District[a]	2002	Lake Cumberland and Big South Fork River	2.2	18,000
Huntsville Utility District (in Scott County, TN; includes the Sunbright Utility District of Morgan County, TN)[b]	Intermittently Operational (as needed)	New River (Pumped to Huntsville Utility District Reservoir on Flat Creek)	1.3	13,000
City of Oneida, TN	1963	North Fork Pine Creek	1.5	11,000
City of Jamestown (also serves Fentress County Utility District, TN, and the Town of Allardt, TN)	1969	North White Oak Creek	1.6	18,000

Sources: Hench, pers. comm., 2009a, 2009b; Elliston, pers. comm. 2009; Dean, pers. comm., 2009; Keaton, pers. comm., 2009; McCoy, pers. comm., 2009; and Owens 2009.

[a] Figures include the Laurel Creek reservoir intake, which supplements the intake at Big Creek.

[b] This intake is not currently in use, and has not been used since 2002.

Impoundments—The northernmost reach of Big South Fork River, approximately 37 miles from the confluence of New River and Clear Fork River, is not free-flowing. It is affected by the levels of Lake Cumberland. This USACE reservoir is formed by the Wolf Creek Dam on the Cumberland River, which was built in 1950 and is outside of the park unit (NPS 1997).

Flat Creek, which is a tributary to the New River, has a large reservoir called the Huntsville Utility District Reservoir. This is approximately 1.6 miles from the confluence with the New River, and approximately 4 miles from the Big South Fork NRRA boundary.

There are two reservoirs on North White Oak Creek. However, they are located several miles to the west of the Big South Fork NRRA boundary. A small reservoir called Old Jamestown Reservoir, having a total area of 4.9 acres, is approximately 2.5 miles upstream of Jamestown Reservoir, which is a larger reservoir with an area of approximately 60.8 acres. Jamestown Reservoir is approximately 3.1 miles to the west of the Big South Fork NRRA boundary.

Surface Water Quality—The states of Kentucky and Tennessee have each declared their portions of the Big South Fork River as an Outstanding National Resource Water (ONRW) (NPS 2005a). An ONRW is a river that is "of exceptional recreational or ecological significance," per EPA water quality standards at 40 CFR 131.12. The entire length of the Big South Fork River is included in this designation as an ONRW.

Chapter 4 of the Big South Fork NRRA General Management Plan (NPS 2005a, p. 159) describes the water quality classification process in the following way:

> Kentucky and Tennessee have stream use classification systems to protect surface water quality. Water quality criteria values are specified for each stream use. Tennessee has classified all streams within the [Big South Fork NRRA] for primary contact recreation and fish and aquatic life. Kentucky classifies all [Big South Fork NRRA] streams for primary contact recreation and for either warmwater or coldwater aquatic habitat. A number of streams in the [Big South Fork NRRA] do not meet standards, primarily due to acid mine drainage and/or sediment. Some of the streams have been identified as impaired streams, pursuant to the Clean Water Act [CWA].

The report (NPS 2005a) continues to describe the state of water quality within the Big South Fork NRRA:

> [Big South Fork] waters are generally considered good quality; however, acid mine drainage and excessive sediment from logging, substandard road construction, and other past and present ground disturbing activities significantly affect certain tributary streams and to a lesser extent the Big South Fork [River]. Agricultural chemicals also contribute negatively to water quality. In general, streams in the western portion of [Big South Fork] are less disturbed than streams in the eastern and southeastern portions. Impacts in the eastern and southern areas are more frequent and severe because coal mining, logging, and stormwater runoff are concentrated in these areas (NPS 1986). The Big South Fork River has nearly twice the dissolved solids and suspended solids, and 2.5 times greater sulfate yield as a comparable unmined river basin (Evaldi and Garcia 1991 in NPS 2005a). Acid mine drainage impacts are most notable in Bear Creek and Roaring Paunch Creek. Sediment impacts are evident in these streams, New River, and several others (pp. 158–159).

The CWA requires each state in the United States to compile a list of streams that are failing to meet one or more of the "uses" for which they have been designated due to water quality problems. Such a list is called the 303(d) list, named for the section of the CWA that requires these lists to be written. Streams on this list are deemed "impaired" as defined by the CWA, and not by the regulations and policies of the National Park Service (NPS). In the 303(d) lists for Kentucky and Tennessee for the year 2008, there are a total of four impaired streams that fall within the Big South Fork NRRA (table 17).

TABLE 17. IMPAIRED STREAMS IN THE BIG SOUTH FORK NATIONAL RIVER AND RECREATION AREA

Stream Name (and Miles)	State	Impairment	Cause	Source
Bear Creek (0.0 to 3.3)	KY, TN	Aquatic habitat, primary contact recreation, secondary contact recreation	pH, loss of biological integrity due to siltation	Subsurface mining, surface mining
Pine Creek (three segments, 10.3 miles)	TN	Water contact advisory	E. coli	Municipal point source collection system failure
Roaring Paunch Creek (0.0 to 7.8)	KY	Aquatic life, primary contact recreation, secondary contact recreation	pH	Acid mine drainage, coal extraction
Rock Creek (0.0 to 4.3)	KY	Fish consumption (partially supports)	Methyl mercury	Source unknown

Source: Based on KY EPPC 2008 and TDEC 2008a.

Surface coal mining does not currently occur inside the Big South Fork NRRA; however, past coal mining has affected water quality within the area. Degraded water used in past mining efforts re-enters the system and degrades water quality. Mining also has disrupted the flow of underground aquifers. Mining wastes also contribute various elements into the flow of Big South Fork NRRA streams that negatively impact water quality (NPS 1997).

Seeps and springs, occurring where the groundwater table intersects the land surface, are common in the Big South Fork NRRA, particularly at the base of ledges and bluff shelters. Springs of moderate yield occur at the base of the Hartsell Formation in Kentucky; other low-yield springs occur at the base of thick sandstone beds and along coal bed horizons (NPS 1997).

Groundwater Quantity—Lack of reliable groundwater in the watershed has resulted in a search for other options of water supply for surrounding communities. This search has included consideration of upstream impoundments (man-made lakes, ponds, or reservoirs) and also direct withdrawals.

There is no published inventory of the Big South Fork NRRA groundwater resources. The Cumberland Plateau's major regional aquifer is the Cumberland Plateau aquifer, formerly known as the Pennsylvanian sandstone aquifer. This is composed of Pennsylvanian-aged sandstone, shale, and conglomerate. These rocks are not porous, and so groundwater is mostly found in bedrock fractures and faults (NPS 1997). As a result, confined groundwater is under sufficient pressure to rise above the surface of the aquifer where breaks in the upper confining unit occur. The water level rises above the top of the aquifer. Perched aquifers, which are aquifers that are located above the water table, are common. The weathered rock material over most of the plateau surface is too thin to be a substantial aquifer (NPS 1997).

In general, groundwater quantity is variable. Wells in the Cumberland Plateau generally yield 5 to 50 gallons per minute, but can yield more than 300 gallons per minute. Records on 376 wells in the region show that 62% of these wells produce an average yield of 10 to 25 gallons per minute. Water wells generally do not yield enough water to be used for public water supply (NPS 1997).

Groundwater in this system is discharged into streams and also into springs. Recharge occurs primarily via precipitation on the outcrops of sandstones and conglomerates. Estimated mean recharge rate for the Cumberland Plateau is 6.5 inches per year. Groundwater flow in the system is shallow-flow. For most of the aquifer's area, the water level in wells rises to within a few feet of the land surface (NPS 1997). It is not known how the typical depth to groundwater varies within the park.

Groundwater Quality—There is no published data describing the water quality of the groundwater in the Big South Fork NRRA. NPS (1997) gives the following general description: "moderately mineralized, slightly acidic, and may have high concentrations of iron, sulfate, chloride, and hydrogen sulfide when it flows through sandstone or shale containing pyritic or ferrous compounds." As with the surface waters at the park unit, groundwater also has low ionic strength and low conductivity. Oil, gas, brine, or chemicals associated with the oil and/or gas extraction processes can influence groundwater quality. NPS (1997) notes that groundwater quality has potentially already been affected by contaminated mine drainage and oil and/or gas operations.

OBED WILD AND SCENIC RIVER

Surface Water

The Obed River, Daddys Creek, and Clear Creek have a combined total drainage area of 520 square miles, and comprise a total of 144 miles of mountain streams flowing northeast then east into the southbound Emory River, which joins the Tennessee River system (Bureau of Outdoor Recreation 1976).

The Obed River flows east for approximately 45 miles to its junction with the Emory River, of which it is the largest tributary (NPS 1998b). The Obed River drains approximately 520 square miles at its mouth (NPS 1998b). The two principal tributaries of the Obed River—Clear Creek and Daddys Creek—join the Obed River within the Obed WSR area. These water bodies are shown on figure 18.

Clear Creek drains 173 square miles in the northwest portion of the watershed. The stream flows northeast to a point near the Fentress-Cumberland-Morgan county line, then southeast to its junction with the Obed River approximately 4 miles above the junction of the Obed and Emory rivers (NPS 1998b).

Daddys Creek is the largest tributary of the Obed River, and drains 175 square miles. The creek flows northeast to its junction with the Obed River, approximately 9 miles above the Obed River mouth (NPS 1998b).

Only a short reach of the Emory River is located within the Obed WSR boundary. This extends from the Emory River confluence with the Obed River at mile 28.4 to Nemo Bridge, mile 27.7. Above mile 28.4, the Emory River drains an area of 91 square miles (NPS 1998b).

As described in the Big South Fork NRRA "Surface Water" section, the waters of this park have low ionic strength and must be protected from brine discharge impacts associated with oil and gas activities. Surface waters with limestone are polluted when conductivity exceeds 60 umhos/cm, or 30 umhos/cm in waters lacking limestone (Rikard et al. 1986).

Streamflow—There are two USGS stream gage stations within the Obed WSR. One is on the Obed River (Obed River near Lancing, station no. 03539800) and the other is on the Clear Creek River (Clear Creek at Lilly Bridge, station no. 03539778). There is also a third gage located approximately 7 miles upstream of the park boundary on Daddys Creek (Daddys Creek near Hebbertsburg, station no. 03539600). As of December 2009, there are plans to install a new gage on the Obed River which is expected to be operational in the near future. The new gage will be installed at Adams Bridge, just upstream from the park boundary.

Streamflow measurements from station no. 03539800 on the Obed River (USGS 2009b) indicate that average flow, measured in cfs, ranges from 66 to more than 3,300 cfs. Flows are highest during the months from January through May, with peak flows occurring somewhere during this period (typically during the winter months). Flows during this period average approximately 1,600 cfs. During the June through December period, flows are lower, and average approximately 530 cfs.

Streamflow measurements from the station no. 03539778 on Clear Creek (USGS 2009b) indicate that average flow is from 10 to 2,270 cfs. Flows are highest during the months of January, February, March, and April. During this period, flows average approximately 500 cfs. During the period from May through December, flows are lower and average approximately 140 cfs.

Impoundments—According to NPS (2007a), there are over 3,500 impoundments within the Obed WSR watershed. Although these are mostly no larger than 1 acre in size, they may have a cumulative impact on water quality and/or quantity, and this impact is uncertain.

Intakes—There is one intake in the Obed River watershed that would affect surface water flows in the Obed WSR. It is on the Holiday Hills Lake, which is a reservoir on the Obed River.

Surface Water Quality—On June 22, 1999, portions of the Obed River were designated as Tier III Outstanding Natural Resource Waters (ONRWs) under the CWA, due to their high water quality. This includes portions of the Emory River. It also includes Clear Creek and Daddys Creek, although Daddys Creek is designated as Tier II. There are numerous upstream threats to the Obed River's water quality. Currently, the Cumberland Plateau Regional Water Authority is considering using the Obed River as a source for regional water supply. If it can be found that such a use is necessary, the Obed River would be treated as an "Exceptional Tennessee Water" and designated Tier II. Any permit issued for the river would thereafter be considered under guidance for a Tier II, rather than Tier III, classification.

One water body within the Obed WSR, Clear Creek, was listed in the 303(d) report for the state of Tennessee in 2008, and is described in table 18, below.

TABLE 18. IMPAIRED STREAMS IN THE OBED WILD AND SCENIC RIVER

Impacted Waterbody	County	Miles/Acres Impaired	Cause	Comments
Clear Creek	Morgan	1.41	Oil from Petroleum Activities	Serious oil spill in this section in the Obed WSR. This stream is Category 5, impaired for one or more uses. The stream provides habitat for the listed spotfin chub (*Cyprinella monacha*) and tangerine darter (*Percina aurantiaca*).

Source: TDEC 2008a.

This stream is listed impaired as a result of an oil spill that occurred on July 19, 2002 when an oil well blew out and released an undetermined amount of crude oil into the stream. Oil began to spill around the well and outside of the containment area at an estimated 200–500 barrels per hour, and flowed downhill from the wellhead into White Creek—at approximately 0.21 miles above its confluence with Clear Creek—and into Clear Creek—at approximately 0.37 miles above Barnett Bridge (OWSRNRTC 2008). The well also caught fire, which followed both oiled paths, burning the vegetation, oil-soaked soils, and oil adjacent to the banks in both creeks. After the initial spill, oil continued to seep from the creek bank into Clear Creek through 2007, with higher rates of release during periods of low river flow (OWSRNRTC 2008). As of 2008, this water body was listed as "Category 5, impaired for one or more uses."

All of Clear Creek, Daddys Creek, the Emory River, and some sections of the Obed River within the Obed WSR are designated for the following uses: recreation, fish and aquatic life, livestock and wildlife watering, and irrigation (NPS 1998b). The Obed River from river mile 40.1 (near Crossville) to its origin is also designated for domestic and industrial water supply.