River Values Evaluation

For Red Wild and Scenic River

Figure 1. Photo of the Wild Segment of the Red River (Photo Credit Tim Eling)

November 2020

Contents

List of Tables

List of Figures

Introduction

This report describes the values for which the Red River, located within the Daniel Boone National Forest in Kentucky, was added to the National Wild and Scenic Rivers System. River values include free flow, water quality and outstandingly remarkable values. This report documents the existing conditions for the free flow and water quality river values. In addition, this report will determine and document which scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values within each wild and scenic river segment meet the standard for outstandingly remarkable values. It also documents the evaluation of resource conditions and river values at the time that Congress designated the Red River as a wild and scenic river as compared to its present condition. We also identify indicators for future monitoring of river values because the Wild and Scenic Rivers Act requires the administering agency to "protect and enhance" these river values. Protecting and enhancing the free-flow condition, water quality, and outstandingly remarkable values becomes the basis for managing the Red River's wild and scenic corridor.

Wild and Scenic Rivers Act Requirements

Enacted in 1968, the Wild and Scenic Rivers Act (16 U.S.C. 1271-1278) preserves selected rivers and their immediate environments in free-flowing conditions for the benefit and enjoyment of present and future generations. The Act requires river-administering agencies and other federal agencies to protect and enhance the values for which the river was designated. The following statutory provisions highlight this "protect and enhance" mandate:

> *Section 10(a): Each component of the national wild and scenic rivers system shall be administered in such manner as to protect and enhance the values which caused it to be included in said system without, insofar as is consistent therewith, limiting other uses that do not substantially interfere with public use and enjoyment of these values. In such administration primary emphasis shall be given to protecting its aesthetic, scenic, historic, archeologic, and scientific features. Management plans for any such component may establish varying degrees of intensity for its protection and development, based on the special attributes of the area.*

Rivers designated by the Act may possess outstandingly remarkable values that may include one or more of the following: "scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values" (Section 1(b)).

This assessment uses the criteria developed by the Interagency Wild and Scenic Rivers Coordinating Council (Interagency Wild and Scenic Rivers Coordinating Council 1999 and 2002) and incorporated into agency policy (Forest Service Handbook 1909.12, Chapter 82.14) to evaluate river values and determine the outstandingly remarkable values associated with the river.

To be characterized as outstandingly remarkable, a river-related value must be a unique, rare, or exemplary feature that is significant at a comparative regional or national scale. Dictionary definitions of the words "unique" and "rare" indicate that such a value would be one that is a conspicuous example from among a number of similar values that are themselves uncommon or extraordinary.

While the spectrum of resources and opportunities that may be considered is broad, all values should be directly river-related. That is, they should:

1) Be located in the river or on its immediate shorelands (generally within 1/4 mile on either side of the river);

2) Contribute substantially to the functioning of the river ecosystem; and/or

3) Owe their location or existence to the presence of the river.

Because a feature is rare or unique does not alone make it outstandingly remarkable. It must also be conspicuously dissimilar from the class of feature to which it belongs. That is, just being an example of a type of feature that is remarkable is insufficient; the feature must be an outstandingly remarkable example of the type. For instance, river-based recreation opportunities are rare in the arid southwest. To be outstandingly remarkable, the recreational opportunity must be an unusual exemplar among arid rivers. Every archaeological site is inherently unique and irreplaceable. To be outstandingly remarkable, an archaeological site must be of a quality or extent such that it is among the best examples of a historical resource. The determination that a river area does or does not contain one or more outstandingly remarkable values is a professional judgement on the part of the Responsible Official, as informed by the Interdisciplinary Team, best available scientific information, and public participation (FSH 1909.12, sec. 82.73).

Red River Segments

The Red River was designated in 1993 (P.L. 95-625). The Act established the segments and classification, listed in Table 1 and Figure 2.

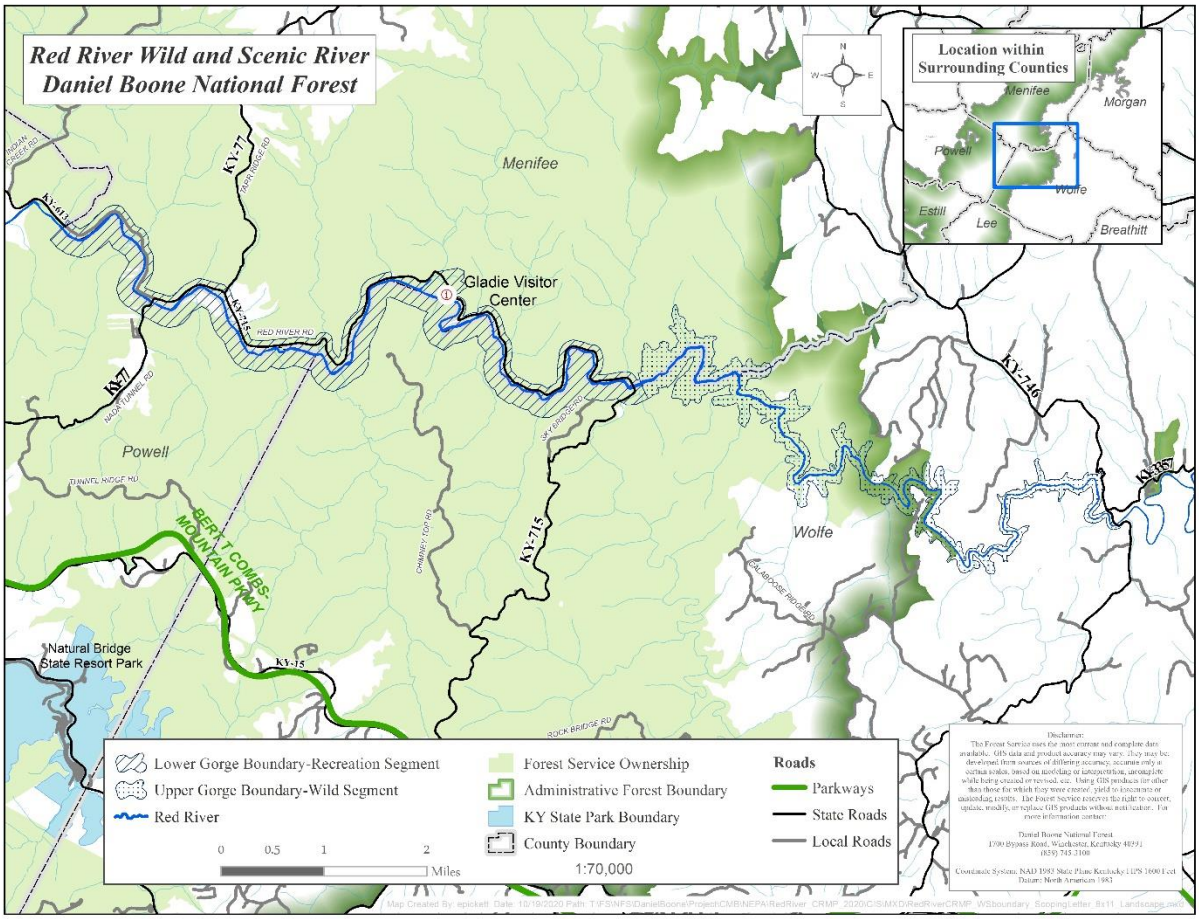

Figure 2: Map of Red River.

Table 1: Description and Classification River Segments.

Designated Segment	Description	Miles	Classification
Upper Gorge	Red River from Highway 746 Bridge to Swift Camp Creek in the Clifty Wilderness.	9.1	Wild River
Lower Gorge	Red River from Swift Camp Creek to the School House Branch.	10.3	Recreational River

The wild classification is applied to "those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watershed or shorelines essentially primitive and water unpolluted." (Wild and Scenic Rivers Act Section 2(b)). The recreational classification is applied to "those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past" (Wild and Scenic Rivers Act Section 2(b)).

River Setting Description

The 9.1-mile Upper Gorge Section includes 683 acres in the Middle Kentucky River Management Area classified as wild river. This segment was also designated by the State of Kentucky as a wild river. It is free of impoundments, meets water quality requirements, and has an essentially primitive shoreline and immediate environs. No habitations or other signs of development can be seen from the stretch of river. It is completely inaccessible except by trail and can only be accessed easily at two sites, except where an undeveloped trail parallels the river for approximately 2.5 miles in the lower reach of the segment (USDA Forest Service 1988). This segment is located in the Clifty Wilderness.

> The Wild segment of the river is in the upper reach of the river and starts at the bridge that crosses the river on State Route 746. The Wild segment terminates 9.1 miles from this point at the mouth of Swift Camp Creek, approximately 600 feet upstream of the State Route 715 Bridge. This is the only segment of the river designated by the Commonwealth of Kentucky (1980) as a State Wild and Scenic River. Approximately five miles of the upper reach of the Wild segment is outside the Daniel Boone National Forest proclamation boundary and the remainder if this segment is within the Clifty Wilderness portion of the Red River Gorge Geological Area. There are no developments within the corridor inside the wilderness area other than some trails. Outside the Wilderness, beyond the proclamation boundary, the steep terrain precludes most development. Most of the rest in this section of the corridor is comprised of mostly forested private land with a few areas of pasture and cropland (USDA Forest Service 2004, p. 3-268).

The 10.3 mile Lower Gorge includes a proposed 1,440 acres in the Middle Kentucky River Management Area classified as recreational. This segment is a recreational river because it is paralleled by Kentucky Highways 715 and 77 and has some development along the shoreline but remains primarily forested with some agricultural land, visible dwellings, and commercial subdivisions. This segment contains three bridges (USDA Forest Service 1988). The Lower Gorge is non-wilderness in the Red River Gorge Geological Area.

> The Recreational segment of the corridor is 10.3 miles long and extends from the mouth of Swift Camp Creek to [the river ford below] Schoolhouse Branch[1]. This segment is entirely within the RRGGA [Red River Gorge Geological Area] and includes some trail segments, two canoe-launch sites, trailheads, pastureland and the Gladie Historic Site. Additionally, there are portions of three public roads and some private land more fully discussed in the following section of this document. The corridor is generally described as a line 300 feet north and parallel to the north edge of State

[1] The proposed terminus was changed to Schoolhouse Branch in the designating legislation.

> Routes 23, 77, and 715, except for the section between Greasy Branch and Bell Branch where the boundary is the south edge of State Route 715. On the southern side, the Recreational segment boundary is a line 800 feet from and parallel to the southern edge of the river (USDA Forest Service 2004, p. 3-268 and 3-269).

Previous Evaluation of River Values

Outstandingly remarkable values for the Red River were identified in a suitability study in the 1988 Environmental Impact Statement and Wild and Scenic River Study Report, Appendix A. They were also included in the Environmental Impact Statement for the 2004 Daniel Boone National Forest Land and Resource Management Plan (Forest Plan) (p. 3-266 through 3-268). “The Red River meets all established criteria for evaluating streams for potential inclusion in the National Wild and Scenic Rivers Systems” (USDA Forest Service 1988). This includes the outstandingly remarkable values of scenic, recreational, and geological value, fish and wildlife, historical and cultural, and botany values. Wildlife was included with fish as an outstandingly remarkable value in the study but not in the Forest Plan. The proposed segments for designation were also found to meet the criteria from the guidelines of free-flowing river, opportunity for meaningful experience, volume of water, and quality of water.

This report serves to validate previously identified river values and update descriptions of baseline and present conditions and outstandingly remarkable values.

Evaluation Process

This report will inform management recommendations in a comprehensive river management plan to protect and enhance river values. The evaluation of river values must take into consideration all features which are directly river-related and helps provide a holistic approach to investigating the relationship of river features. Three components are included in the river values evaluation process: 1) determine the region of comparison; 2) refine the evaluation criteria for each outstandingly remarkable value; and, 3) confirm or determine the outstandingly remarkable values for each segment. Forest Service directives establish a baseline set of criteria as minimum thresholds to establish outstandingly remarkable values (Forest Service Handbook 1909.12 Chapter 82.73a). This report will discuss each of these components in the following sections.

The Daniel Boone National Forest convened an interdisciplinary team in June of 2020 to evaluate river values for the Red River. Members of the team included specialists in the following areas: scenery, recreation, geology, fisheries, wildlife, archaeology, botany, and hydrology. Worksheets were prepared for each river segment for each value to assess existing conditions, changes, values, and potential indicators. The draft worksheets have been kept on file as draft workshop documents, and the findings from the worksheets and workshop discussion have been incorporated into this report.

Region of Comparison

Outstandingly remarkable values must be judged in comparison with the characteristics of other similar regional rivers (Forest Service Handbook 1909.12, Chapter 82.14). To do this, the region of comparison is identified for each resource or grouping of resources that defines the area where rivers with similar characteristics to those being analyzed are found regionally.

Geology, Botany, Scenery, and Wildlife

The area of comparison for geology, botany, scenery, and wildlife is the Cumberland Plateau of Kentucky on which lies most of the Daniel Boone National Forest. At the western edge of the Plateau, a northeast to

southwest line of dense dissection and cliff formation is known as the Pottsville Escarpment. The Red River Gorge is located on this escarpment and has the highest concentration of natural arches east of the Mississippi, making it nationally significant. A number of rivers and large creeks, including the Red River, cross or parallel the escarpment. Rivers that parallel the escarpment tend to lie on lower Pennsylvanian rocks and therefore geological strata exposed tend to be sandstones and shales that weather to soils with lower pH values. Rivers that cross the escarpment cut through both Pennsylvanian and Mississippian rocks exposing sandstones, shales, and limestones that weather to soils with a range of pH values, creating more diverse botanical habitats. The location of Forest ownership relative to the location of the transition from Pennsylvanian to Mississippian strata provides the best array of these strata along large rivers in the Daniel Boone National Forest.

The Red River crosses the escarpment; similar rivers include the Cumberland River, the Kentucky River, and the Middle Fork Rockcastle River. Of them, only the Red River and the Middle Fork Rockcastle River are free flowing. Additionally, most of the land along the Kentucky River around the escarpment is in private ownership. While more than half forested, there are numerous farms and other disturbances along the corridor, especially on the floodplain. Much of the Mississippian portion of the Cumberland River at the escarpment is affected by impounded waters. The Middle Fork Rockcastle River is mostly bordered by private land, Again, it is more than half forested, but numerous farms and other disturbances occur all along the river.

The Red River crosses multiple geologic strata and is free flowing across the escarpment, providing generally good water quality and aquatic habitat in the river and a wide variety of habitats along the river for both plants and animals. Because this stretch of river is mostly in Federal ownership, most of the corridor is forested with generally intact vegetation.

The combination of geographic location, a variety of aquatic and riparian habitats, and vegetation in generally excellent condition (including a number of northern flora elements) provide the best example of this diversity and array on the plateau and along a large river. Other smaller areas occur on the plateau, but this is the best.

Recreation

The unique geological features of the Red River corridor attract recreationists from Kentucky, southwest Ohio, and southeast Indiana, because of its vicinity to the relatively flat land of the Bluegrass, Ohio, and Indiana. The Red River also attracts visitors from across the United States and internationally, with wilderness whitewater paddling opportunities and world class rock climbing.

Fisheries

The assessment of the fisheries outstandingly remarkable value for the designated segments was made at both a national and regional scale. The national assessment compared value(s) in the designated segments and within their HUC 8[2] watershed to other HUC 8 watersheds occurring outside of the southeastern United States. The regional assessment compared value(s) in the designated segments and within their HUC 8 watershed to other HUC 8 watersheds occurring in Kentucky.

[2] The United States is divided and sub-divided into successively smaller hydrologic units. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to twelve digits, with two digit codes (HUC 2) representing the largest units and twelve digits (HUC 12) the smallest units.

History and Archaeology

The river corridor and the surrounding Red River Gorge area has been occupied for over 10,000 years, often by multiple cultural groups and for sacred purposes. Many sites have unique and rare characteristics and have both regional and national importance. The history and archaeology of the gorge is so complex and significant that the gorge has its own National Register District comprised of 336 contributing sites, at least 20 of which are located within the portion of the Wild and Scenic River corridor that has been surveyed.

Summary of the Outstandingly Remarkable Values

The interdisciplinary team determined that scenery, recreation, geology, fisheries, history/archaeology, and botany are outstandingly remarkable values for both the wild and recreational segments of the Red River. Wildlife is not an outstandingly remarkable value. Baseline criteria for each resource, a description of baseline and present conditions, and river value determinations and descriptions are provided below.

Scenery

Baseline Criteria (FSH1909.12)

The landscape elements of landform, vegetation, water, color, and related factors result in notable or exemplary visual features and/or attractions. When analyzing scenic values, additional factors such as seasonal variations in vegetation, scale of cultural modifications, and the length of time negative intrusions are viewed, may be considered. Scenery and visual attractions may be highly diverse over the majority of the river or river segment.

Baseline and Present Situation

Wild Segment

The Upper Gorge wild segment of the river (Table 1) has many unique sections defined by geology, width of the river gorge, exposure to sunlight, presence or absence of vegetation canopy, and confluence of tributaries to the river. The curvilinear nature of the cliff lines and drop-offs allows the river to meander naturally between nearly vertical walls without intrusion from human activities undertaken on the plateaus above. The hillsides appear to rise almost from the riverbank itself, so there are very few visible signs of human activity, other than user created routes and evidence of river travel.

The natural meander of the river allows views to be shielded and revealed as a river explorer comes around the bend, increasing the sense of wonder, mystery and anticipation for each newly revealed vista. The first few river miles downstream from the Highway 746 bridge have shady tree canopy cover with occasional openings as the gorge banks withdraw from the water’s edge. This stretch of the river has a moderate gradient and clear, fast-flowing water through areas of large boulders. At higher flows, rapids create turbulent whitewater.. The water appears clean and free flowing; large boulders and downed wood are present in the river channel.

A few miles into the downstream flow, vegetation density decreases and more of the river is exposed to sunlight. This reduced vegetative density allows more of the vertical hillsides and cliffs to be visible along the river. Vegetation density opens and closes as the river meanders downstream.

Approximately ½ mile upstream from Clear Creek Branch and just upstream from Twin Branch, the vegetation and canopy density changes. Cliff lines become visible; boulders in the river are numerous; a complex of rapids exist; and the vertical cliff walls are visible along the reach, predominantly on the east side. This reach still displays geologic features such as cliff overhangs, large boulders, whitewater, natural free flow, and solitude. The plateau above is developed as farms with interspersed open fields, yet they are invisible from the river itself.

The length of river from Twin Branch to approximately ¼ mile upstream from Copperas Canoe Launch on Highway 715 is characterized by a wider gorge with steep, heavily vegetated gorge walls that rise almost vertically from the river. A large rock outcropping lies in the river at the confluence with Big Calaboose Creek. Rock outcroppings in the river continue downstream to near the confluence with Swift Camp Creek. On this reach, the boulders extend from the riverbanks into the river or jut out of the river vertically, creating obstacles and rapids. The cliff outcrops are visible at the edges of the plateaus from the river, partially shielded by vegetation.

Seasonal changes are evident on the river. In autumn, the leaves of deciduous trees range in colors from gold to red. In winter months, the trees are naked, but the sprinkling of snow creates a dramatic and idyllic image. The water in the river is lower in fall and winter, making the rocks and boulders more prominent. However, rains in winter and spring provide sufficient water to the river to create whitewater at class III level. Spring brings leaf green up and wildflowers, while summer brings a rich, dense tree canopy and clear moving river water.

The scenic integrity of these features is very high due to difficulty accessing the reach, except within approximately one mile upstream of the Swift Camp Creek confluence. The Douglas Trail (unauthorized trail) and numerous campsites line the bank of the river and the disturbance detracts from the scenic integrity, untrammeled wilderness setting.

Recreational Segment

The Lower Gorge recreational segment of the river (Table 1) differs dramatically from the wild segment. The water flows as flatwater with the occasional sand bar, downed trees, or rock outcrops. The river meanders less through the landscape but gently curves and flows as it leaves the steepness of the upper gorge heading toward the valley outside the gorge boundaries. The river channel is wide with steep topography on each side, yet sufficiently wide and flat enough to allow a two-lane highway to parallel the river. This segment has numerous parking lots, trailheads, and evidence of human activity. The water is free flowing but typically muddy.

Cliff walls and dense, lush, riverine vegetation are visible from the river. The vegetation differs in the deeper gorge from that above and in more open areas. The trees are bigger and lusher, with more undergrowth. Fall colors are just as dramatic in this segment as the wild, with more opportunity to view and experience them up close.

Changes Since Designation

A suspension bridge, built by the Forest Service circa early 1990s, extends across the river for the Sheltowee Trace National Recreation Trail. A parking lot and connector trails were also constructed to access the National Recreation Trail. Nearby is Jump Rock, a popular day use destination for swimming. Jump Rock and the suspension bridge are popular destinations for visitors. Well designed and constructed cultural modifications are positive elements that complement the natural appearing landscape.

Effects of increased visitation, such as trash, loss of vegetation, introduction of invasive species, and erosion, diminish the river corridor's scenic integrity. The spatial arrangement and aesthetics of human created constructs also modify the river corridor's natural appearance. Addressing impacts of visitation and carefully planning future cultural modifications would restore scenic integrity in the areas where it has been adversely affected.

Finding/ Outstandingly Remarkable Value Description

Scenery along the Red River corridor, within the Red River Gorge, is exemplary within the region of comparison. The following attributes meld together to create attractive and distinctive scenery:

- The concentration of unique geologic features
- The rich composition of plant communities
- The distinct water characteristics

The gorge instills a sense of enclosure within a rich, intact natural area. Natural sounds are pleasing to the ear. Birdsong and insect noises constantly change throughout the day and night. Night skies are dark with little light pollution. Vegetation has mostly recovered from human modifications and appears intact with little fragmentation except in areas of very high public use.

Erratic erosion along the Pottsville Escarpment has created a high diversity of distinct geologic features such as alcoves, rock houses, natural arches, spires, palisades, pillars, boulders, precipitous cliffs, and promontories (USDA1984, p. A-5). This in turn has created diverse soil types, moisture conditions, plant communities, spatial dimensions (Braun 1950, p.97), and sun and shade contrasts (Berry 1991, p. 75). Soils on ridges and along the river are derived from sandstone, making them sandy and well drained. Soils on the side slopes and in the more sheltered landscape positions are deep well-drained silt loams derived from shale and sandstone. Shale deposits add to the patterns of terrain weathering. Bold bands of exposed sandstone are prominent focal points in the upper elevations of the cliffs (Braun 2001, p. 97). Huge boulders have cleaved off from the canyon walls and become popular destination points along the river.

Along the river and its tributaries, floodplains harbor rich bottomland forest. Pockets of limestone outcrops add to a diverse mosaic of riparian vegetation. Picturesque plant assemblages adorn the tops of large boulders in the river that rise above the scour of the flood stage (Berry 1991, p. 58). Slope forest grows beneath sandstone cliffs that tower 500 to 600 feet above the river valley (Braun 2001, p. 100). On the surface of the flat-topped plateau, dry pine and oak forest contrast with moister forest within the gorge. Coniferous trees complement deciduous forest with year-around green. Pine trees cap the rims of the winding cliff lines (Braun 2001, p. 100). Coves and recesses along the escarpment shelter dark pockets of hemlocks. Evergreen, glossy leaves of rhododendron, and kalmia grow in the shrub layer, sometimes limiting views.

Seasonal changes create a suite of distinct settings. In spring, deciduous forest emerges with bright green leaves and carpets of ephemeral wildflowers beneath. Summer brings humidity and a lush, full-bodied, contiguous tree canopy. Rock features and meadows of asters, goldenrods and grasses add variety to the matrix of green. Leaves, such as those of bigleaf magnolia, filter sunlight for a soft lighting inside deciduous forest. Fall colors are picturesque with oranges, bronzes, yellows, greens and reds. In winter, leafless trees reveal a tangle of interesting woody branching structures and allow for more sun exposure.

Within the Red River Gorge, water takes on numerous forms and characteristics. Where tributaries have eaten away at the plateau escarpment, spectacular spindly waterfalls drop long distances into crystalline plunge pools. The main stem of the Red River's flow is robust and fluctuates between flood stage and base flow. In times of flood, the river is swollen, turbid, noisy, and palpable (Berry 1991, p. 7). Low flow is sluggish, revealing boulders and beaches - shallows become clear, and deeper pools murky green.

The attributes of the scenery outstandingly remarkable value occur throughout the wild and recreation sections. However, the scenic character differs between the two sections. In the wild section, the river's floodplain is more constrained. The river and its tributaries are actively incising a cleft in the upland plateau. This has created a variety of spatial dimensions between the canyon walls (Berry 1991, p. 54). Reaches of the wild section contain jumbled piles of large sandstone boulders. Wendell Berry describes one particular reach as the Roughs of the Red where impressive boulders impede overland travel and make river navigation treacherous (Berry 1991, p. 56). The wild section's river gradient is high and displays whitewater in rapids and translucent water in straight runs. Overall, the wild section has less suspended sediment than the muddier recreation section. It is also shallower with more riffles and rapids. Named geologic features visible in this section are Red Byrd Arch, Eagle Peak, and Moonshiners Arch.

The dimensions of the recreation section open within a broader floodplain with deeper views towards the enclosing cliffs. The river's banks are steeper and muddier. Here, the river has incised deeper into its floodplain. Foliage of bankside plants shade the river. In the recreation section, erosive forces appear to have had more time to shape the landscape, and the plant communities' have had more time to develop. Prominent landmarks are visible, such as Sky Bridge Arch, Hens Nest Rock, Jewell Rock, Raven Rock, Auxier Ridge, Chimney Top Rock, Courthouse Rock, Tower Rock, Cloud Splitter, and Jump Rock. As the river takes a sinuous path through the valley, spaces between river and cliffs contract and expand. Views vary in duration as terrain hides, reveals, and frames scenes. The gradient of the river in the recreation section is low. The flow is deeper and slower with more flow volume than the wild section.

Recreation

Baseline Criteria (FSH1909.12)

Recreational opportunities are, or have the potential to be, popular enough to attract visitors from throughout or beyond the region of comparison or are unique or rare within the region. River-related opportunities include, but are not limited to, sightseeing, interpretation, wildlife observation, camping, photography, hiking, fishing, hunting, and boating. The river may provide settings for national or regional usage or competitive events.

Baseline and Present Situation

Wild Segment

The 9.1-mile wild segment of the Red River sees a variety of uses year-round, though most of this use is concentrated between the months of March and November. Hiking, sightseeing, photography, camping, kayaking, canoeing, rock climbing, and rappelling are the most popular recreation uses within the wild section, drawing visitors from Kentucky and surrounding states such as Ohio and Indiana. Fishing and hunting (deer, wild turkey, and waterfowl) also occur within the river corridor; however, visitors who partake in these recreation uses are typically locals. Hiking is the most popular recreation use and occurs year-round. Most hiking within the wild section of the river corridor is along the user-developed "Douglas Trail" to access attractions such as Moonshiner's Arch, Red Byrd Arch, Sampson's Cave, and a scenic viewpoint and waterfall named Eagle Point. Visitors also use the Douglas Trail to access clifflines that are

popular rock climbing and rappelling areas such as Moonshiner's Wall, Woody's Wall, Doorish Wall, and Wall of Denial. The sandstone cliffs of the Red River Gorge attract rock climbers from around the world. In total, approximately 80 climbing routes exist within the river corridor of the wild segment. Numerous user-created campsites are located along the river, with most camping occurring from April through November. Kayak and canoe use typically occurs in late winter through early spring, coinciding with optimal river flow. Through summer and fall, the river level is often too low to support boating opportunities. The wild section of the Red River is often considered one of the most challenging stretches of whitewater in the southeast. It consists of a technical river run through class III rapids and inaccessible wilderness with limited portages. Because of this, it is only recommended for experienced paddlers, resulting in low to moderate use. Access to the wild section is provided by Big Branch launch as well as from the Osborne Bend Trailhead.

Recreational Segment

The 10.3-mile recreational section of the Red River sees similar seasonal use and recreation use type patterns as the wild section, drawing visitors from across Kentucky, the United States, and internationally. Swimming occurs more often in the recreational section. Of these uses, hiking is the most prevalent, and occurs year-round. Most hiking within the recreational section of the river corridor occurs along the Sheltowee Trace National Recreation Trail to access a suspension bridge, user-created campsites, and swimming areas. The most popular swimming area in the recreational section is known as "Jump Rock", a very large sandstone boulder adjacent to a deep pool in the river. Visitation to "Jump Rock" has increased immensely over the last 10 years. This increase has led to overcrowding, erosion, litter, human waste, and denuding of upland and riparian vegetation. Additional less popular swimming holes can be found along the entire recreational section of the river. Primitive camping near these swimming areas is also popular. Many user-created campsites near the Red River are illegal, as they are within 300 feet of a road or system trail. Additional primitive campsites are located near the Red River along Forest Road 23. These sites are legal, as this location falls outside of the Geological Area where the 300-foot rule does not apply.

The recreational section of the river experiences moderate to heavy kayak and canoe use from March through August. Use level is often dictated by river level and flow, which fluctuates and is often too low for paddling in mid to late summer. The recreational section is primarily flat water with small riffles and some class I rapids, making it a popular option for beginning paddlers. Most boaters access the river at Copperas Creek Canoe Launch using either privately owned watercraft or through the local outfitter/guide Red River Adventure. Visitors who rent from or are shuttled by Red River Adventure may take out on their property, a private inholding approximately seven miles downriver. An additional public launch is needed to meet recreation demand near the confluence of Gladie Creek, Schoolhouse Branch, or both.

Sightseeing is also among the most popular activities within the recreational section of the river. As paddlers float from Copperas Creek to Schoolhouse Branch, they are awarded views of towering cliff lines and arches such as Sky Bridge, Tower Rock, Jewel Pinnacle, Chimney Top Rock, Revenuer's Rock, Raven Rock, and Auxier Ridge. Most of these locations fall within the river corridor. They can also be accessed via hiking trails, where the river adds to the scenic backdrop from atop these overlooks. Finally, seven rock climbing areas with approximately 100 routes are located within the recreational section of the river corridor, of which 13 have been established since designation. Tower Rock and Jewel Pinnacle have the highest concentration of use. Access to Jewel Pinnacle and other climbing areas are by user-created trails, some requiring fording the river.

Changes Since Designation

Conditions of recreation values have primarily remained the same since designation. No development has occurred within the wild section of the river nor is a permit for water-based recreation required, preserving outstanding opportunities for recreation. Twenty-eight new rock-climbing routes have been established since designation, 15 within the wild segment and 13 within the recreational. Along the recreational segment, some development has occurred including the private inholding operated by outfitter Red River Adventure, the construction on the Gladie Visitor Center and development of the Stanton Sheltowee Trace parking area trailhead. All developments have had a positive change on recreation conditions by increasing river access and river information and education. In 2004, a launch near the Sheltowee Connector Trailhead was washed away in a flood. A launch may have also existed at Schoolhouse Branch but is no longer usable. Recreation use has increased in both wild and recreational segments, especially at "Jump Rock". Increased recreation has also caused impacts to natural resources in the form of user created campsites and trails, campfire and wildfire scars, litter, graffiti, tree cutting, etc.

Finding/Outstandingly Remarkable Value Description

Recreation is an outstandingly remarkable value along the wild and recreational segments of the Red River. The Red River attracts visitors from across Kentucky, the United States, and internationally to partake in canoeing, kayaking, hiking, sightseeing, photography, camping, rock climbing, and rappelling. Recreation use occurs year-round, although type and intensity vary per season, with the highest use occurring from March through November.

Two launches, Big Branch and Copperas Creek, and the Osborne Bend Trailhead access the wild segment of the river. Rugged shorelines, large boulders, and inaccessible Wilderness provide canoeists and kayakers with one of the most challenging stretches of whitewater in the southeast. This technical river run varies from class III during winter and spring run-offs to class I during the low water flows of summer. Visitors also access user developed trails, camping areas, arches, caves, waterfalls, and scenic overlooks along the river corridor. The towering sandstone cliff lines that buttress the wild segment of the Red River are known as some of the world's premier rock-climbing areas, attracting rock climbers from across the globe.

The recreational section of the river sees moderate to heavy canoe and kayak use during spring and early summer. Use level is often dictated by river level and flow, as this fluctuates and is often inadequate for paddling mid-summer through fall. The recreational segment is primarily flat water with small riffles and some class I rapids, making it a popular option for beginning paddlers. Canoeists and kayakers access the river at Copperas Creek Canoe Launch using personal watercraft or an outfitter/guide. Hiking, sightseeing, and camping opportunities are abundant within the recreational segment. Multiple trails within the corridor, including the Sheltowee Trace National Recreation Trail, access the river, campsites, arches, and geological features where the river adds to the scenic backdrop from ridgetop overlooks. During the hot summer months, the river serves as a cooling spot as many visitors congregate to swim, especially at a deep pool adjacent to a large sandstone bolder named "Jump Rock". The soaring sandstone cliffs formed by the slow and steady carving of the Red River offer outstanding rock-climbing opportunities. Similar to the wild segment, miles of cliff line within the recreational corridor attract rock climbers from around the word with premier rock-climbing opportunities.

Geology

Baseline Criteria (FSH1909.12)

The river, or the area within the river corridor, contains one or more examples of a geologic feature, process, or phenomenon that is unique or rare within the region of comparison. The feature(s) may be in an unusually active stage of development, represent a “textbook” example, and/or represent a unique or rare combination of geologic features (erosional, volcanic, glacial, or other geologic structures).

Baseline and Present Situation

The Red River Gorge Geological Area is the result of deposition, uplift, downcutting, and differential weathering occurring in the same place over millennia. The Red River Gorge Geological Area began around 370 million years ago when Kentucky was covered by a shallow tropical sea atop sedimentary deposits of mud, sand, silt, and marine life. The sediments came from the ancient Appalachians located to the east of Kentucky. As the tectonic plates of North America and Africa shifted and got closer, the area of the Red River Gorge Geological Area began to rise in elevation until the plates collided around 280 million years ago. It was at this point that the Red River started creating the Red River Gorge Geological Area by cutting down into the uplifted geologic strata, causing them to be exposed like a cut layer cake. Some geologic strata lower in the profile had higher erosion potential and weathered out before the more resistant strata higher up. It was this differential weathering that was responsible for the unique geological formations found throughout the Red River Gorge Geological Area.

The Red River Gorge Geological Area sits on the Pottsville Escarpment of the Cumberland Plateau, a region of mature dissection that forms deep and usually cliff bound valleys. The escarpment in Kentucky is located along a southwest to northeast line between the Tennessee and Ohio borders. Stratigraphically, the geology of the escarpment is dominated by Pennsylvanian strata. Pennsylvanian strata include the resistant, cliff-forming Lee Formation conglomerates (Rockcastle member) and sandstones (Corbin member) as well as softer shales, sandstones, siltstones, and in places coal, of the Lower Breathitt Formation. Less prominent in general are Mississippian strata including cliff-forming Slade limestone and softer shales, siltstones, and thin bands of resistant sandstones. The latter strata are part of the Borden Formation.

The Lee Formation dominates the Red River Gorge Geological Area and the Red River corridor. The resistant nature of the Lee Formation allows for the creation of numerous erosional features including pinnacles, cliffs, rockhouses, arches, waterfalls, and tafoni, creating the stunning views on display in the area. Differential erosion accentuates liesegang banding in many areas. Cliffs are the main feature in the wild segment of the river corridor. Limited arches, pinnacles, rockhouses, waterfalls, tafoni, and liesegang banding are also present. In the lower 1.6 miles of this section, Mississippian strata, largely shales and siltstones, are exposed along the riverbed (Weir and Richards 1974). Along the recreational segment, cliffs remain the dominant landscape feature. Pinnacles, rockhouses, arches, waterfalls, tafoni, and Liesegang banding become more prevalent as well. The riverbed is on Mississippian strata, mostly shales, for the entire length of the recreational segment (Weir 1974). Slade limestone is exposed in places along the lower portion of the segment, although it does not form cliffs until the last three to four river miles.

All features offer opportunities for educational outreach. All are formed by differential weathering, but not all are formed in the same way. In particular, arches are of interest to the public, and forest personnel receive numerous questions about how they form. Rockhouses attract hiking visitors and many are regularly frequented. Tafoni and Liesegang banding are frequently photographed, and visitors ask what

they are and how they got there. The river corridor and surrounding area is frequently visited by universities and colleges as well as other groups to view and discuss the geologic formations.

Changes Since Designation

The primary change since designation is the level of visitation. The Red River Gorge, including the river corridor, has been a popular destination point for hiking, backcountry camping, and rock climbing for decades. Visitors have increased rock erosion on trails, in rockhouses, and on cliff faces. Additionally, atmospheric pollution and acid rain deposition have softened the face of many rock surfaces, increasing the rate of erosion. Some formations are more friable than others and are at greater risk of weathering.

Finding/Outstandingly Remarkable Value Description

There is an outstandingly remarkable value for geology in the wild and recreational segments of the Red River corridor. The wild segment is remarkable for large boulders along the shore and in the river that have created class III rapids. Within the recreational section, the geologic features reach their greatest density and development, and large boulders add scenic value for river users.

Much of the wild and scenic river corridor is located within the Red River Gorge Geological Area. The area contains unique and rugged topography full of natural arches, pinnacles, and prominent cliffs among other geologic formations. Most ridges harbor clifflines with rock shelters at their base. Perhaps the most striking feature is the sandstone arches carved out by years of wind and water erosion. The most popular arch is Sky Bridge, a graceful arch over 70 feet long and 23 feet tall. Another is Princess arch, over 30 feet long and eight feet tall. With over 100 known arches, the Red River Gorge Geological Area contains the largest concentration of arches east of the Rocky Mountains.

Fisheries

Baseline Criteria (FSH1909.12)

Fish values may be judged on the relative merits of either fish populations or habitat, or a combination of these river-related conditions.

- ***Populations***. The river is nationally or regionally an important producer of resident and/or anadromous fish species. Diversity of fish species or the presence of wild stocks and/or Federal or State listed or candidate threatened, endangered, or species of conservation concern are of particular significance.
- ***Habitat***. The river provides uniquely diverse or high quality habitat for fish species indigenous to the region of comparison. Exemplary habitat for wild stocks and/or Federal or State listed or candidate threatened, endangered, or species of conservation concern is of particular significance.

Baseline and Present Situation

The fish community of the wild segment of the river reflects a stream with a great diversity of native species, particularly in the lower-most section. That section has a high number of native species including darters and insectivores. The area of analysis within the Red River Gorge is occupied by two federally listed Threatened or Endangered species (USFWS 2016, 2019). The river's remoteness has made surveys a challenge, resulting in limited sampling. Two previously published fish surveys (Branson and Batch 1974; and Thomas 2000) reported a total of 22 species. Unpublished collections by several fish biologists have been made at the Highway 715 bridge from 1982-2018. These collections reported observations of 40 fish species.

The most recent survey completed by David Eisenhour in 2019 detected a substantially higher species richness and higher quality of fish community, as indicated by Kentucky Index of Biotic Integrity (KIBI) values, compared to previous surveys. Increases may be due to (1) a thorough effort to sample all microhabitats, using diverse gear (seining and shocking), and (2) excellent collection conditions (low, clear water).

There may be as many as 15 sensitive species or species of concern on the USFS Region 8 sensitive species list within this analysis area. One of these, the northern brook lamprey (*Ichthyomyzon fossor*) was encountered during the 2019 study. This species is listed as threatened by the state of Kentucky (Kentucky Department of Fish and Wildlife Resources 2020). Two specimens (both larva stage) were captured in the lower end of the study reach. This species is uncommon to fairly common in the Red River downstream of the study area.

The Cumberland Plateau darter, also known as the Kentucky arrow darter (*Ethostoma spilotum*) listed as threatened by the United States Fish and Wildlife Service (USFWS 2016), is known from a tributary (Rock Bridge Fork) of Swift Camp Creek, which feeds into the Red River at the lower end of the wild segment (Thomas 2000). The Kentucky arrow darter is primarily associated with headwater streams (Burr and Warren 1986, USFWS 2016) and is highly unlikely to occur in the mainstem of the Red River.

The snuffbox mussel (*Epioblasma triquetra)* is an Endangered freshwater mussel found within Swift Camp Creek (USFWS, 2019). The snuffbox is indigenous to midwestern streams and lakes; however, it is now found in only 79 of these water bodies. Primary threats to these mussels have been attributed to pollution, sedimentation associated with poor land management and the introduction of non-native species.

Changes Since Designation

Fish communities at eight sites in the wild section of the Red River were surveyed in late summer and early fall of 2019 by Eisenhour. Sampling detected 41 fish species, including five species not detected in previously published surveys. A high KIBI score, high number of species, and high numbers of combined darter, madtom, and sculpin species reflect a high-quality, nearly undisturbed fish community, especially at the lower end of the wild segment reach. Seven of the eight sites scored as “excellent” by the KIBI. Comparison with previous surveys (late 1960s, late 1990s) indicate a stable, or possibly improved fish communities. One state threatened species, the northern brook lamprey, was encountered in the lower end of the wild segment. A number of species reported from the lower end of the wild section were not detected above the rapids that occupy the middle of the wild section, possibly indicating (1) differences in habitat above and below the rapids, and (2) the rapids acting as a partial barrier to upstream movement of fishes, or 3) seasonal variability in habitat access/utilization.

It is not certain if habitat conditions or species numbers have changed within the recreation section of the river. Results from the 2019 surveys seem to indicate conditions have not changed and fish populations are increasing.

Finding/Outstandingly Remarkable Value Description

The Red River designated segments collectively possess an outstandingly remarkable value based on the river’s ability to support high native aquatic biodiversity and provide habitat for recreational fisheries and at-risk aquatic species. A total of 70 native fish species and 16 mussel species have been detected or are believed to occur in the river segments. In general, fish species biodiversity in the river segments is at or above the average species diversity values reported for entire HUC 8 watersheds within the southeastern United States (Elkins et al. 2016). Extensive research has demonstrated that the southeast has the highest

biodiversity of freshwater fishes and levels of rarity or imperilment within North America (Sheldon 1988; Warren and Burr 1994; Warren et al. 2000; Jelks et al. 2008). Therefore, the designated river segments have outstandingly remarkable value relative to their fish biodiversity on at least the national scale.

Habitat in the wild segment is considered to be good or great based on high Kentucky Index of Biotic Integrity (KIBI) scores coupled with high biodiversity. In general, habitat in the wild segment consists of cooler water, higher gradients, and coarser substrates compared to the recreation segment. These differences in habitat along the designated river segments contributes to habitat diversity which likely supports high biodiversity. The designated river segments provide habitat for at least three aquatic species of management concern, which include the northern brook lamprey, eastern sand darter (*Ammocrypta pellucida*), and elktoe mussel (*Alasmidonta marginata*). Both the northern brook lamprey and elktoe mussel are listed as threatened by the state of Kentucky. Although not a listed species, the eastern sand darter has almost vanished in much of Kentucky because of stream channelization, dam construction, and siltation (Grandmaison et al. 2004). This species requires clean sand in moderate to large rivers (Daniels 1993; O'Brien and Facey 2008). While the species can no longer be found in many of its former habitats, it is still present in the Red River. The river segments also provide habitat that supports wild fish stocks used in recreational fisheries. These wild fish stocks include rock bass (*Ambloplites rupestris*), sunfish (*Lepomis* sp.), catfish, smallmouth bass (*Micropterus dolomieu*), and muskellunge (*Esox masquinongy*). The river is one of the few free-flowing muskellunge streams in Kentucky. Most of the muskellunge fishery occurs in the recreational segment given the presence of suitable habitat. Therefore, the Red River designated segments have outstandingly remarkable value relative to their habitat on the regional scale.

Wildlife

Baseline Criteria (FSH1909.12)

Wildlife values may be judged on the relative merits of either terrestrial or aquatic wildlife populations or habitat, or a combination of these conditions.

- ***Habitat.*** The river, or area within the river corridor, provides uniquely diverse or high quality habitat for wildlife of national or regional significance, and/or may provide unique habitat or a critical link in habitat conditions for Federal or State listed or candidate threatened, endangered species, or species of conservation concern. Contiguous habitat conditions are such that the biological needs of the species are met.

- ***Populations.*** The river, or area within the river corridor, contains nationally or regionally important populations of indigenous wildlife species. Of particular importance are species diversity, species considered to be unique, and/or populations of Federal or State listed or candidate threatened or endangered species, or species of conservation concern.

Baseline and Present Situation

The Red River Wild and Scenic River corridor includes Appalachian mesophytic forest as well as hemlock mixed forest. This is a similar habitat type to much of the surrounding area and is found throughout the Red River Gorge, particularly in other riparian areas. The corridor is capable of supporting a number of species, including proposed, endangered, threatened and Regional Forester sensitive species. Although these species are probably no more likely to occur within the river corridor than within the adjacent wilderness or areas throughout the Western Allegheny Plateau ecoregion within the state of Kentucky.

Species surveys have not been conducted extensively throughout the area. Historical survey records in the corridor range from 1951 through 2012. These records indicate known occurrences and locations for 30 species.

Finding/Outstandingly Remarkable Value Description

Although some of these species are federally-listed (such as the Indiana and northern long-eared bats) and others are sensitive species or conservation species (such as Rafinesque's bats and green salamanders or Swainson's warbler and four-toed salamanders, respectively), similar habitat is present throughout the Western Allegheny Plateau ecoregion within the state of Kentucky in which these species are just as likely to occur. Although suitable habitat is present for several terrestrial wildlife proposed, endangered, threatened and Regional Forester sensitive species found in the Red River Wild and Scenic River corridor, these species do not contribute substantially to the function of the Red River, nor do they owe their location or existence to the presence of the river. These species can be found in similar river corridors across the landscape. As a result, wildlife does not constitute an outstandingly remarkable value of the Red Wild and Scenic River.

History and Archaeology

Baseline Criteria (adapted from FSH1909.12)

The river, or area within the river corridor, contains important evidence of occupation or use by humans. Sites may have national or regional importance for interpreting history or archaeology.

- ***History.*** Site(s) or feature(s) associated with a significant event, an important person, or a cultural activity of the past that was rare or one-of-a-kind in the region. A historic site or feature, in most cases, is 50 years old or older. Historic resources generally consist of standing architecture, landscape features, or significant places related to the past.

- ***Archaeology***. Sites may have unique or rare characteristics or exemplary human interest value; represent an area where a culture or cultural period was first identified and described; may have been used concurrently by two or more cultural groups, or may have been used for rare sacred purposes. Archaeological resources generally consist of material remains of past activities either buried below the surface or located directly on the surface. They can include remnants of architectural and landscape features, but generally do not include standing or intact examples.

Baseline and Present Situation

Archaeological and historical evidence for human occupation and use of the Red River Gorge dates from over 10,000 years ago for archaeological sites to over 50 years ago for historical sites (Cowan 1975, 1985; Cowan and Wilson 1977; Faulkner et al. 2014; Ison et al. 2008; Pollack 2008; Turnbow 1976; Wyss and Wyss 1977). Evidence for this historic use comes in the form of archaeological remains (buried below ground), architectural remains (primarily above ground), and archival and documentary sources. Every archaeological and historic period is represented in the Red River Gorge. The archaeological periods include Paleo-Indian, Archaic, Woodland, and Fort Ancient, and the historic periods include Native American/Pre-Colonial Exploration, Colonial, Antebellum, Civil War, Postbellum/Industrialization, and Industrial (Faulkner et al. 2014; Ison et al. 2008; Pollack 2008).

Only approximately 17.8 percent of the area within the Wild and Scenic River boundary has been surveyed for cultural resources. A total of 33 archaeological sites have been recorded in the area surveyed. Of these, 20 are contributing elements to the Red River Gorge National Register District, nine are not

eligible, and four are indeterminate eligibility with the data currently available. The 33 sites located in the proposed river boundary contain 37 individual components (episodes of human use) including: one indeterminate Archaic, one Middle Archaic, two Late Archaic, one Early Woodland, six Middle Woodland, one Late Woodland/Mississippian, 12 European/Euro-American, and 24 Native American lithic scatters of indeterminate temporal affiliation. Seven site types were identified including 18 rockshelters, nine open habitations without mounds, two historic farmsteads/residences, one cave, one European/Euro-American industrial, Euro-American architectural transportation feature, and a Middle Woodland isolated find.

The density of sites in the area surveyed is 7.5 sites per 100 acres surveyed. For comparison, the Red River Gorge Geological Area (18.7 percent surveyed, 458 sites) has a density of 5.6 sites per acre, and the Cumberland District (27.6 percent surveyed, 1784 sites) has a density of 3.5 sites per acre. Based on this data, the density of sites within the Wild and Scenic River boundary is 34 percent greater than the Red River Gorge Geological Area and 114 percent greater than the Cumberland District. This strongly suggests that the river itself had a strong and unique influence on the location of past settlement and land use.

Although government-backed British and (later) American colonists forcibly removed Native Americans from the central Ohio Valley during the late 1700s (Warren 2014; Sleeper-Smith 2018), this did not completely sever the historic ties of these communities to the area. Today, the six federally recognized Cherokee and Shawnee Tribes consider the Red River Gorge to be part of their homeland or place of ancestral origin. They recognize the Red River Gorge contains cemeteries; former town, village and habitation sites; and culturally significant spaces (e.g., caves, rock shelters), features (petroglyphs, bedrock mortars), and artifacts. These six federally recognized Native American Tribes are consulting parties on all federal undertakings that have the potential to effect cultural resources. As managers of these cultural resources, the Cumberland Ranger District heritage program has two sets of responsibilities related to Native American archaeological and cultural resources. The first is to protect these sites because they are federal property. The second is to manage these sites knowing they also contain cemeteries and other remains that are symbolically significant to Native American descendant communities. In addition, because only the last two centuries of Native American history are recorded in writing, archaeological remains are the primary source of information that can be used to reconstruct past lifeways, events, and uses of the land. Every archaeological site has the potential to reconstruct a portion of unwritten Native American history. Since history is one of the central components of cultural identity, the protection and study of Native American archaeological sites plays a role in shaping the identities of descendant communities.

Changes Since Designation

The Daniel Boone National Forest visits a sample of archaeological sites every year to assess changes in the condition of this resource. Of the 33 archaeological sites recorded within the Wild and Scenic River boundary, long-term (2000-2020) condition assessment records are available from 15. Assessment forms record the presence/absence of new disturbance, and also estimate the proportion of the site disturbed on a five level scale (Level 0=0 percent, Level 1=1-25 percent, Level 2=26-50 percent, Level 3=51-75 percent, Level 4=76-100 percent). Of these 15 sites, 13 (85 percent) were undisturbed when they were first recorded, and eight (53 percent) exhibited disturbance Level 2 or greater. Since the year 2000, new disturbance has been recorded at eight (53 percent) of these sites, with six (40 percent) exhibiting disturbance Level 2 or greater. Although sites with disturbance Level 2 or greater decreased from 53 to 40 percent between 2000 and 2020, 13 sites (85 percent) exhibited at least some disturbance. So overall, the proportion of sites subjected to disturbance is the same as it was twenty years ago, the proportion of sites

with Level 2 or greater disturbance has decreased slightly. These data should be considered impressionistic since the sample of sites with monitoring data is not statistically significant.

Finding/Outstandingly Remarkable Value Description

Cultural resources in the Red Wild and Scenic River boundary meet the evaluation criteria for an outstandingly remarkable value along both the wild and recreational segments. As described above, many sites have unique and rare characteristics, with both regional and national importance. The Wild and Scenic River area and the surrounding Red River Gorge area has been occupied for over 10,000 years, often by multiple cultural groups and for sacred purposes. At least 20 sites within the corridor are contributing elements to the National Register of Historic Places, and the corridor is only 17.8 percent surveyed.

The uniqueness of the Red River Gorge Geological Area and its river corridor is not only a draw for present day recreation, but it has also drawn the interest of Native Americans for over 10,000 years, and Euro-Americans for the last 200 years (see references above). The dry microclimate of the rock shelters has preserved, to this day, woven fiber slippers, fiber bags filled with cultivated and foraged products, and wooden tools, as well as the remains of cultivated and uncultivated plants. Preservation of these artifacts has produced an important and unique insight into the culture of ancient Native Americans. Wyss and Wyss (1977) state, “The prehistoric archaeological sites of the Red River Gorge area are well known for excellent preservation of normally perishable ethno-botanic remains, the bulk of which have been recovered from sites of the Woodland Tradition. The remains of about 50 species are present in these collections.”

Further, the numerous petroglyphs in the Red River Gorge Geological Area are an important addition to the artifacts mentioned above. The Red River Gorge Geological Area reportedly has the highest concentrations of petroglyphs east of the Rocky Mountains (Coy et al. 1997; Ison 2004).

In addition to unique archaeological features, the Gorge (including the area within Wild and Scenic River boundary) also contains significant historic resources. These include standing structures, architectural and landscape features. The significance of these features is embellished by recorded descriptions of the area. The earliest intact historic resources are wooden remnants of 19th century niter (saltpeter) mining, which supplied a component of gunpowder to early Euro-American settlers of Kentucky and to the early American military effort during the War of 1812. In the late 19th century, the Gorge was a hotspot of logging. The Nada tunnel, the western portal for the Red River Gorge Geological Area, is a narrow tunnel dug out of the rock originally for a narrow-gage rail line to haul logs out of the area. The Gladie Cabin site, over a century old, was built near the end of this early logging industry and still stands. Finally, the Sleepy Hollow Lodge is another standing cabin along the Red River. Built around 1930, this cabin was reportedly built to attract tourists during the earliest period of Euro-American recreational use of the Red River Gorge area.

Botany

Baseline Criteria (FSH1909.12)

No baseline criteria are included in Forest Service policy or guidance documents.

Other Criteria

Botany values may be judged on the relative merits of either botanical populations or habitat or a combination of these conditions.

- ***Populations:*** The river, or area within the river corridor, contains nationally or regionally important populations of indigenous plant species. Of particular importance are species considered to be unique and/or populations of federal or state listed (or candidate) threatened, endangered, or sensitive species. Diversity of species is an important consideration and could, in itself, lead to a determination of outstandingly remarkable.

- ***Habitat:*** The river, or area within the river corridor, provides exceptionally high quality habitat for plant species indigenous to the region. Of particular significance is habitat for federal or state listed (or candidate) threatened, endangered or sensitive species. Diversity or uniqueness of habitats is an important consideration and could, in itself, lead to a determination of outstandingly remarkable.

Baseline and Present Situation

Currently, no federally listed plant species are known to be present along either segment of the Red River. The locally endemic white-haired goldenrod (*Solidago albopilosa*) (USFWS 1993), delisted in 2016 (USFWS 2016) and currently a Region 8 Regional Forester sensitive species, occurs at one location within the wild river segment and in one location within the recreational river segment. It occurs close to, but outside of, the river corridor in other locations near both river segments. Butternut (*Juglans cinerea*), another Regional Forester sensitive species, has been reported in the recreational segment. Sweet pinesap (*Monotropsis odorata*), also a Regional Forester sensitive species, is in the recreational segment and likely the wild segment as well. Two rare Kentucky bryophytes, also Regional Forester sensitive species, Closter's brook-hypnum (*Hygrohypnum closteri*) and Agoyan cataract moss (*Scopelophila cataractae*) are known from the recreational segment of the river corridor (Studlar and Fuselier 2018; CNABH 2018). American chestnut (*Castanea dentata*), not a Regional Forester sensitive species, but still of interest, occurs as sprouts in the drier forests along both segments. Both segments of the river support populations of an uncommon aquatic plant associated with clean, clear, flowing water, threadfoot (*Podostemum ceratophyllum*). Several northern clime species occur in the corridor. In the wild segment, Canada yew (*Taxus canadensis*), red elderberry (*Sambucus racemosa* ssp. *pubescens*) - possibly extirpated, Canada mayflower (*Maianthemum canadense*), and small enchanter's nightshade (*Circaea alpina*) are found. In the recreational segment, Canada yew, blue monkshood (*Aconitum uncinatum*), and purple fringed orchid (*Platanthera psycodes*) have been recorded. More northerly bryophytes associated with rock shelters, are also present.

The river corridor provides a variety of habitats, including sand and gravel/cobble bars, talus slopes, mesic forest, dry forest, and cliffs including rock shelters. Both cliffs and rock shelters may be wet or damp to dry. All these habitats are found elsewhere on the forest, but sand and gravel/cobble bars are limited in number across the forest. Cliffs and rock shelters are well-developed in the corridor and provide not rare, but somewhat limited habitat across the forest. Shelters in this area have more pronounced tafoni than the majority farther south on the escarpment. The latter are best developed within the lower end of the wild segment and most of the recreational segment. Studlar and Snider (1989) and Studlar and Fuselier (2018) point out that the Red River Gorge bryoflora shows affinities to both the bryoflora of the Gulf Coast and the northern United States and Canada.

The entire river segment is diverse with influence from somewhat acid sandstones, conglomerates and shales, and basic limestone and siltstone. Spring wildflowers are diverse and plentiful in the mesic forest of both segments. Fewer summer and fall species are present in the mesic forest. Dry forests offer additional diversity of spring wildflowers as well as late summer and fall species. River bars provide habitat for some species not found in other habitat, e.g., water-willow (*Justicia americana*) and a few sedge (*Carex*) species. Cliffs and rockhouses provide habitat for species that specialize in those habitats:

white-haired goldenrod, littleflower alumroot (*Heuchera parviflora*), Appalachian filmy fern (*Vandenbochia boschiana*), Appalachian gametophyte fern (*Vittaria appalachiana*), and weft fern (*Trichomanes intricatum*). *Syrrhopodon texanus* is a warm climate moss that can be found in rock shelters.

Numerous rock shelters and ridges around the river corridor have known archaeological sites, and there is evidence of plant domestication in the area. Nut trees (oaks, hickories, walnuts, hazelnuts) and soft mast trees and shrubs (serviceberry, wild crab apple, plums, cherries, and persimmon) provided food. River cane (*Arundinaria gigantea*), once abundant in the recreational segment, provided building and weaving material. Large numbers of herbaceous and low shrub plants provided seeds, tubers, roots, and greens for consumption or medicines including spring beauty, wild ginger, Jack-in-the pulpit, native sunflowers, ragweeds, blueberries, blackberries, plantain, and Bowan's-root.

In the vicinity of the Daniel Boone National Forest, most geological variation occurs east-west as opposed to north-south as a result of the weathering pattern around the Cincinnati Arch. As one travels east, younger exposed strata are encountered. In a few miles, Devonian to middle Pennsylvanian rocks are encountered. Any stream with east to west orientation crosses these diverse strata. At the western edge of the Forest, the Pottsville Escarpment is crossed. The only rivers of size that cross the Forest east-west are the Red and the Cumberland rivers. This orientation provides a greater habitat diversity than streams that trend north-south along or through the escarpment. Using the general area of the Pottsville Escarpment on the Forest, the Red River area is distinguished from the Cumberland River, located further south, by its greater geological diversity. Limestone is exposed and cliff-forming mostly west of the Forest along the Cumberland River, whereas it is well represented on the Forest portion of the Red River, providing additional habitat types. The latter has generally more northerly affinities of vascular plants. Nonvascular plants include southern and northern elements along the Red River, while fewer northern elements occur to the south along the Cumberland River. A more intricate development of rockhouses, tafoni, and pinnacles in the Red River area provide greater numbers of microhabitats. The combination of limestone and sandstone cliffs and outcrops also increases numbers of microhabitats.

Changes Since Designation

Two major changes have occurred since designation. One is a large increase in recreational use and general visitation as shown in National Visitor Use Monitoring Surveys (USDA Forest Service 2018). The increased presence of people has increased trampling of vegetation, exposure of soil, and the spread and introduction of nonnative invasive plant species. The effects have been especially severe along the recreational segment of river itself and in rock shelters, both sensitive habitats.

The other major change, tied to the first, is the expansion and introduction of several nonnative invasive plant species. Garlic mustard (*Alliaria petiolata*) has become established in the corridor in several areas. Efforts to remove it from some areas have been successful, but the repeated work necessary to patrol the sites and remove rogue individuals has not occurred. Japanese chaff flower (*Achyranthes japonica*) has established in the corridor (confirmed along the recreational segment and suspected along the wild segment) and is spreading. Efforts have been made to control and contain Japanese chaff flower, but it has likely spread downstream. Common chickweed (*Stellaria media*) has become established in talus slopes and boulder fields along the river. This species is difficult to eradicate or even control as seed production is high and it is easily spread by water and soil movement. The species is devastating to the moss and forb flora of boulders. Another species expected in the corridor, but undocumented, is fig buttercup (*Ranunculus ficaria*). It is known in another heavily visited area near the western end of the recreational segment and is known to spread via soil and water movement. Several other nonnative invasive species have been transported to rock shelters and threaten species that live in them.

Finding/Outstandingly Remarkable Value Description

Botanical resources are an outstandingly remarkable value for the Red River corridor. The outstandingly remarkable value is related not to any one species, but rather the combination and stratification of species within the corridor. While the local endemic species, white-haired goldenrod, is present in both segments, the bulk of its distribution is outside the corridor. No outstandingly remarkable value is specifically related to that species. The diversity of vegetation, both canopy trees and understory species including herbaceous plants in the corridor is exceptional. Species range from mesic yellow buckeye, sugar maple, American basswood and eastern hemlock to xeric pitch pine, scarlet oak, chestnut oak, and downy serviceberry. All are on display on the face of the river gorge. Less visible but still present are the shrubs and herbaceous plants. Shrubs range from spicebush, bladdernut, and leatherwood at lower elevation to buffalo nut, lowbush blueberry and pinxter flower azalea on dry to xeric sites. Herbaceous species range from the typical spring wildflower suite of mesic forest including trilliums, hepatica, blue cohosh, and seersucker sedge to dwarf iris, yellow-eyed grass, and hastate violet of upland forest. Summer flowers include poke milkweed, Canada lily, and a variety of asters and sunflowers. The flora in the corridor is relatively intact, especially in the federal ownership portion of the wild segment where access is somewhat more difficult, and provides a good example of dry to mesic, sandstone to limestone, shaded to exposed, and spring to fall variation. Mixed in are several state rare and regionally rare species. The species that occupy specialized habitats of river bars, cliffs, and rockhouses provide additional diversity in the corridor.

The recreational segment has somewhat more diverse flora than the wild segment as more discrete habitat types are available in that segment. This diversity is the outstandingly remarkable value. The wild segment, however, has a more intact flora and the outstandingly remarkable value for this segment is bolstered by this.

Water Quality and Free Flow

As defined in the Wild and Scenic Rivers Act, water quality and free flow are values to be protected and enhanced for all designated rivers. This report documents and updates the baseline and current condition for water quality and free flow. It also identifies indicators.

Federal Reserved Water Rights

Federal reserved water rights are limited to the minimum amount of water necessary to satisfy the primary purposes of the Organic Act to maintain favorable conditions of flow in streams. There are no reserved water rights on the Daniel Boone National Forest at this time.

Free Flow

Section 7 of the Wild and Scenic Rivers Act directs federal agencies to protect the free-flowing condition and other values of designated rivers. The term free-flowing is defined in the Act as “existing or flowing in natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway.” Therefore, it is important to describe both the free-flowing characteristics of the river as well as structures that impact it.

The Red River meets the free-flowing condition requirements. The Wild and Scenic Study Report states that the river meets free-flowing requirements for eligibility and describes the free-flowing condition:

> With the exception of two state highway bridges, the Red River has no impoundments, diversions, or other modifications on the designated segments. The highest monthly flows are between

February and March with the lowest from September to October. The low mean is 86 cubic feet per second and the high mean is 1,075 cubic feet per second. Peak flows are between 5,000 and 15,000 cubic feet per second (Walker 2001b). Distribution of flows, compared with rainfall, indicates that geology influences movement of rainfall into the stream. This influence is the apparent capability to store rainfall as groundwater and slowly release this water as surface streamflow. (USFS 1988)

Baseline and Current Conditions

A U.S. Geological Survey (USGS) gage is located on the Red River near Hazel Green, Kentucky, approximately 4.1 miles upstream of the Red River wild segment upper boundary. The drainage area at the gage is 65.8 square miles (USGS 2020). Monthly streamflow averages from 1954 to present were averaged to show the baseline patterns of streamflow throughout the year and allow months with different numbers of days to be compared (**Error! Reference source not found.**). The month that typically has had the highest and lowest monthly averages were March and September, respectively. Leaf out in this region occurs mainly in April, which combines with increases in air temperatures to increase evapotranspiration and sequentially decrease the amount of water available for streamflow. Precipitation is fairly evenly distributed throughout the year, but spring is generally the wettest season and fall is generally the driest season (Weather Atlas 2020). 7Q10 flow is the lowest average flow that occurs for seven consecutive days that has a probability of occurring once every 10 years. This value is near zero for low flow periods, so it is likely for this site to go dry during severe droughts. Monthly streamflow averages range from 192 cfs in March to 15 cfs in September.

Another USGS gage is located on the Red River at Clay City, Kentucky, about three miles downstream of the lower boundary of the Red River recreational segment. The drainage area at this gage is 362 square miles. Table 2 shows the average of the monthly streamflow averages at the Clay City gage where data were collected from 1930 to present. Table 3 shows low-flow and flood statistics from the USGS gage at Clay City, Kentucky. The month that typically had the highest and lowest monthly averages were March and October, respectively. Streamflow at Clay City is greater than at the gage near Hazel Green, Kentucky (Table 3), because the drainage area increases substantially. The distribution of streamflow over the year is similar at Clay City compared to Hazel Green and likely similar in-between, at the wild and recreational reaches. A small portion of karst geology along the designated segments is known to cause gaining and losing reaches on the Daniel Boone National Forest (Cherry 2019).

Table 2. Average of monthly streamflow averages collected 1930 to present, Red River at Clay City, Kentucky

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Average of monthly streamflow	765	1,020	1,060	838	574	316	273	184	124

Table 3. Low-flow and flood statistics from the Red River near Clay City, Kentucky, USGS gage

Average Annual Flow	Lowest Flow ($7Q_{10}$) of record	2-Year Flood	100-Year Flood
91.1	0.1	3,376	10,561

The Red River wild and recreational segments react quickly to precipitation. Total streamflow during precipitation events is dominated by stormflow runoff and base-flow, or flow derived from groundwater discharge dominates during dry periods.

Besides one groundwater and one surface water withdrawal permit in the area, where Campton Water Treatment Plant withdraws water from Swift Camp Creek, no hydropower or other facilities are in the area that would modify streamflow rates (RRWPR 2015). No major diversions are on the Red River, but some small withdrawals for agriculture may exist along the reaches downstream of the Daniel Boone

National Forest. There are no official records of withdrawals. Any withdrawal along the wild or recreational segments of the Red River is likely minimal and not expected to significantly reduce flows.

Because no structures, such as impoundments (i.e., dams), are in the Red River Wild and Scenic River corridor, nothing regulates flows, particularly during floods. Since 1937, when the USGS gage at Clay City was established, 25 flood events were responsible for inundating Clay City residences and five flood events cut off the city and severely flooded residences and businesses (Brooks and Day 2014).

No evidence suggests the free-flowing conditions of the Red River have substantially changed since its designation in 1993. In order to change the natural flow condition, a major project would need to impound, divert, straighten, riprap, or modify the waterway. Currently, two highway bridges (KY-77 and KY-715) are the only structures that exist along the Wild and Scenic River segments (Figure 2), and those structures do very little to influence the free-flowing conditions of the river. At low flows, bridge piers would influence flow no differently than a large boulder, which are prevalent throughout both sections of the Red River, and at very high flows, would possibly constrict flows very rarely and briefly. Highway 715 sits on the ridge adjacent to the river, typically much higher than the river. This likely indicates there was no channelization of the river when Highway 715 was built.

Water Quality

Wild Segment

The wild segment of the Red River flows entirely through the Clifty Creek HUC12 sub-watershed in Menifee and Wolfe Counties (Fig. 1). Tributaries to this segment include upper Red River, Stillwater Creek, Big Calaboose Creek, Silvermine Branch, and Clifty Creek. The downstream border ends where Swift Camp Creek converges with the Red River.

The water quality is generally good in the wild segment of the Red River (RRWPR 2015). The entire reach of this segment is designated as exceptional use waters - outstanding state resource water. Exceptional use waters fall into six categories: cold water aquatic habitats, outstanding state resource waters, outstanding national resource waters, exceptional waters, reference reach waters, state wild rivers, and federal wild and scenic rivers (Kentucky Division of Water 2015). The quality of exceptional use waters exceeds that necessary to support propagation of fish, shellfish, wildlife, and recreation in and on the water (Kentucky Division of Water 2015). Neither the wild segment of the Red River nor any of its direct tributaries are listed as impaired. However, an impaired stream, Swift Camp Creek, flows into the Red River at the boundary between the wild and recreational sections.

Clifty Creek and Big Calaboose Creek fully support warm-warm aquatic habitat but have insufficient data to assess other uses. Karst topography can be found at the boundary between the wild and recreational segments of the Red River. Karst topography can cause gaining and losing streams on the Daniel Boone National Forest (Cherry 2019). Gaining and losing streams can pose a threat to water supply, as they can be direct conduits of pollution to groundwater.

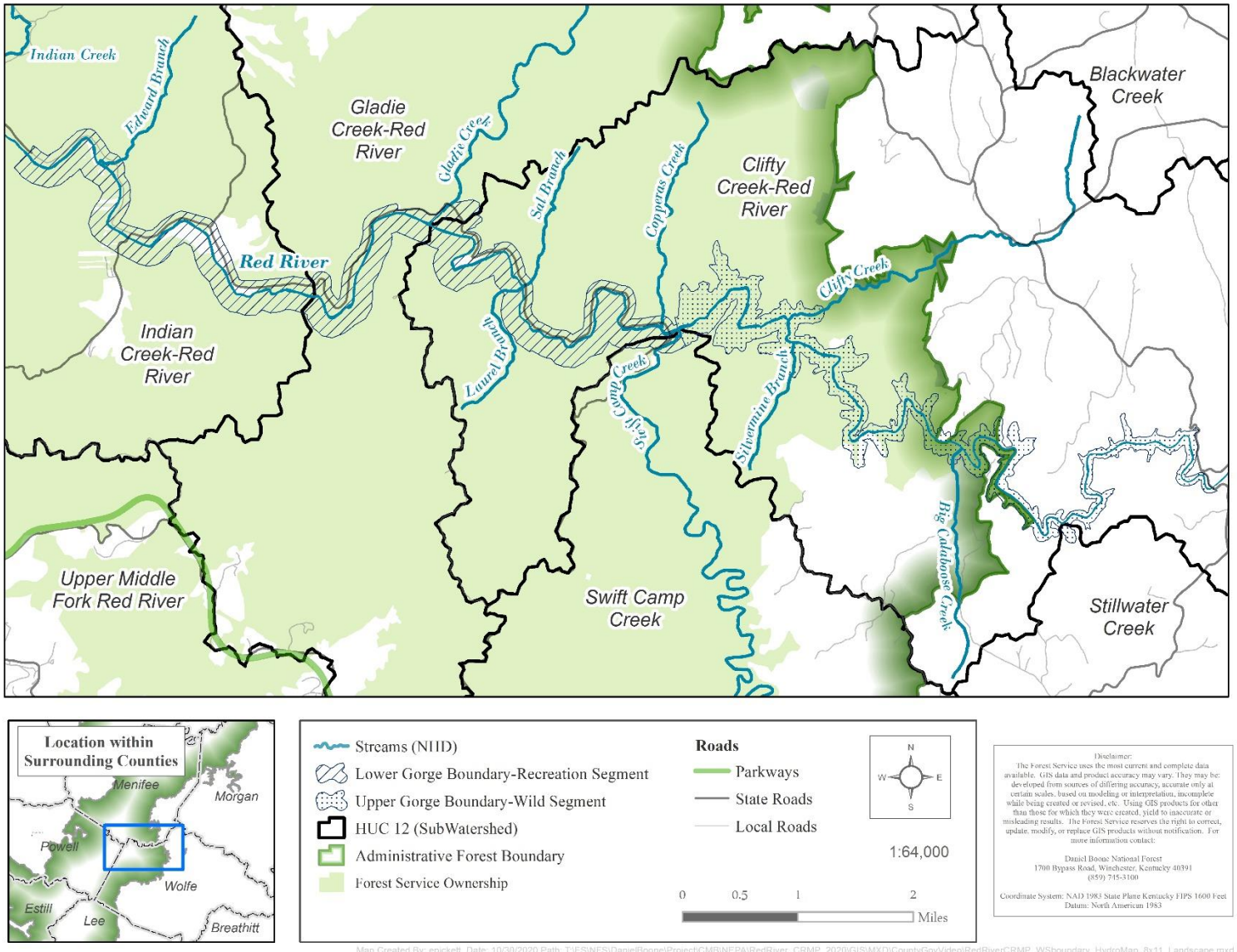

Figure 3. Wild and recreational segments of the Red River with sub-watersheds and streams

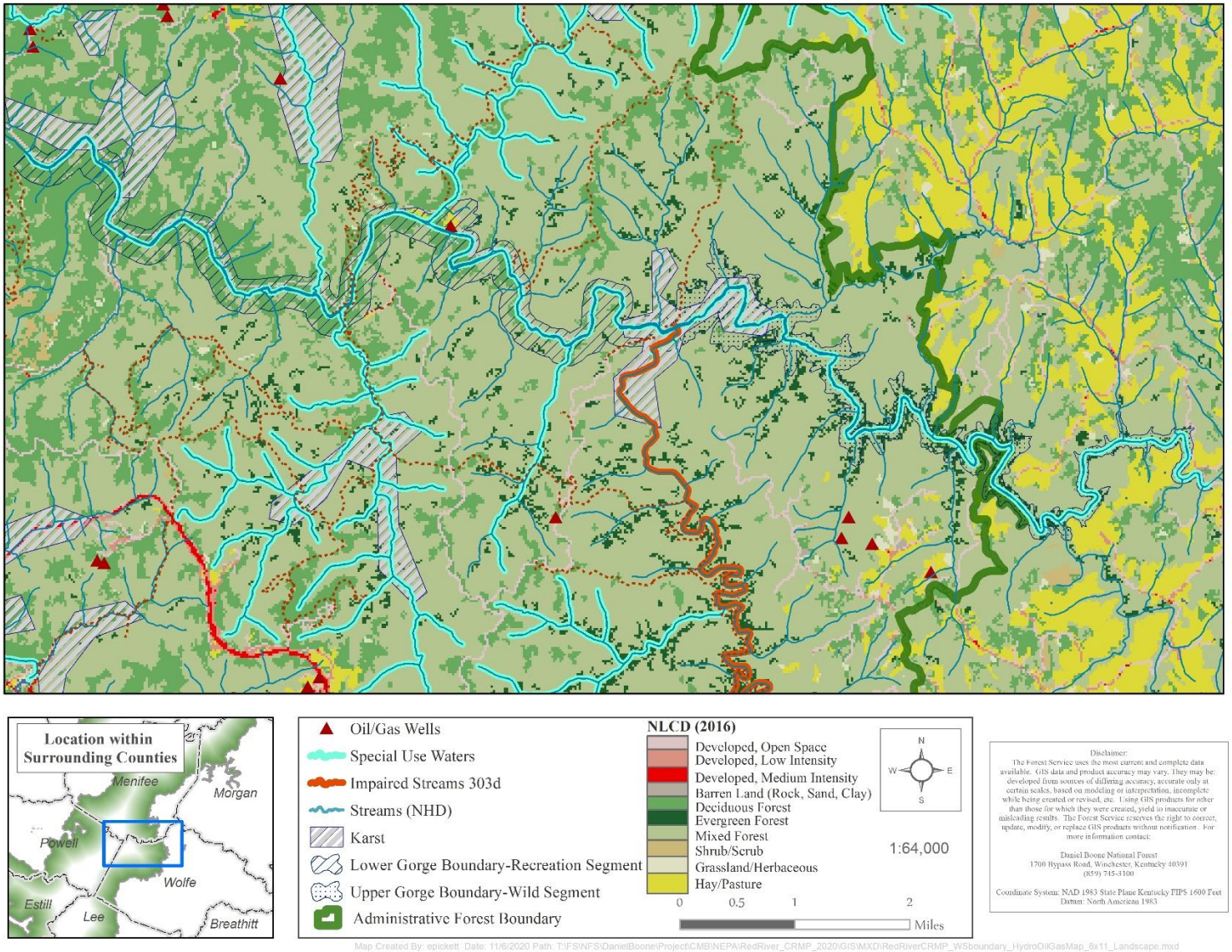

Figure 4. Red Wild and Scenic River with designations, streams, karst, land use, and oil and gas wells

The dominant land use directly adjacent to the wild segment of the Red River is mixed and evergreen forests. At the upstream reaches of the Red River wild section, hay and pastureland becomes more prevalent as land ownership changes to private (Figure 4). Developed land can be found in the area and what little is found usually lies adjacent to a road. A few oil and gas wells can be found in the Clifty Creek HUC12 sub-watershed (Figure 4).

Recreational Segment

The recreational segment of the Red River originates in the Clifty Creek HUC12 sub-watershed, briefly flows through the Gladie Creek HUC12 and ends in the Indian Creek HUC12. Tributaries to this segment include Edward Branch, Chimney Top Creek, Gladie Creek, Sal Branch, Laurel Branch, Compress Creek, and Swift Camp Creek.

The water quality in the Red River recreational segment is worse than in the wild segment. Swift Camp Creek, an impaired stream, flows into the Red River at the border between the wild and recreational sections. The headwaters of Swift Camp Creek are impaired from Escherichia coli (E. coli) and sediment, and Swift Camp Creek mainstem is impaired from E. coli. Red River mainstem and Wolfpen Creek are special use waters - outstanding state resource water. Chimney Top Creek, Swift Camp Creek, and Gladie Creek are special use waters - cold water aquatic habit. Wolfe County officials estimate that there are approximately 35 failing septic systems or direct discharges in the Swift Camp Creek area (personal communication with Wolfe County Health Department in RRWPR, 2015). This is likely a major factor for why Swift Camp Creek is impaired for E. coli.

The dominant land use draining to the Red River recreational segment is mixed and evergreen forests (Figure 4). The land use along this segment is similar to the wild segment, but with more forest and less developed land, primarily because less private land surrounds the recreational segment. The developed land around the headwaters of Swift Camp Creek and the city of Campton is likely a major source of E. coli. A few oil and gas wells can be found in the vicinity of the Red River recreational segment.

On July 11 and 18, 2012, watershed team members participated in Swift Camp Creek Walks. The sections of the creek encountered, in general, revealed degraded habitat and lack of robust riparian vegetation and buffers. The group encountered several pipes and other water and wastewater structures in the creek, eroded banks, and solid waste (Figure 5).

Figure 5. Pictures of eroded streambanks and trash taken by watershed team members in July 2012

The Red River Gorge Restoration and Watershed Plan Project included in-depth monitoring of portions of the Red River recreational segment between 2011 and 2012. Indian Creek was also sampled, downstream of the Red River recreational segment. These efforts established a critical framework for understanding the water quality in this segment. All the results are available in the Red River Gorge Restoration and Watershed Plan Project (RRWPR 2015) and are summarized below:

- Dissolved oxygen levels met the state water quality standards (Kentucky Department of Environmental Protection, Division of Water 2017) for cold water and warm water aquatic habitats; dissolved oxygen was not indicated as a cause of impairment for aquatic habitats.

- The pH levels were mostly between 7.34 to 8.84, and all were within state water quality standards (Kentucky Department of Environmental Protection, Division of Water 2017).

- Water temperature did not exceed water quality standards at any of the sites, including the overall maximum high temperature of 31.7°Celsius, or the monthly instantaneous maximum (RRWPR 2015).

- Specific conductivity is an indicator of the number of dissolved ions in the water and can be a very useful proxy for the level of pollutants in water. Specific conductivity in surface waters is affected by the geology of the area. The highest specific conductivity value was 343 microSiemens per centimeter (µS/cm), which is not uncommon in surface waters. Depending on the geology, unpolluted surface waters can be as high.

- Total suspended solids and turbidity can be proxies for sediment but can be easily biased by organic matter. The highest total suspended solids were in an unnamed tributary to Swift Camp Creek, which had the greatest amount of urbanization and eroding stream banks in many locations.

- Samples were analyzed for nitrate-nitrite and total nitrogen. The average total nitrogen levels were below the 0.600 mg/L benchmark at all sites except Swift Camp Creek below Hirams Branch. This is a little high for forested streams but can be explained because of the urbanization in the headwaters of Swift Camp Creek. Average nitrate-nitrite levels often exceeded the benchmark.

- Samples were analyzed for total phosphorus. The highest total phosphorus concentrations were from the headwaters of Swift Camp Creek and ranged between 0.133 and 0.241 mg/L. Similar to elevated nitrogen levels, higher than expected total phosphorus loads are probably a result of urbanization, failing sewage systems, and erosion.

- E. coli is commonly used as a proxy for illness-causing pathogens in water as presence of E. coli often indicates that other pathogens are present. Seven sites were sampled monthly for E. coli from July 2011 to June 2012. In addition, an intensive survey was done during the month of May 2012; sites were sampled on five days in a 30-day period in order to calculate the geometric mean for E. coli. All results for E. coli in Swift Camp Creek exceeded the instantaneous and geometric mean for water quality standards, except for two instantaneous values at Swift Camp Creek at Kentucky Highway 15.

- The macroinvertebrate score for Gladie Creek was rated “good” which means the stream meets its designated use for cold-water aquatic habitat (when last sampled in 2011). A macroinvertebrate sample was taken on Clifty Creek near the mouth of the Red River in 2011. The score was “fair”, indicating the designated use was not being met. A macroinvertebrate sample was collected at the mouth of Clifty Creek in 2011. The sample scored “fair”, indicating that activities may be impacting the segment that is currently listed as fully supporting aquatic life. Sampling locations in Swift Camp Creek for macroinvertebrates scored from “fair” to “very poor” (Table 7), likely related in part to the habitat conditions that are important for healthy aquatic communities. “Fair”

to “very poor” scores indicate a non-use attainment for the designated uses of cold water or warm water aquatic habitat.

The samples collected for the Red River Gorge Restoration and Watershed Plan Project, from 2011 to 2012, established baseline water-quality conditions for the Red River recreational segment and helped identify areas of concern. Since then, a Clean Water Act 319(h)-funded project in the Red River Gorge has worked to improve conditions.

During the first grant cycle, from May 2010 through December 2015, 157 user-developed campsites were closed, 32 miles of trails in the Red River Gorge were rehabilitated, trash was removed from 75 miles of stream, numerous environmental outreach events were held, and a watershed plan was written for the Red River Gorge and the upper portions of Swift Camp Creek Clifty Creek, Gladie Creek, and Indian Creek 12-digit HUCs. During the second grant cycle, from April 2016 through July 2019, a watershed coordinator was hired, 358 user-developed campsites were closed, 84 miles of trails in the Red River Gorge were rehabilitated, trash was removed from 41 miles along the Red River riparian corridor, several environmental outreach events were held, previously straightened streams were restored, and six failing septic tanks on privately-owned land were replaced. The third grant cycle is underway and will continue to improve water quality in the Red River Gorge through more trail and campsite rehabilitation, replacement of more failing septic systems, and more outreach events.

Interdisciplinary Team Members

The river values report was prepared by Lynette Miller, Environmental Coordinator, with the Daniel Boone National Forest and Forest Service Enterprise Program, based on the values worksheets and input received during the 2020 workshop. The following specialists prepared the river values worksheets, attended the workshop, and provided input to this river values report.

- Deborah Schoenberg, Forest Landscape Architect
- David Fothergill, Enterprise Program Landscape Architect
- Eric Dodd, District Recreation Specialist
- Claudia Cotton, Forest Geologist/ Soil Scientist
- Teresa Evans, Forest Wildlife Biologist
- Joseph Kirsch, Enterprise Program Fisheries Biologist
- Paul Powers, Enterprise Program Fisheries Biologist
- Christina Wampler, District Wildlife Biologist
- Katherine Malengo, Enterprise Program Wildlife Biologist
- Matt Davidson, District Archaeologist
- David Taylor, Forest Botanist
- Terry R. Miller, Enterprise Program Botanist
- Mac Cherry, Forest Hydrologist
- Mike McNamara, Enterprise Program Hydrologist

We also consulted the following individuals with river-specific expertise:

- Matt Able, Forest Trails, Wilderness, Wild and Scenic River Program Manager
- Tim Eling, Forest Public Affairs Staff Officer and previous Red River Gorge Manager
- Jon Kazmierski, District Ranger

References

General

Diedrich, J. 2002. Wild and Scenic River management responsibilities. Interagency Wild and Scenic Rivers Coordinating Council.

Diedrich, J. and C. Thomas. 1999. The Wild and Scenic River study process. Interagency Wild and Scenic Rivers Coordinating Council.

USDA Forest Service. 1988. Final Environmental Impact Statement and Wild and Scenic River Study Report, Red River, Daniel Boone National Forest.

USDA Forest Service. 2004. Final Environmental Impact Statement, Land and Resources Management Plan for the Daniel Boone National Forest. Accessed at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_032460.pdf

USDA Forest Service. 2004. Land and Resource Management Plan for the Daniel Boone National Forest. Accessed at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_032532.pdf

Scenery

Berry, W. 1991. The unforeseen wilderness: Kentucky's Red River Gorge. San Francisco, CA: North Point Press. 74 p.

Braun, L. 2001 reprint of first editions, 1950. Deciduous Forests of Eastern North America. Caldwell, NJ: Blackburn Press.

Woods, A.J., Omernik, J.M., Martin, W.H., Pond, G.J., Andrews, W.M., Call, S.M, Comstock, J.A., and Taylor, D.D. 2002. Ecoregions of Kentucky (color poster with map, descriptive text, summary tables, and photographs): Reston, VA. U.S. Geological Survey (map scale 1:1,000,000).

USDA Forest Service. 1984. Draft Environmental Impact Statement and Wild and Scenic River Study Report. U.S. Department of Agriculture, Forest Service.

USDA Forest Service. 1995. Landscape aesthetics: A handbook for scenery management. Agriculture Handbook Number 701. U.S. Department of Agriculture, Forest Service. 104 p.

Recreation

USDA Forest Service. 2008. Limits of Acceptable Change. Accessed at: https://www.fs.usda.gov/detail/dbnf/home/?cid=stelprdb5346360

USDA Forest Service. 2018. National Visitor Use Monitoring Master Report. Accessed at: https://apps.fs.usda.gov/nvum/results/ReportCache/2017_A08002_Master_Report.pdf

Geology

Weir, G.W. 1974. Geologic Map of the Slade Quadrangle, East-Central Kentucky. GQ-1183. U.S. Department of the Interior, Geological Survey; Kentucky Geological Survey.

Weir, G.W. and P.W. Richards. 1974. Geologic Map of the Pomeroyton Quadrangle, East-Central Kentucky. GQ-1184. U.S. Department of the Interior, Geological Survey; Kentucky Geological Survey.

Fisheries

Branson, Branley A & Batch, Donald L, (joint author.) (1974). *Fishes of the Red River drainage, Eastern Kentucky*. University Press of Kentucky, (Lexington)

Burr, B.M., and M.L. Warren, Jr. 1986. A distributional atlas of Kentucky fishes. Kentucky Nature Preserves Commission, Science and Technical Series Number 4:1–398

Daniels, R.A. 1993. Habitat of the eastern and darter, *Ammocrypta pellucida*. Journal of Freshwater Ecology 8(4): 287–295.

Eisenhour, David J.; Thomas, Matthew R.; Culp, J. Jacob; Compton, Michael C.; Brandt, Stephanie L.; and Pierce, Rodney (2018) "Updated Distributional Records of Selected Kentucky Fishes," *Southeastern Fishes Council Proceedings*: No. 58.
Available at: https://trace.tennessee.edu/sfcproceedings/vol1/iss58/1

Elkins, D.C., Sweat, S.C., Hill, K.S., Kuhajda, B.R., George, A.L., and S.J. Wenger. 2016. The Southeastern aquatic biodiversity conservation strategy. Athens, GA: University of Georgia, River Basin Center. 84 p.

Grandmaison, D.D., Mayasich, J.M., and D.A. Etnier. 2004. Eastern sand darter status assessment. Natural Resources Research Institute Technical Report No. NRRI/TR-2003/40. 51 p.

Jelks, H.L., Walsh, S.J., Burkhead, N.M., Contreras-Balderas, S., Diaz-Pardo, E., Hendrickson, D.A., Lyons, J., Mandrak, N.E., McCormick, F., Nelson, J.S., Platania, S.P., Porter, B.A., Renaud, C.B., Schmitter-Soto, J.J., Taylor, E.B., and M.L. Warren. 2008. Conservation status of imperiled North American freshwater and diadromous fishes. Fisheries 33: 372–407.

Kentucky Department of Fish and Wildlife Resources. 2020. Species of Concern.
https://fw.ky.gov/WAP/Documents/Fish%20and%20Lamprey%20CWCS%20Species.pdf

O'Brien, S.M. and D.E. Facey. 2008. Habitat use by the eastern sand darter, *Ammocrypta pellucida*, in two Lake Champlain tributaries. The Canadian Field-Naturalist 122(3): 239–246.

Sheldon, A.L. 1988. Conservation of stream fishes: patterns of diversity, rarity, and risk. Conservation Biology 2(2): 149–156.

Thomas, J.A. 2000. The fish fauna of the Red River system (Kentucky River Basin) in Eastern Kentucky with biotic assessment of water quality. Unpublished M.S. Thesis, Eastern Kentucky University, Richmond.

US Fish and Wildlife Service. 2016. Listing of the Kentucky darter as Threatened.

https://www.fws.gov/policy/library/2016/2016-23545.html

U.S. Fish and Wildlife Service. 2019. Updated fact sheet for the snuffbox mussel.

https://www.fws.gov/midwest/endangered/clams/snuffbox/snuffboxfactsheet.html

Warren, M.L. and B.M. Burr. 1994. Status of freshwater fishes of the United States: overview of an imperiled fauna. Fisheries 19(1): 6–18.

Warren, M.L., Burr, B.M., Walsh, S.J., Bart, H.L., Cashner, R.C., Etnier, D.A., Freeman, B.J., Kuhajda, B.R., Mayden, R.L., Robison, H.W., Ross, S.T., and W.C. Starnes. 2000. Diversity, distribution, and conservation status of the native freshwater fishes of the southern United States. Fisheries 25(10): 7–31.

History and Archaeology

Cowan, C.W. 1975. An archaeological survey and assessment of the proposed Red River Reservoir in Wolfe, Powell, and Menifee Counties, Kentucky. Report Submitted to the National Park Service, Tallahassee, Florida, by the University of Kentucky Museum of Anthropology in accordance with provisions of Contract CX500031431.

Cowan, C.W. 1985. From foraging to incipient food production: Subsistence changes and continuity on the Cumberland Plateau of Eastern Kentucky. Ann Arbor, MI: University of Michigan. Unpublished Ph.D. dissertation

Cowan, C.W. and F.T. Wilson. 1977. An archaeological survey of the Red River Gorge area. Frankfort, KY: Kentucky Heritage Commission.

Coy, F.E. Jr., Fuller, T.C., Meadows L.G., and J.L. Swauger. 1997. Rock art of Kentucky. Lexington, KY: University Press of Kentucky.

Faulkner, J., Bodkin, F., and W. Adams. 2014. An archaeological assessment of 425 acres: Daniel Boone National Forest, limits of acceptable change (LAC) study area, Powell County, Kentucky. Winchester, KY: U.S. Department of Agriculture, Forest Service, Daniel Boone National Forest.

Ison, C. 2004. Farming gender and shifting social organization: A new approach to understanding Kentucky's rock art. In: C. Diaz-Granados, ed. Rock art of the Eastern United States. Tuscaloosa, AL: University of Alabama Press: 177-189.

Ison, C., Faulkner, J., Boedy, R., Bodkin, F.M., and C. Jenkins. 2008. An archaeological assessment of 51 dispersed recreation areas in the Red River Gorge, Cumberland Ranger District, Daniel Boone National Forest. Winchester, KY: U.S. Department of Agriculture, Forest Service, Daniel Boone National Forest.

Neumeyer, S. 2003. National Register of Historic Places registration form: Red River Gorge National Register District. Winchester, KY: U.S. Department of Agriculture, Forest Service, Daniel Boone National Forest.

Pollack, D., ed. 2008. The archaeology of Kentucky: an update, volumes I-II. Frankfort, KY: Kentucky Heritage Council.

Sleeper-Smith, Susan. 2018. Indigenous Prosperity and American Conquest: Indian Women of the Ohio River Valley, 1690-1792. Omohundro Institute of Early American History and Culture, Williamsburg, Virginia, and University of North Carolina Press, Chapel Hill, North Carolina.

Turnbow, C. 1976. An archaeological survey of the Red River Gorge Geological Area in the Daniel Boone National Forest in Powell, Wolfe and Menifee Counties, Kentucky. Report Submitted to the National Forest Service, Winchester, Kentucky, by University of Kentucky, Museum of Anthropology in accordance with provision of Contract No. 38-2830.

Warren, Stephen. 2014. The Worlds the Shawnees Made: Migration and Violence in Early America. University of North Carolina Press.

Wyss, J.D. and S.K. Wyss. 1977. An archaeological assessment of portions of the Red River Gorge, Daniel Boone National Forest, Kentucky. Archaeological Report No 1. Atlanta, GA: U.S. Department of Agriculture, Forest Service, Southern Region.

Botany

Consortium of North American Bryophyte Herbaria [CNABH]. 2018. Online database. http://bryophyteportal.org/portal/index.php. [Accessed 21 June 2018 to 13 August 2018].

Studlar, S.M. and L. Fuselier. 2018. The 2016 Crum Workshop: Bryophytes of the Red River Gorge Geological Area, Kentucky. Evansia 35(1):6-23.

Studlar, S.M. and J.A. Snider. 1989. Bryophytes of the Red River Gorge of Kentucky: floristics and phytogeography. Castanea 54(3): 133-152.

U.S. Department of the Interior Fish and Wildlife Service [USFWS]. 2013. White-haired goldenrod recovery plan. Atlanta, GA: U.S. Department of the Interior, Fish and Wildlife Service. 33 p.

U.S. Department of the Interior Fish and Wildlife Service [USFWS]. 2016. Endangered and threatened wildlife and plants; removal of *Solidago albopilosa* (white-haired goldenrod) from the federal list of endangered and threatened plants. Federal Register 81(196): 70043-70059.

Hydrology

Brooks, F. and C. Day. 2014. Analyzing the mixed flood hydroclimatology of the Red River Basin, Kentucky. Journal of the Kentucky Academy of Science 75: 47-52.

Cherry, M.A. 2019. Streamflow gain and loss, hydrograph separation, and water quality of abandoned mine lands in the Daniel Boone National Forest, eastern Kentucky, 2015–17. Scientific Investigations Report 2019–5006. U.S. Department of the Interior, Geological Survey. 36 p.

Kentucky Department of Environmental Protection, Division of Water. 2015. Integrated report to Congress on the condition of water resources in Kentucky, 2014. Kentucky Energy and Environment Cabinet, Department for Environmental Protection, Division of Water, Water Quality Branch. 242 p.

Kentucky Department of Environmental Protection, Division of Water. 2017. 401 Kentucky Administrative Regulations 10:031. Surface water standards. Kentucky Energy and Environment Cabinet, Department for Environmental Protection, Division of Water.

Kentucky Department of Environmental Protection, Division of Water. 2020. 401 Kentucky Administrative Regulations 4:010. Water withdrawal permits; criteria, reports. Kentucky Energy and Environment Cabinet, Department for Environmental Protection, Division of Water.

Pond, G.J, Call, S.M., Brumley, J.F., and M.C. Compton. 2003. The Kentucky macroinvertebrate bioassessment index derivation of regional narrative ratings for assessing wadable and headwater streams. Kentucky Department for Environmental Protection, Division of Water, Water Quality Branch, Ecological Support Section. 53 p.

Red River Gorge Watershed Plan and Restoration [RRWPR]. 2015. Red River Watershed Team. Submitted to Kentucky Division of Water, under 319(h) of the Clean Water Act (Grant # C9994861-10). 220 p.

USDA Forest Service. 1984. Draft environmental impact statement and Wild and Scenic River study report. U.S. Department of Agriculture, Forest Service, Southern Region. 90 p.

U.S. Geological Survey [USGS] National Water Information System – Web interface. Page last modified: 2020. U.S. Department of the Interior, Geological Survey. https://waterdata.usgs.gov/nwis. [Accessed April 2020].

Weather Atlas. Page last modified: 2020. https://www.weather-us.com/en/kentucky-usa-climate. [Accessed May 2020].