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FINAL ENVIRONMENTAL ASSESSMENT

**REQUEST FOR SECTION 26A APPROVAL  
FOR A PEDESTRIAN BRIDGE AT  
SEVEN ISLANDS WILDLIFE REFUGE  
French Broad River Mile 15.6  
Knox County, Tennessee**

**PREPARED BY:**  
TENNESSEE VALLEY AUTHORITY

SEPTEMBER 2009

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## ACRONYMS, ABBREVIATIONS, AND SYMBOLS

<b>§</b>	section
<b>APE</b>	area of potential effect
<b>ARAP</b>	Aquatic Resource Alteration Permit
<b>BMPs</b>	best management practices
<b>cfs</b>	cubic feet per second
<b>EA</b>	environmental assessment
<b>FBRM</b>	French Broad River Mile
<b>FEMA</b>	Federal Emergency Management Agency
<b>FHWA</b>	U.S. Federal Highway Administration
<b>IBI</b>	Index of Biotic Integrity
<b>MOA</b>	Memorandum of Agreement
<b>msl</b>	mean sea level
<b>NEPA</b>	<i>National Environmental Policy Act</i>
<b>NHPA</b>	<i>National Historic Preservation Act</i>
<b>NPS</b>	National Park Service
<b>NRHP</b>	National Register of Historic Places
<b>NRI</b>	Nationwide Rivers Inventory
<b>ORV(s)</b>	outstandingly remarkable value(s)
<b>PBA</b>	Public Building Authority of Knox County and the City of Knoxville
<b>SHPO</b>	State Historic Preservation Officer
<b>TDEC</b>	Tennessee Department of Environment and Conservation
<b>TVA</b>	Tennessee Valley Authority
<b>TWRA</b>	Tennessee Wildlife Resources Agency
<b>USACE</b>	U.S. Army Corps of Engineers
<b>USCG</b>	U.S. Coast Guard
<b>USFWS</b>	U.S. Fish and Wildlife Service
<b>USGS</b>	U.S. Geological Survey

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# CHAPTER 1

## 1.0 PURPOSE OF AND NEED FOR ACTION

### 1.1. The Decision

Seven Islands Wildlife Refuge is a 360-acre wildlife sanctuary located adjacent to the French Broad River approximately 12 miles from downtown Knoxville, Tennessee. The refuge is operated jointly by the Knox County Division of Parks and Recreation and the Seven Islands Foundation.

Knox County proposes to construct a pedestrian bridge across the river at French Broad River Mile (FBRM) 15.6 near the eastern border of the county where it adjoins Sevier County. The bridge would connect the eastern side of the Seven Islands Wildlife Refuge with the western side. A vicinity map is provided as Figure 1-1. Location maps are provided as Figures 1-2 and 1-3. The proposed pedestrian bridge would give visitors access to both parts of the refuge without driving about 45 minutes to cross the river by the nearest existing bridge.

The French Broad and Holston rivers join to form the Tennessee River at Knoxville. Douglas Dam is located on the French Broad 32.3 miles upstream of this point. This reach of the river downstream of Douglas Dam is a “regulated stream” because its flow is controlled by the operation of Douglas Dam. Thus, any structure located in, across, or along this reach is subject to Tennessee Valley Authority (TVA) approval under Section 26a of the *TVA Act*. The county has requested TVA Section 26a approval for the bridge. Thus, the decision before TVA is whether to issue Section 26a approval for the bridge.

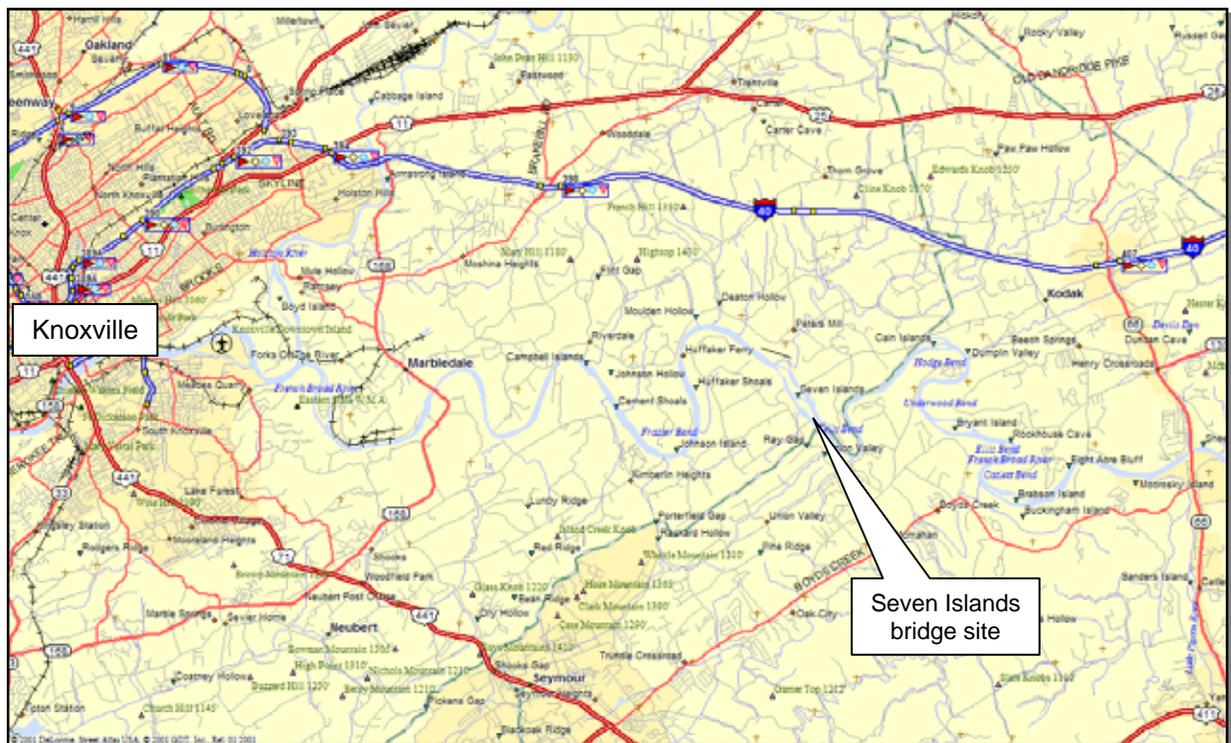


Figure 1-1. Vicinity Map of the Seven Islands Pedestrian Bridge Project

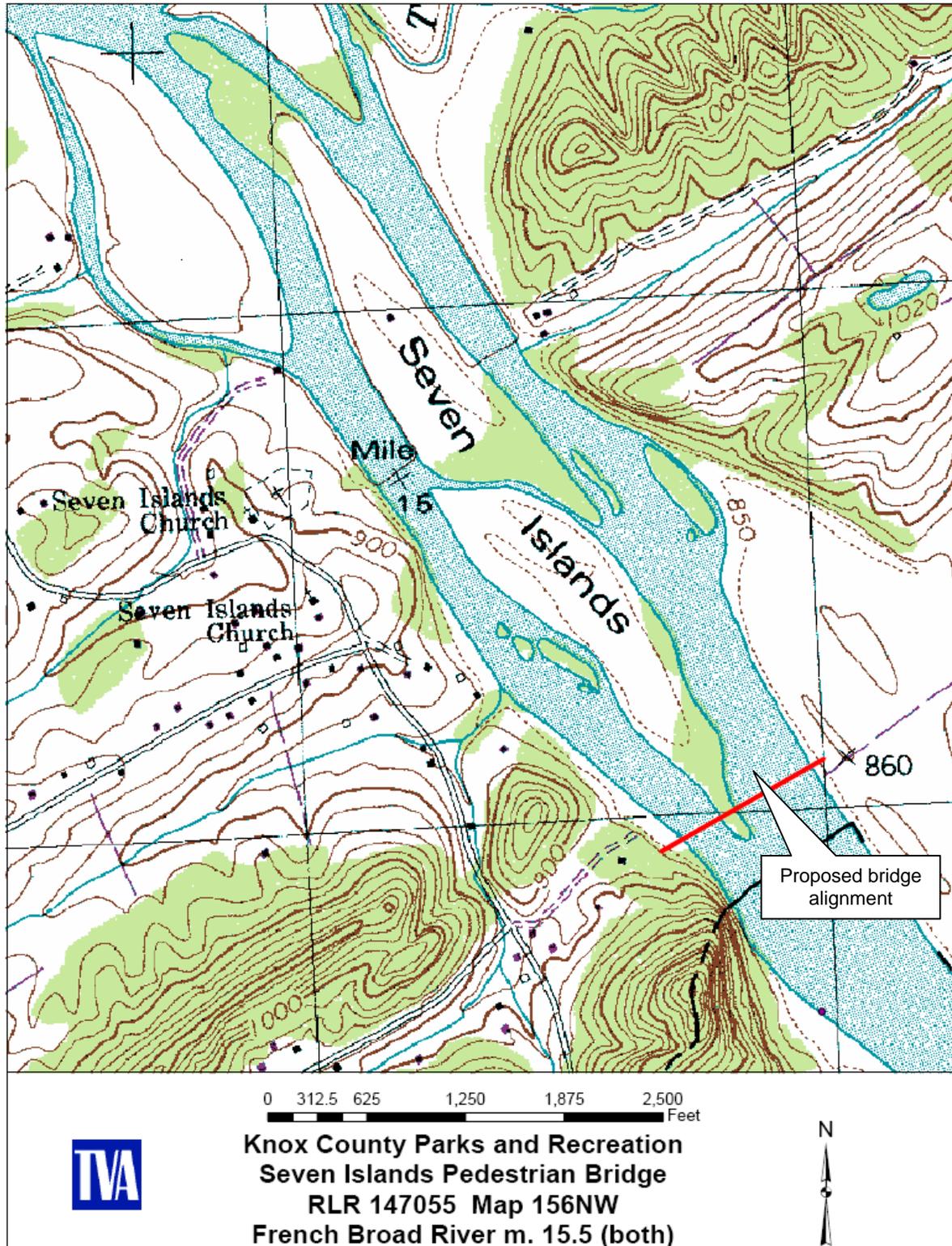
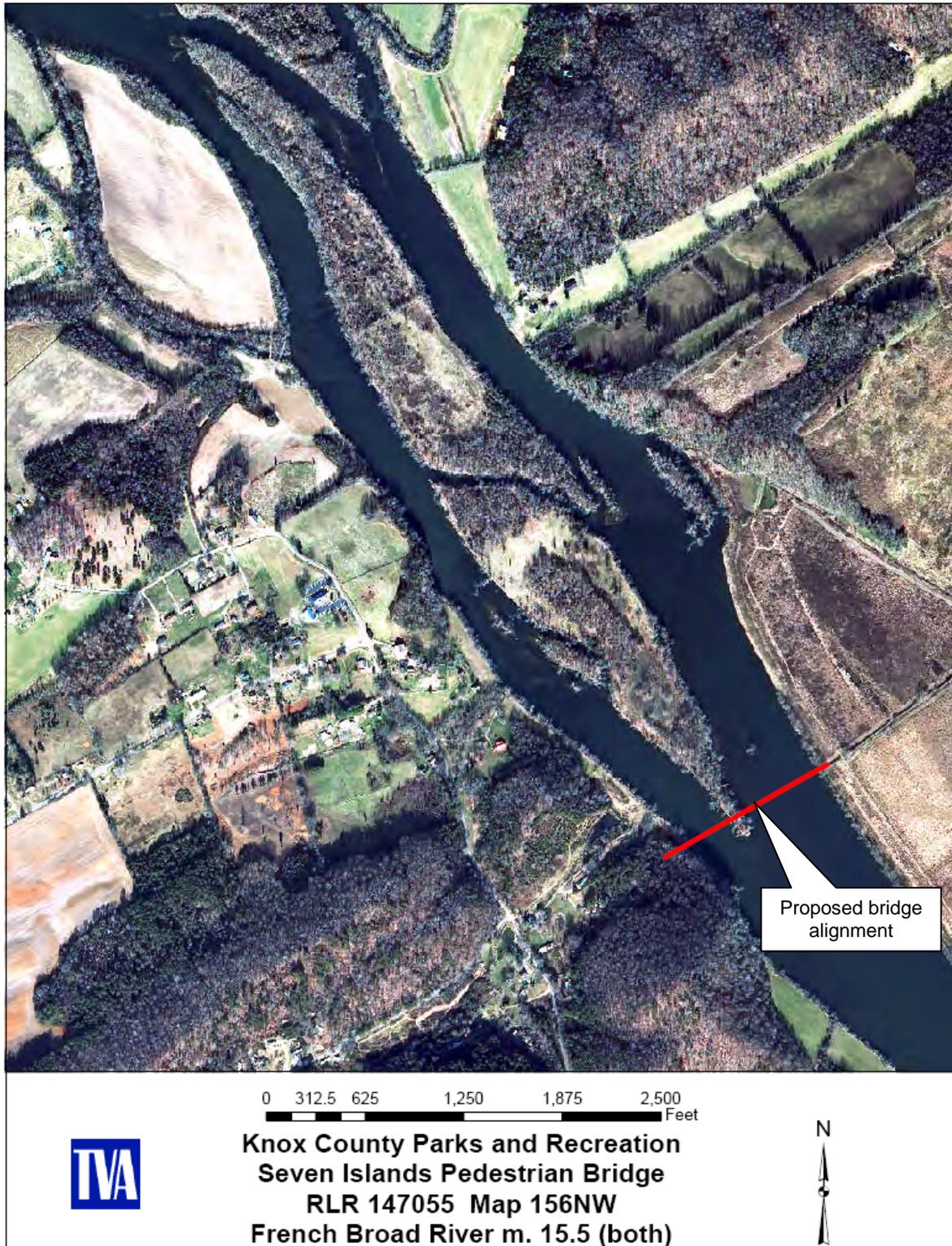


Figure 1-2. Topographic Location Map of the Seven Islands Pedestrian Bridge Project Area



**Figure 1-3. Aerial Photographic Map of the Seven Islands Pedestrian Bridge Project Area**

The proposed bridge would be funded by the Knox County Division of Parks and Recreation, the State of Tennessee, and a Transportation Enhancement Grant from the U.S. Federal Highway Administration (FHWA), administered through the Tennessee Department of Transportation. The project is being managed by the Public Building Authority of Knox County and the City of Knoxville (PBA). The potential environmental impacts of constructing the proposed bridge are addressed in this environmental assessment (EA).

## 1.2. Other Pertinent Environmental Reviews or Documentation

TVA (2003) prepared a generic EA that addressed potential environmental effects of private water use facilities in the lower French Broad River. Several archaeological studies have been conducted in the area. D'Angelo (2002) conducted Phase I archaeological surveys in the area, and Ezell (2001) investigated the immediate project area. An earlier study (Hermann 2000) addressed archaeological resources in an area of high erosion potential in the Douglas Dam tailwater. Additional archaeological testing of the proposed bridge site was conducted by Pace et al. (2005) and by Pace and Spice (2006).

## 1.3. Scoping, Agency Consultation, and Public Involvement

TVA determined that the proposed bridge project has the potential for adverse effects to water quality and aquatic life (including endangered aquatic species), terrestrial life, cultural resources, floodplains, recreation, and a river listed on the Nationwide Rivers Inventory<sup>1</sup> (NRI). As a result of an initial review and evaluation of the proposed bridge project, TVA determined that impacts to other natural features of prime or unique farmland; groundwater; unique or important terrestrial habitats; parklands, state or national forests, trails, greenways, wilderness, scenic or other ecologically critical areas; and wetlands would be either absent or minor. Other than temporarily during construction, noise levels and emissions of air pollutants would not increase. No production of hazardous wastes, wastes requiring special handling and disposal, or negative social or socioeconomic impacts are anticipated. The project is not in conflict with any plan, existing land use, or zoning regulation. No adverse effect on public facilities or services is expected. Therefore, potential impacts to these other features and existing conditions were not considered further.

Because this stretch of the river contains species federally listed as endangered that could be affected by constructing the proposed bridge, TVA consulted informally with the U.S. Fish and Wildlife Service (USFWS) in compliance with Section 7 of the *Endangered Species Act*. The Tennessee State Historic Preservation Officer (SHPO) and the following tribes were consulted in compliance with Section 106 of the *National Historic Preservation Act*: United Keetoowah Band of Cherokee Indians in Oklahoma; Cherokee Nation; Eastern Band of Cherokee Indians; Muscogee (Creek) Nation of Oklahoma; Alabama-Coushatta Tribe; Alabama-Quassarte Tribal Town; Kialegee Tribal Town; Thlopthlocco Tribal Town; Shawnee Tribe; Absentee-Shawnee Tribe of Oklahoma; Eastern Shawnee Tribe of Oklahoma; Chickasaw Nation; Choctaw Nation of Oklahoma; and Jena Band of Choctaw Indians. Only the United Keetoowah Band and the Choctaw Nation of Oklahoma provided comments. Because this stretch of the French Broad River is on the NRI, TVA requested comments from and consulted with the National Park Service (NPS). These comments are contained in Appendix A.

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<sup>1</sup> The Nationwide Rivers Inventory is a list, maintained by the National Park Service, of those streams that are potentially eligible to be considered for inclusion in the national Wild and Scenic Rivers System under the *Wild and Scenic Rivers Act* (16 United States Code §§ 1271-1287).

Knox County placed a notice of its intent to build a bridge in the *Knoxville News-Sentinel* on April 29, 2007. The notice stated that TVA would be preparing an EA on the proposal and requested that comments be submitted by May 29, 2007. No comments were received. As part of its compliance with Federal Emergency Management Agency (FEMA) requirements, the county had previously sent letters to affected property owners and placed a public notice in the *Knoxville News-Sentinel* on March 21, 2006, regarding the expected change to the floodway due to the proposed bridge. Comments regarding the project from property owners and from the public notice were taken from March 21 through April 20, 2006. There was one general question in response to the county's notice. This question did not require further action.

TVA released the draft EA on October 4, 2007, and copies of the draft were sent to the governmental agencies listed in Chapter 6 for review and comment. The agency comments received in response to the draft EA and TVA's responses to those comments are included in Appendix B. The draft EA was also made available to the public for 60 days for review and comment. The PBA hosted a public meeting on the proposed project on November 7, 2007. Two comments were received from the public; those comments and TVA's responses are included in Appendix B.

#### **1.4. Necessary Federal Permits or Licenses**

Depending on the specific bridge design as described in Sections 2.1.2, 2.1.3, and 2.1.4, construction of the proposed bridge could require a permit under Section 404 of the *Clean Water Act* from the U.S. Army Corps of Engineers (USACE). If less than 0.5 acre were disturbed by the bridge, Nationwide Permit Number 14 would apply. Otherwise, an Individual Permit is necessary. The Activity Specific Conditions and General Conditions for Nationwide Permit Number 14 are contained in Appendix C.

An Aquatic Resource Alteration Permit (ARAP) from the State of Tennessee would be necessary for a bridge design that involves placing piers in the river. However, construction of a suspension bridge with no structures in the water (see Sections 2.1 and 2.1.4) would not require an ARAP. A General Permit for Construction and Removal of Minor Road Crossings would be granted if the bridge results in the alteration of 200 linear feet or less of streambed. Otherwise, an Individual Permit is necessary. The provisions of the General Permit are contained in Appendix D. The county would prepare a Storm Water Pollution Prevention Plan as part of the ARAP. The county has also complied with FEMA requirements for changes that the bridge would cause in the floodplain near the bridge. A U.S. Coast Guard (USCG) Bridge Permit is not required because the French Broad River is classified in the "Advance Approval" Category. However, the county would be required to send final plans to the USCG to record the location and design.

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## CHAPTER 2

### 2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

#### 2.1. Alternatives

Three feasible alternatives concerning the proposed pedestrian bridge were evaluated in the draft EA. Following the release of the draft document, an additional alternative was developed. This new alternative involves the construction of a suspension bridge. The alternatives analyzed in the final EA include the No Action Alternative and three action alternatives. The three action alternatives (i.e., Alternatives B, C, and D) differ with respect to construction methods and the design of the proposed bridge. Specifically, Alternatives B and C involve a common bridge design using a series of nine piers placed in the river. However, these two alternatives differ in construction techniques with respect to the manner of providing instream access for construction equipment. Under Alternative B, construction of the piers and bridge would be done from barges and mats placed in the river. Under Alternative C, construction equipment would use pads or causeways constructed in the river parallel to the bridge alignment to provide access for construction. Under Alternative D, a suspension bridge would be constructed. Because the bridge support towers would be placed on the riverbank and the bridge would be constructed “from the top down,” there would be no need for construction equipment in the river under Alternative D. Likewise, the suspension bridge design would not involve excavation within the river channel.

Under each of the action alternatives, the construction contractor would employ appropriate best management practices (BMPs) to prevent erosion and the off-site movement of soil and sediment from excavations of exposed areas. In addition, the contractor would comply with the terms and conditions of necessary permits. The alternatives are described in detail below.

##### 2.1.1. *Alternative A – The No Action Alternative*

Under the No Action Alternative, TVA would not issue the necessary Section 26a approval. Lacking this approval, the county would likely not build the proposed bridge.

##### 2.1.2. *Alternative B – Issue Section 26a Approval for Construction of the Pedestrian Bridge Using Barges and Mats*

Under Alternative B, TVA would issue the necessary Section 26a approval, allowing construction of the proposed bridge. The bridge would have a bank-to-bank distance of approximately 950 feet. It would require the placement of nine piers in the river, one pier on each bank, and two bridge abutments. The bridge would span the islands. The piers would have a concrete foundation and framework made of steel, which would be allowed to rust to a brown color for visual purposes. The deck would be 10 feet wide between the railings and made of wood treated with linseed oil to resist weathering. There would be an 8.5-foot clearance between the bottom of the bridge deck and the normal high river water level (i.e., when water is being released from Douglas Dam through all four turbines) of 848 feet above mean sea level (msl). The bridge would be wheelchair-accessible. A schematic diagram of the proposed bridge is provided as Figure 2-1. Additional design drawings of the bridge are contained in Appendix E.

Seven Islands Pedestrian Bridge

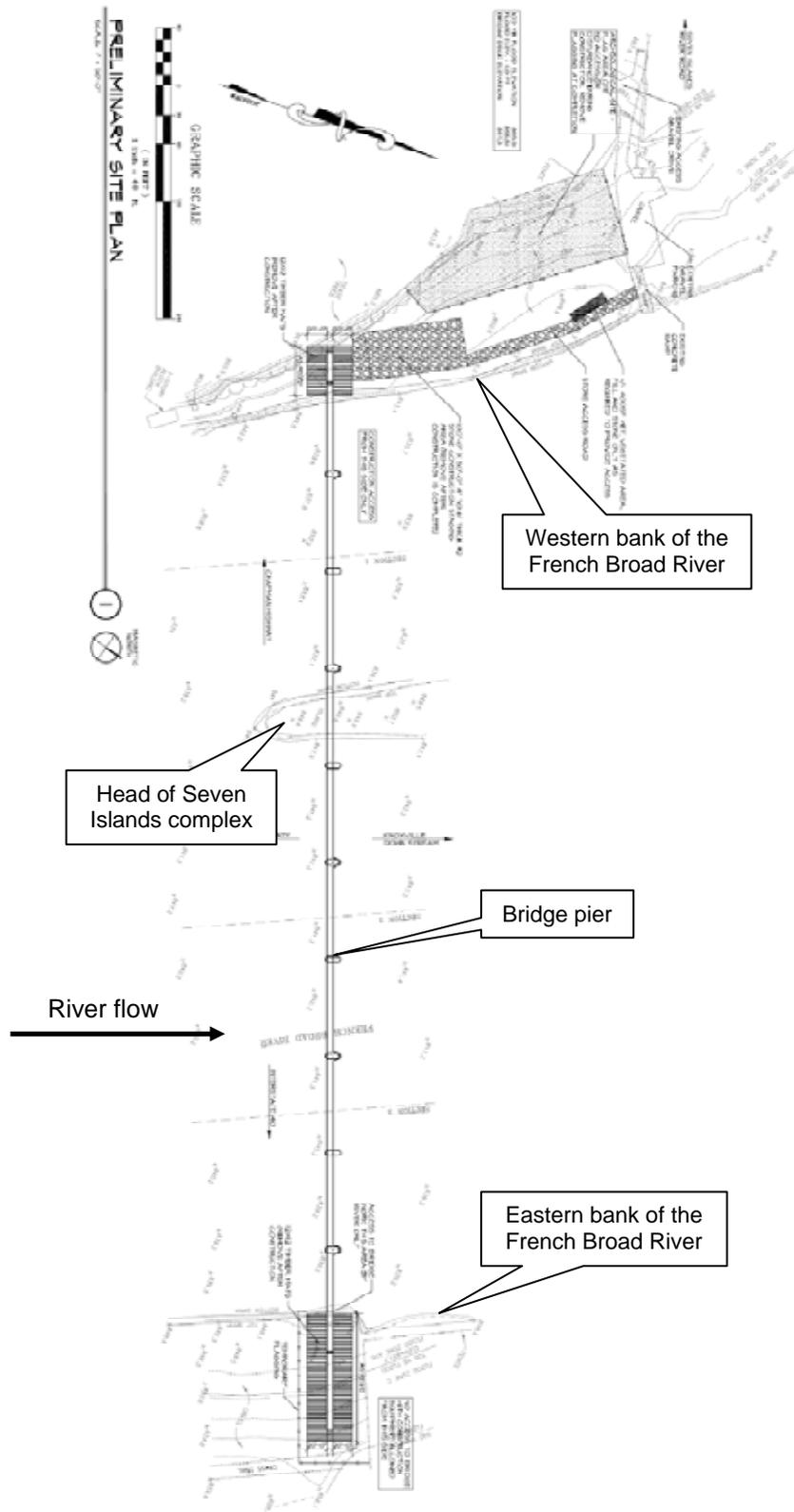


Figure 2-1. Schematic Plan of the Proposed Seven Islands Pier-Type Bridge

The concrete base for each pier would be an oval 9 feet long by 5 feet wide, with the long axis of the oval aligned with the stream flow. The pier bases would vary in height depending on the river depth at their respective locations. There would be a cylindrical extension of the base embedded 6 feet into the riverbed. This extension would be 5 feet in diameter.

Each pier base would be constructed within a coffer cell. The cell would be installed and pumped dry. The hole for the embedded portion of the pier would then be drilled into the river bottom with jackhammers or percussion drilling. Blasting would not be used. Waste material from the drilling would be removed and placed in an approved upland disposal area. The base would then be filled with concrete. After the concrete cured, the steel part of the pier would be installed. The coffer cell would then be removed, and work would begin at the next pier location. After installation of the steel parts of the piers, the framework and deck would be installed. The county expects that one pier would be installed at a time.

Under this alternative, the pier sites would be accessed by using work barges and/or mats. Work barges may be needed in the deeper parts of the river, while piers in the shallower parts of the river may be accessed by placing mats on the river bottom and driving equipment across the mats. Preliminary plans indicate a construction period of eight to 12 months. The construction start date and duration would depend on when bids could be obtained, as well as on weather and river conditions.

Construction laydown and staging areas approximately 100 feet by 50 feet in size would be located on the riverbank at both ends of the proposed bridge. They would be surfaced with 4 to 6 inches of gravel 1.5 to 2.5 inches in diameter, which would be removed at the completion of bridge construction. These sites and any other areas disturbed during construction would be revegetated with native or noninvasive plants. Equipment and material would be brought to the western end of the bridge site by truck and to the eastern end either by truck through the roads in the refuge or across the river from the west side by a work barge and trucks driven over the mats. Construction equipment brought to the site would be cleaned prior to use to ensure they are free of invasive weed seeds and plant parts.

### 2.1.3. *Alternative C – Issue Section 26a Approval for Construction of the Pedestrian Bridge Using Rock Pads*

Under Alternative C, the bridge design would be the same as under Alternative B. The difference between Alternatives B and C is in the method used to access the pier sites. Under Alternative C, temporary causeways or pads created from rock fill would be placed on the riverbed, and construction equipment would be operated from them. The pads would be extended from each shore to the island parallel to the alignment of the bridge so that the equipment could be out of the water in a stable location. They would be built of 1-foot to 2-foot rock at the base with 2-inch gravel at the top and would be thick enough to be above expected water levels. For purposes of analysis, we assumed that the construction access causeways would be built so that the top of the causeway would be at an elevation of 852 feet. This is 4 feet above the maximum generation elevation (848 feet) and would allow construction activities to continue under all likely flow conditions in the French Broad River during the limited construction time. The initial assumption by the PBA is that the causeways would be 10 feet wide at the top to allow equipment movement and would be sloped at 2:1 to the river bottom. Based on these assumptions, causeway width at the river bottom in the right-descending channel would vary from 50 to 70 feet. Causeway width in

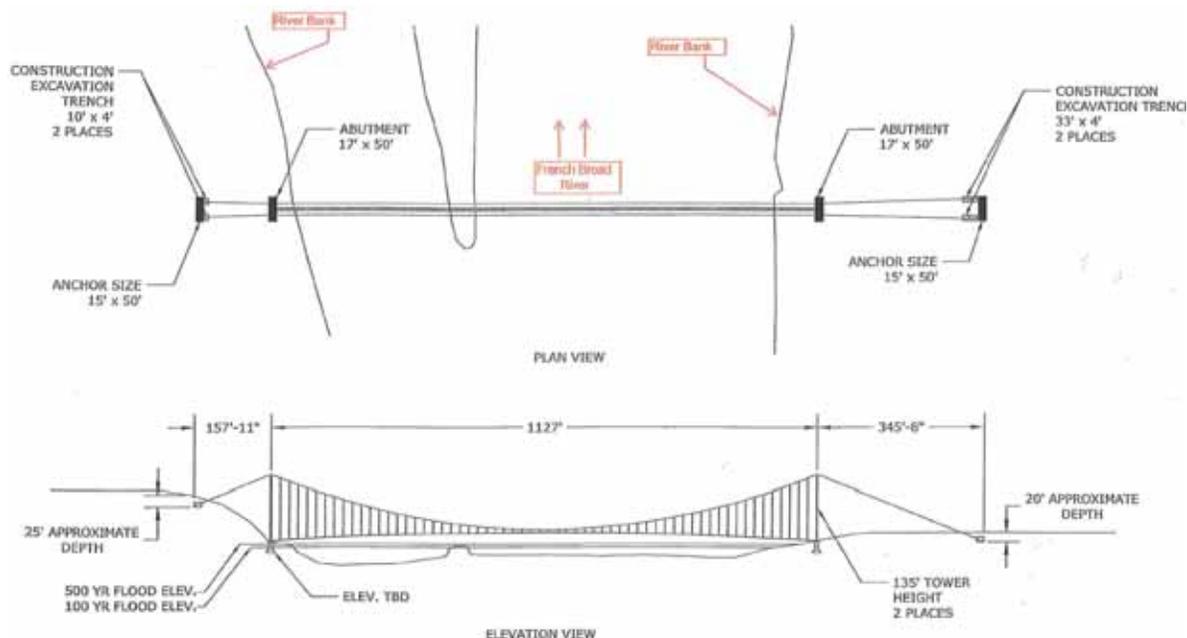
the deeper left-descending (i.e., the westernmost) channel could be as wide as 100 feet, depending upon channel depth.

Under this alternative, one causeway would be built from one side of the river, those piers built, then it would be removed, and the other pad would be built. The other pad would be removed after the piers along it were built. The full length of each pad would be installed before starting to build the piers along it so that trucks traveling along the pad would not be a problem for the pier constructors. Based on the expectation that the construction could take 12 months, each causeway could be in place six months or more.

As under Alternative B, precautions would be taken to prevent the introduction of invasive plants, and any areas of soil disturbance would be revegetated with native plants or noninvasive plants. Only clean, weed-free rock would be used for bank stabilization.

**2.1.4. Alternative D – Issue Section 26a Approval for Construction of a Suspension Pedestrian Bridge**

The county considered building a single-span bridge across the river with bridge abutments located on each bank and with no piers in the river. Initially, this construction concept was rejected due to potentially high construction costs. However, because of potential impacts to water quality and aquatic life inherent under the other alternatives, in May 2009, new plans were developed by the construction contractor (S&ME 2009), and this proposal was considered as Alternative D. A schematic illustration of the proposal is presented as Figure 2-2.



**Figure 2-2. Schematic Plan of the Proposed Seven Islands Suspension Pedestrian Bridge**

Alternative D involves the construction of an approximately 1,127-foot-long suspension bridge. The bridge abutments on each bank would be placed above the 500-year flood elevation (862.5 feet). These abutments would be approximately 17 feet wide and 50 feet long. This design may require a third support tower located on the tip of the island. The

need for this will be determined in the final design following issuance of all regulatory permits. The abutment for this support tower would be located above the 100-year flood elevation (855.5 feet). In the event a support (including the foundation abutment) is required on the island, excavation equipment (i.e., a track hoe) would be transported to the island on a small barge, and concrete for the abutment would be pumped from the bank. Support towers would be located atop each abutment. Height of these towers would likely be approximately 80 to 100 feet, but would be no taller than 135 feet above the foundation. To support the span, the two landward towers would be anchored with cables attached to buried anchors located on each bank. A tower on the island would not require additional support cables.

On the west bank, the support cables would be secured to a deadman-type buried anchor located approximately 158 feet from the abutment. This anchor would be 15 feet wide, 15 feet high, and 50 feet long and would be buried approximately 25 feet deep. Two trenches, 10 feet long and 4 feet wide, would be excavated for attaching the support cables to the anchor. Excavation of rock material would be done by drilling; blasting would not be used.

On the east bank, a similar deadman anchor would be installed approximately 345 feet inland from the support tower. This anchor would be buried approximately 20 feet deep. Two 33-foot-long, 4-foot-wide trenches would be dug to attach the support cables to this anchor.

The suspension bridge design offers advantages over the other designs in that it would not require the placement of piers in the river. This design would not involve the disturbance of the river bottom for pier excavation, and the placement of construction equipment in the river would not be required. Water flows would not be altered during construction under Alternative D. This design would require less excavation and less concrete than the design under Alternatives B and C.

As with the other action alternatives, precautions would be taken during construction under Alternative D to prevent the introduction of invasive plants. These measures include revegetation of areas of disturbed soil with native plants or noninvasive species and the use of clean riprap for bank stabilization to prevent the introduction of weed seed or plant parts.

#### *2.1.5. Other Alternatives and Options Not Considered in Detail*

Knox County considered another general alternative, a ferry service, to achieve the goal of connecting both sides of the refuge. A ferry service could transport visitors across the river, and adoption of this alternative would result in minimal, if any, impact to the aquatic resources at the site. However, this alternative was determined to be infeasible from an economic and human health and safety standpoint. The county does not have the funding to create a full-time position for a ferry operator. There would also be safety risks associated with the operation of a ferry related to operator error and the possibility of rapidly changing water levels due to releases from Douglas Dam upstream. Additionally, implementation of this alternative could have negative impacts on the visitor experience. The necessity of an engine to support the ferry operation could impinge on the visitors' ability to watch wildlife and enjoy the peace and quiet of the refuge.

The feasibility of alternate bridge alignments upstream or downstream of the proposed location was also considered. By siting the alignment farther downstream near FBRM 15 (see Figure 1-2), two shorter spans could be used to connect the east and west banks to the midchannel island(s). This option proved infeasible for several reasons. First, the

county does not own land along the west riverbank and would have to acquire additional shoreline for a bridge abutment, parking, and road access. In addition, a foot trail across one or more of the islands would be necessary. Because the islands are privately owned, special arrangements, including easements or purchases, would be necessary. Similarly, locating the bridge alignment upstream (i.e., to the south) would involve siting the west abutment in Sevier County. Road access to the river is limited in this area. For these reasons, the option of locating the proposed pedestrian bridge either upstream or downstream of the proposed location was considered infeasible and was not considered further in the environmental review.

## **2.2. Comparison of Alternatives**

Under the No Action Alternative, there would be no change from the current conditions. Thus, there would likely be no impacts to the natural environment or to historic properties of the site. Likewise, there would be no visual changes or changes in noise levels. In order to visit both parts of the refuge, visitors would continue to drive approximately 45 minutes to reach the other side.

Under Alternative B, long-term benefits following construction of the bridge would include reduced driving time and associated transportation costs and the enhanced recreational experience of the wildlife refuge. There would be minor long-term negative impacts to cultural resources, floodplain values, visual quality, and river recreation. There would be minor short-term negative impacts from construction to water quality, aquatic life (including threatened and endangered species), aesthetic characteristics (including noise and visual quality), and health and safety.

The implementation of Alternative C would have the same long-term benefits of reduced driving time and costs and the enhanced recreational experience of the wildlife refuge. Under Alternative C, there would also be the same minor long-term negative impacts on floodplains, visual quality, and river recreation as there would be under Alternative B. Under Alternative C, there would be slightly higher potential for impacts on cultural resources due to the increased likelihood of bank erosion during construction. There would be larger and potentially adverse short-term impacts from construction on water quality and aquatic organisms under Alternative C due to the placement of fill in the river. The potential effects to aquatic organisms, including threatened and endangered species, from construction could be so large that they might persist in the long term and have larger cumulative impacts than those anticipated under the other action alternatives.

Adoption and implementation of Alternative D would also offer visitors access to both parts of the wildlife refuge without a long drive. Potential effects to floodplains and river-based recreation would be less than those expected under the other action alternatives. Because construction under Alternative D would not involve placing equipment or foundations in the river, potential effects to water quality and aquatic life, including threatened and endangered species, would be minor. However, potential visual effects under this alternative could be more pronounced due to the height of the support structures. However, these visual changes would be lessened by a commitment to use natural background colors, such as dark brown, gray, or green, on the bridge finish. Because of the need to install the buried anchors and the main cable stays, implementation of Alternative D would result in more soil disturbance landward than the other two action alternatives. Alternatives B and C involve more overall soil disturbance; however, most of this is within the river channel.

### **2.3. The Preferred Alternative**

TVA's preferred alternative is Alternative D - Issue Section 26a Approval for Construction of a Suspension Pedestrian Bridge. Because the bridge would not involve placement of structures in the riverbed or the disturbance of the channel for equipment, potential impacts to water quality and aquatic life would be avoided. The bridge would afford convenient access to the Seven Islands Refuge.

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## CHAPTER 3

### 3.0 AFFECTED ENVIRONMENT

The proposed bridge for the Seven Islands Wildlife Refuge would be located on the French Broad River at FBRM 15.6. The site is in the eastern part of Knox County near the Knox-Sevier county boundary. The Seven Islands Wildlife Refuge is located in the Kelly Bend area of the river. This general area is predominantly rural, with scattered agricultural operations and residential developments. The gently rolling countryside is broken up by intermittent hills and low ridges.

Douglas Dam, which impounds the French Broad to form Douglas Reservoir, is located at FBRM 32.3. The proposed bridge site is located approximately 16.7 miles downstream from Douglas Dam. A bridge on Douglas Dam Road is located at FBRM 31.7 approximately 0.5 mile downstream of the dam. State Route 66, a four-lane highway, crosses the French Broad River on the Ray L. Reagan Memorial Bridge at FBRM 28.2. For several miles downstream of this bridge, there are a few residences along the river. However, development is expanding in this area, and increasing residential development along the river is likely in the long term. The River Islands Golf Club is located on the south side of the river and on Cain Islands near FBRM 19 to 20. Four low-profile bridges connect the Islands to both banks. Downstream from the golf course to the edge of the Seven Islands Wildlife Refuge, there are several upscale homes overlooking the river from both sides of the river.

The segment of the river in the area of the proposed bridge is rural in nature with few houses that can be seen from the river. With the exception of Johnson Bible College (FBRM 10) and a residential development overlooking the river on the south bank at FBRM 7.5, this rural, agricultural character is predominant downstream to the John Sevier Highway (State Route 168) bridge at FBRM 3.9. Immediately downstream of this bridge, the river is bounded on the north by a large industrial complex. However, the south bank is mostly forested, with scattered agricultural land.

As a result of an initial review and evaluation of the proposed bridge project, TVA determined that impacts to other natural features of prime or unique farmland; groundwater; unique or important terrestrial habitats; parklands, state or national forests, trails, greenways, wilderness, scenic or other ecologically critical areas; and wetlands would be either absent or minor. Other than temporarily during construction, noise levels and emissions of air pollutants would not increase. No production of hazardous wastes, wastes requiring special handling and disposal, or negative social or socioeconomic impacts are anticipated. The project is not in conflict with any plan, existing land use, or zoning regulation. No adverse effect on public facilities or services is expected. Therefore, potential impacts to these other features and existing conditions are not discussed further.

TVA determined that the proposed bridge project has potential for adverse effects to water quality and aquatic life (including endangered aquatic species), terrestrial life, cultural resources, floodplains, aesthetic quality, recreation, and NRI-related values. These environmental resources are described below, and potential effects to them are described in Chapter 4.

### 3.1. Aquatic Environment

The aquatic environment in the Seven Islands area can be described in terms of water quality; overall aquatic communities; common and threatened or endangered fish species; and benthic invertebrates, particularly mussels (both common and threatened or endangered species).

The French Broad River is approximately 930 feet wide at the head of the Seven Islands complex. The head of Seven Islands is located approximately 300 feet from the left-descending bank (i.e., the western side) of the river. The river channel on the left-descending side of the island is approximately 285 feet wide and varies in depth from 3 to 10 feet during minimum-flow conditions in the river. Substrate consists primarily of gravel and cobble with some sand and silt in areas with slower current. No aquatic vegetation was observed in this channel. The river on the right-descending side (eastern side) of the Seven Islands complex is much wider (approximately 570 feet) and shallower (3 to 5 feet in depth at minimum flows). Much of this channel is a relatively shallow run/riffle shoal complex with habitat consisting of cobble, gravel, and sand. The deepest portion of the channel on the right-descending side, which is about 5 feet deep at minimum flows, is located along the bank of the river. Extensive aquatic weed beds are present in deeper areas of this channel.

Because the river in this area is located about 17 miles below Douglas Dam, stream flow varies with both rainfall and the operation of the dam. Precipitation in the project area averages about 48 inches per year with the wettest month in March at 5.2 inches and the driest month in October at 2.7 inches. Water releases from Douglas Dam average about 6,700 cubic feet per second (cfs) but can vary daily as well as seasonally depending on factors such as the need for hydropower generation or holding water to minimize flooding downstream. At maximum generation with all four turbines, releases are about 22,000 cfs.

In the summer, there is typically one peak period of generation in a 24-hour period. In the winter, there are typically two peaks in 24 hours. The duration of the peak generation period depends upon the availability of water. Thus, the depth of the river at the site of the proposed bridge would vary from day to day and within each day, creating a fluctuation of as much as 5 feet in water surface elevation. This is the "normal" river environment. The water elevation identified in the description of the proposed action as normal elevation (848 feet) is the elevation at maximum generation, the top of the daily range (TVA 1989).

River elevations can be higher during floods and storms. The calculated 100-year flood would bring river elevations to 855.5 feet above msl and would create an average river depth of 15.5 feet. The calculated 10-year flood has an elevation of about 852 feet and an average depth of about 12 feet. Within the last 20 years, fall tropical storms have given rise to elevations of about 850 feet, or an average water depth across this section of river of 10 feet. The calculated 500-year flood elevation is 862.5 feet.

#### 3.1.1. *Water Quality*

The French Broad River is classified by the Tennessee Department of Environment and Conservation (TDEC) for domestic and industrial water supply, fish and aquatic life, recreation, irrigation, and livestock watering and wildlife. Downstream of Douglas Dam, the French Broad River is also designated as a high-quality (Tier 2) stream due to the presence of aquatic species federally listed as endangered or threatened. The French Broad River for a distance of about 5 miles immediately downstream of Douglas Dam is on the state

303(d) list as impaired (i.e., not fully supporting its designated uses) due to low dissolved oxygen, thermal modifications, and habitat loss due to stream flow alteration caused by Douglas Dam. However, the installation of surface-water pumps at Douglas Dam has improved dissolved oxygen levels in recent years.

### 3.1.2. Overall Aquatic Communities

Prior to the construction of Douglas Dam in 1943, the lower portion of the French Broad River had diverse aquatic communities. This diversity was heavily impacted by the subsequent operation of Douglas Dam and a general lack of concern/awareness of water quality during that era. However, following recent changes in dam operations carried out through TVA's Reservoir Releases Improvement Program, which began in 1987, and subsequent changes resulting from the *Reservoir Operations Study* (TVA 2004), the aquatic communities in the river have improved.

Biological improvements in fish and benthic macroinvertebrate communities have created interest in restoring aquatic species to the French Broad River. Based on TVA monitoring data, recent survey results, and the results of experimental mussel introduction efforts, the French Broad River from Douglas Dam (at FBRM 32.3) downstream to its confluence with the Holston River (at FBRM 0) was recently designated by the USFWS as an "experimental, nonessential population" area for 15 federally listed mussel species, one federally listed snail species, and five federally listed fish species (USFWS 2007).

### 3.1.3. Fish Communities

The French Broad River in the area of the proposed bridge is a hydropower tailwater and is subject to daily fluctuations in flow. Until recently, the tailwater suffered from low dissolved oxygen concentrations and lack of minimum flows. However, it is currently inhabited by reasonably diverse fish communities. Species diversity has increased since TVA began monitoring in 1987 (TVA unpublished data), and 66 fish species have been collected at Seven Islands in recent years. Seventy-four fish species have been recently collected at Saffell Island and 71 species at Campbell Islands. These tailwater sites are located about 14.5 miles upstream and 7 miles downstream, respectively, of Seven Islands.

Fish communities have improved greatly at the monitoring sites in Douglas tailwater following reaeration of discharges and minimum flows from Douglas Dam. TVA routinely monitors the health of stream communities by conducting Index of Biotic Integrity (IBI) sampling in streams throughout the Tennessee Valley. The Seven Islands area has been sampled yearly (with the exception of 2001) since 1997. The IBI scores at Seven Islands (FBRM 15.1) have shown a steady trend of improvement over the last 10 years from initial "fair" or "poor to fair" ratings to recent "good ratings."

One fish species federally listed as threatened, the snail darter (*Percina tanasi*), occurs in this section of the French Broad River. Additionally, three state-listed fish species are present in this section of the river. These are the lake sturgeon (*Acipenser fulvescens*), which is listed as endangered, and the blue sucker (*Cycleptus elongatus*) and tangerine darter (*Percina aurantiaca*), which are both considered in need of management by the Tennessee Wildlife Resources Agency (TWRA). Lake sturgeon are being reintroduced in the French Broad and Holston rivers through a cooperative project of several state and federal agencies. All of these species have been collected at Seven Islands. Suitable spawning habitat for the snail darter and tangerine darter is present at Seven Islands. Most of this habitat is located downstream of the bridge alignment and would not be impacted directly by bridge construction because of the distance. Lake sturgeon and blue sucker

occupy the area, but the presence of any important spawning habitat for these species is unlikely in the project area.

#### 3.1.4. *Benthic Communities*

Benthic (i.e., bottom-dwelling) invertebrate communities, primarily insects and mussels, are also sampled as part of TVA's routine monitoring. The benthic community ratings have consistently been in the "fair" range. This is indicative of the relatively uniform invertebrate communities present in tailwater areas throughout the Tennessee Valley.

#### 3.1.5. *Mussels*

Freshwater mussels and snails are very sensitive to pollution and habitat alteration and are generally very rare in tributary tailwaters. Their persistence in Douglas tailwater is largely due to the warm temperatures of releases from the dam. Declining mussel communities of primarily very old individuals are typically found in the lower half of the Douglas tailwater. However, the improvements that have been seen in fish communities in the French Broad River are also being seen in the mussel community.

The pink mucket (*Lampsilis abrupta*), federally listed as endangered, occurs near Seven Islands. A freshly dead specimen was collected in 2000 during monitoring of U.S. Geological Survey (USGS) mussel transplant efforts at Seven Islands (Dr. James Layzer, Tennessee Technological University, personal communication). Two mussel surveys have been conducted at the proposed project site at Seven Islands. In 2005, in support of a USACE Nationwide Permit for core drilling to determine bridge design, a private contractor conducted a USFWS-required survey for a narrow 20-foot strip across the river (Pennington and Associates Inc. 2005). In 2007, in response to the public notice for the TDEC permit approval for bridge construction, TWRA conducted a second mussel survey (TVA and TWRA 2007). These recent survey efforts found live mussels of at least 10 species at Seven Islands. The vast majority of living mussels are of only one species, the elephantear (*Elliptio crassidens*). However, at least seven mussel species are presently reproducing in the Douglas tailwater. Based on collections of young individuals, these species include elephantear, fragile papershell (*Leptodea fragilis*), pink heelsplitter (*Potamilus alatus*), pistolgrip (*Tritogonia verrucosa*), black sandshell (*Ligumia recta*), pimpleback (*Quadrula pustulosa*), and giant floater (*Pyganodon grandis*). Along the left-descending channel, numerous pistolgrip mussels and one relict pink mucket shell were found. Along the right-descending bank, a couple of hundred elephantears were found. In addition, some pistolgrips and lesser numbers of pimplebacks, pink heelsplitters, and fragile papershells were located. One weathered dead shell of a pink mucket was recovered during the survey. No live specimens of any listed species were collected.

### 3.2. **Terrestrial Life**

#### 3.2.1. *Terrestrial Ecology*

The site of the proposed bridge is located in the Ridge and Valley ecoregion. The Ridge and Valley occurs between the Blue Ridge Mountains on the east to the Cumberland Plateau on the west and is a relatively low-lying area made up of roughly parallel ridges and valleys (Griffith et al. 1998). The proposed bridge project occurs on the very edge of the Southern Shale Valleys subregion and has some geologic characteristics of the Southern Dissected Ridge and Knobs subregion. In the area of the project, the east bank of the French Broad River has characteristics of the Southern Shale Valleys, which consist of lowlands, rolling valleys and slopes, and hilly areas dominated by shale materials. The

west bank of the river is composed of a series of exposed limestone shelves within a heavily forested upland area.

The project footprint of the proposed Seven Islands pedestrian bridge spans from the west side of the French Broad River, across the southeastern tip of the Seven Islands complex, to the east side of the French Broad River (see Figure 1-3). Terrestrial habitat comprises less than half of the project footprint, while the remainder is comprised of riverine habitat. During field reviews in June 2009, two types of terrestrial habitat were observed. These were deciduous forest and early successional or herbaceous habitat. Deciduous forest was present on the island and on the west side of the river; herbaceous vegetation was observed on both the east and west sides of the river.

Early successional habitat observed during the field visit included a herbaceous human access corridor between the river and upland forest on the west side and planted native warm season grasses and wildflowers on the east side (i.e., on the refuge). Birds observed in these areas included red-winged blackbird, brown thrasher, indigo bunting, yellow-breasted chat, Carolina wren, field sparrow, brown-headed cowbird, common yellowthroat, mourning dove, and blue-gray gnatcatcher. Common mammals in the area include striped skunk, eastern cottontail rabbit, white-tailed deer, Virginia opossum, and various rodents. Reptiles often found in early successional habitats include racers, black rat snake, milksnake, and common garter snake.

Deciduous forest habitats consisted of both open deciduous forest on the island and upland deciduous forest with exposed limestone shelves on the west side of the river. The upland forest was comprised of a mature closed canopy, semidense midstory and open understory. Birds observed included great blue heron (near the island), yellow-billed cuckoo, white-breasted nuthatch, Carolina chickadee, tufted titmouse, and pileated woodpecker. These forested areas also provide habitat for other numerous migratory birds such as wood thrush, red-eyed vireo, ovenbird, hooded warbler, and black-and-white warbler. Woodchucks were observed entering and exiting a den in the limestone shelving. Scattered rock outcrops within upland forests also provide habitat for woodrats and other small mammals. Northern zigzag and slimy salamanders may be abundant in deciduous forests. Common reptiles in the local area include eastern box turtle, ring-necked snake, black rat snake, and copperhead.

The west bank of the French Broad River is dominated by deciduous forests, and according to NatureServe (2009), it can be classified as the Ridge and Valley Calcareous Forest. Dominant canopy species included American beech, basswood, black oak, black walnut, chestnut oak, hackberry, pignut hickory, sugar maple, tulip poplar, and yellow buckeye. The understory and shrub-layer are diverse with bladderpod, cucumber magnolia, hop-hornbeam, muscle wood, pawpaw, redbud, red mulberry, and spicebush. The herb-layer contains a variety of flowering plants such as black cohosh, bloodroot, Jack-in-the-pulpit, mayapple, resurrection fern, Solomon's plume, Solomon's seal, and trillium. In addition, alumroot, black-stemmed spleenwort, blunt-lobed woodsia, sedum, and Virginia saxifrage were found growing on the limestone ledges. This community is believed to be relatively common and secure, although good mature examples of large size may be uncommon (NatureServe 2009). Between the forested area and the river, there is a herbaceous corridor primarily used for recreational access to the area. Common fescue, Japanese stiltgrass, and giant ragweed were common. In addition, box elder and tulip poplar occur on the banks of the river.

Native warm season grasses, along with native and nonnative wildflowers have been planted on the Seven Islands Wildlife Refuge on the east bank of the French Broad River. Hackberry, silver maple, and tag alder grow along the east bank of the river in the area of the proposed bridge construction. Blackberry, Japanese honeysuckle, heart-leaf peppervine, poison ivy, and Virginia creeper are common vines along fencerows and areas adjacent to the river. Two large bald cypress trees occur on the south end of the island in the area to be spanned by the bridge.

A June 2009 review of the TVA Natural Heritage database indicated no recorded heronries or caves within 3 miles of the proposed bridge. No heronies or caves were observed during the field visit.

### 3.2.2. *Invasive Nonnative Plants*

Executive Order 13112 defines an invasive nonnative species as any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem, and whose introduction does or is likely to cause economic or environmental harm or harm to human health (U.S. Department of Agriculture [USDA] 2007).

There are no known federal noxious weeds listed on the Federal Noxious Weeds List (USDA 2007) reported from the lands around the project area. In addition, the Southeastern Exotic Plant Pest Council (2006) provides a list of nonnative invasive species that could pose potential threats to native ecosystems and human health for each southeastern state. In reviewing the Tennessee exotic plant pest list (Tennessee Exotic Plant Pest Council 2001), there were 10 (Rank 1) species that pose a severe threat to native ecosystems observed in the area of the proposed bridge. Plants listed as a severe threat include bush honeysuckle, Chinese lespedeza, Chinese privet, Japanese honeysuckle, Japanese stiltgrass, Johnson grass, mimosa, multiflora rose, and oriental bittersweet. Other nonnative species such as Queen Anne's lace, tall fescue, and virgin's bower were also encountered. All of these species have the potential to adversely affect the native plant communities because of their potential to spread rapidly and displace native vegetation. All of the Rank 1 (severe threat) species are of high priority to TVA. Claspig coneflower (*Rubeckia amplexicaule*), a native to the coastal plain species and not known to naturally occur in Tennessee, was found growing in fields where native warm season grasses had been planted.

### 3.2.3. *Endangered and Threatened Terrestrial Species*

A review of the TVA Natural Heritage database indicated that no federally listed or Tennessee state-listed plant species are known to occur within 5 miles of the proposed bridge site. During field surveys in July 2009, no state or federally listed plants were found growing within the footprint of the proposed project.

Review of the TVA Natural Heritage database indicated records of one federally listed as endangered animal (the gray bat) within 3 miles of the project area. No federally listed and no Tennessee state-listed terrestrial animal species are reported from within 3 miles of the project area. However, one federally listed animal (gray bat) and nine Tennessee state-listed terrestrial animals are known to occur within Knox County (see Table 3-1).

**Table 3-1. Protected Terrestrial Animal Species Reported From Knox County, Tennessee**

Common Name	Scientific Name	Federal Status <sup>1</sup>	State Status <sup>1</sup>
<b>Amphibians</b>			
Hellbender	<i>Cryptobranchus alleganiensis</i>	-	NMGT (S3)
Tennessee cave salamander	<i>Gyrinophilus palleucus</i>	-	THR (S2)
<b>Reptile</b>			
Northern pine snake	<i>Pituophis melanoleucus melanoleucus</i>	-	THR (S3)
<b>Birds</b>			
Bald eagle	<i>Haliaeetus leucocephalus</i>	-	NMGT (S3)
Common barn owl	<i>Tyto alba</i>	-	NMGT (S3)
Sharp-shinned hawk	<i>Accipiter striatus</i>	-	NMGT (S3)
Peregrine falcon	<i>Falco peregrinus</i>	-	END (S1)
Common moorhen	<i>Gallinula chloropus</i>	-	NMGT (S1)
<b>Mammals</b>			
Southeastern shrew	<i>Sorex longirostris</i>	-	NMGT (S4)
Gray bat	<i>Myotis grisescens</i>	LE	END (S2)

- = Not applicable

<sup>1</sup> Status abbreviations: END = Endangered; NMGT = Deemed in need of management; THR = Threatened; LE = Listed endangered; State ranks: S1 = Critically imperiled with 5 or fewer occurrences; S2 = Imperiled with 6 to 20 occurrences; S3 = Rare or uncommon with 21 to 100 occurrences; S4 = Widespread, abundant and apparently secure with more than 101 occurrences

The hellbender occurs primarily in medium-sized to large free-flowing streams in the Tennessee and Cumberland River drainages. Inhabited streams possess large rocks or logs that provide shelter and breeding sites. Habitat for hellbenders does not exist in the area of the proposed bridge.

The Tennessee cave salamander is known from subterranean waters of the Tennessee River drainage. Little is known about the habitat requirements of this species. Redmond (1996) proposed that inflow (i.e., sinkhole) caves, as opposed to outflow caves, provide the best habitat. Suitable habitat for the Tennessee cave salamander does not appear to exist in the vicinity of the proposed bridge.

Northern pine snakes inhabit well-drained sandy or loamy soils with dense vegetation, and they often live underground. They have been found in a variety of habitats, including pine barrens, mixed scrub pine and oak woods, dry rocky mountain ridges, sand hills, and old fields (Ernst and Ernst 2003). Suitable habitat for northern pine snakes does not appear to exist in the area of the proposed bridge project.

Bald eagles have recently been removed from the endangered species list but are still protected by the National Bald Eagle Management Guidelines (USFWS 2007) and the *Bald and Golden Eagle Protection Act*. This species typically nests near large bodies of water including lakes, rivers, and riparian wetlands. The closest bald eagle nest record occurs approximately 0.5 mile downstream of the project site. Marginally suitable nesting habitat exists within the proposed project area.

Common barn owls range over large areas. Dense grass fields are the chief foraging and breeding habitat. Nesting habitat includes natural as well as man-made cavities, including trees, steep bluffs, large platforms within barns and silos, tunnels dug into silage in roofed

or topless silos, cavities among hay bales stored inside barns, barn cupola shelves, wooden water tanks, feed bins, church steeples and belfries, and platforms within commercial and industrial buildings (NatureServe 2009). Suitable nesting habitat is not present in the proposed project area.

The sharp-shinned hawk inhabits forest and open woodland characterized as coniferous, mixed, or deciduous. Young, dense, mixed or coniferous woodlands are preferred for nesting. Suitable habitat for this species does not exist at the project site.

Suitable nesting habitat for peregrine falcons ranges from open habitat, especially where there are suitable nesting cliffs, to mountains, open forested regions, and human population centers. Pairs often nest on a ledge or hole on the face of a rocky cliff or crag. Riverbanks, tree hollows, and man-made structures (e.g., ledges of city buildings) are used locally. Nests typically are situated on ledges of vertical rocky cliffs, commonly with a sheltering overhang (NatureServe 2009). Suitable habitat for peregrine falcon does not exist at the project site.

The common moorhen inhabits freshwater marshes, canals, quiet rivers, lakes, and ponds, primarily in areas of emergent vegetation and grassy borders. Suitable habitat for common moorhens does not exist at the project site.

Throughout its range, the southeastern shrew is found primarily in bogs, marshy or swampy areas, in wooded areas with dense ground cover, and in upland fields dominated by grasses and some distance from water. Southeastern shrews establish dens underground. Marginally suitable habitat exists at the project site for this species.

Gray bats roost in caves year-round and typically forage over streams, rivers, and reservoirs. Foraging habitat exists over the nearby French Broad River. No known cave records exist within 3 miles of the proposed bridge site, and no unrecorded caves were found during field investigations. No suitable roosting habitat and only marginal foraging habitat for this species occurs in the proposed project area.

### **3.3. Cultural Resources**

For at least 12,000 years, the lands along the Tennessee and French Broad rivers have been an area for human occupation, which became more intense through succeeding cultural periods. The Paleo-Indian Period (10,000 - 8000 B.C.) represents the documented first human occupation of the area. The settlement and land use pattern of this period was dominated by highly mobile bands of hunters and gatherers. The subsequent Archaic Period (8000 - 1200 B.C.) represents a continuation of the hunter-gatherer lifestyle. Through time, there was increasing social complexity and the appearance of horticulture late in the period. The settlement pattern during this period was characterized by spring and summer campsites. Increased social complexity, reliance on horticulture and agriculture, and the introduction of ceramic technology characterize the Woodland Period (1200 B.C. - A.D. 1000). The increased importance of horticulture is associated with a less mobile lifestyle as suggested by semipermanent structures. The Mississippian Period (A.D. 1000 - 1500), the last prehistoric period in East Tennessee, is associated with the pinnacle of social complexity in the southeastern United States. This period is characterized by permanent settlements, maize agriculture, and chiefdom-level societies. The Protohistoric-Contact Period (A.D. 1500 - 1750) consisted of the effects of European contact in the region. During this period, European contact arose through trade and construction of European settlements along the borders of Native American territory.

European-American settlement increased in the early 19th century as the Cherokee were forced to give up their land.

With the expansion of the United States of America, this location became part of Tennessee. From 1792 until 1933, the project area was part of Sevier and Knox counties, but presently all of the project area is within Knox County. The Tennessee River and French Broad waterways became a part of a major transportation and trade network throughout the region. By the mid-1800s, railroads were constructed, and a more passable roadway system connected Knoxville, Tennessee, to Charleston, South Carolina, and other prominent cities at that time (McArthur 1976). All of these developments solved a number of economic needs for Knoxvillians and brought more settlers and skilled workers to the area. With this advantage, East Tennessee had a more mixed economic base than the middle and western portion of the state by 1860. When the Civil War developed, East Tennessee was generally not supportive of the Secessionist movement because of a low slave population and a diverse economy (D'Angelo 2002). Although a number of Civil War battles occurred in the region, no skirmishes are recorded in the project area. After the Civil War, East Tennessee had social and economic instability, as did most of the former Confederate States. However, the Knoxville economy slowly began to recover through manufacturing and mechanical businesses. Outside of Knoxville, there was little change following the Civil War. Most area residents relied on agriculture for their livelihood.

During this period, there was riverboat service between Knoxville and Dandridge. In several areas of the river such as in wide, shallow areas or near islands, shallow-water diversionary weirs were constructed by the USACE. These structures were made of local rock and were designed to divert the water to a channel deep enough for a riverboat. The remnants of these structures are still evident to recreational boaters, especially during periods of low flow.

With the creation of TVA in 1933, the economy and life styles changed with the wide availability of low-cost electrical services. Electricity, in turn, brought about successful ventures in economic development and recreation to Knoxville and the surrounding communities.

The archaeological area of potential effects (APE) for the proposed bridge project was considered to include the bridge alignment, parking area, and equipment access roads. Knox County arranged for a Phase I archaeological survey and a Phase II site evaluation, which were conducted by DuVall and Associates (Pace et al. 2005; Pace and Spice 2006). The archaeological surveys identified two archaeological sites (40KN262 and 40KN287) that contain archaeological material from the Archaic through Mississippian periods. Both of the sites contain intact archaeological resources that contain information important to prehistory or history and have been determined eligible for listing in the National Register of Historic Places (NRHP).

The immediate area within view of the bridge was considered the APE for historic structures. TVA conducted a survey for historic structures. The survey for historic structures identified three historic structures (H1, H2, and H3) within the background view of the bridge. All three structures are farmhouses constructed in the late 19th century, and they are considered eligible or potentially eligible for listing in the NRHP.

Elsewhere in Knox County, there are additional structures that are listed in the NRHP. These include the Seven Islands Methodist Church, the Leroy Keener House and

associated buildings, and the Captain James Newman House and outbuildings. Although these structures are within 2 miles of the proposed bridge, none are within the viewshed of the proposed pedestrian bridge. Thus, they are not within the project APE.

### **3.4. Floodplains**

The current 100-year flood level along the river at the site is 855.5 feet above msl, and the 500-year flood level is approximately 862.5 feet. As shown by the contour lines in Figure 1-2, the floodplain of both floods extends to the east throughout much of the wildlife refuge near the site, but at the west end of the proposed site, the land rises rapidly away from the river so that the floodplain is considerably narrower.

### **3.5. Aesthetic Quality**

TVA utilizes Scenic Value Criteria for Scenery Inventory and Management (see Appendix F) as a tool to objectively classify and rank its properties and affected project areas based upon scenic value. Developed in 1999, the guide is based upon the need for an objective visual assessment methodology for TVA to understand both natural and human processes that have occurred over time and to help us consider the effects of proposed changes in the landscape and to incorporate people's values into our decisions more effectively.

TVA has taken an active position in managing the high-quality scenery throughout the Tennessee Valley in an effort to conserve visual resources for future generations. The position is based upon compliance with *National Environmental Policy Act* (NEPA) policy and the need to meet the demands of an informed public. TVA's scenic value criteria and assessment methodology provides visual resource specialists with a tool to measure scenic character and to objectively assess the consequences of proposed changes in the landscape.

The criteria for classifying the quality and value of scenery has been adapted from a scenic management system developed by the U.S. Forest Service and integrated with current planning methods used by TVA. The classification process is also based on fundamental methodology and descriptions adapted from *Landscape Aesthetics, A Handbook for Scenery Management* (U.S. Forest Service 1995).

The area near the proposed pedestrian bridge is generally rural in nature and lacks any major sources of noise. The local area contains several working farms, and the loudest sources of intermittent noise are local tractors and other work equipment. Scenic attractiveness in the area of the wildlife refuge and adjacent river is distinctive. Scenic integrity is moderate. The landscape appears to be modestly altered on each side of the river where agricultural activities are taking place.

The area of the wildlife refuge and the adjacent river contains a mixture of forests, open fields, scattered residences, and abandoned and active farmsteads. Although there is suburban development within several miles, the immediate area within view of the proposed bridge site is primarily rural. The topography is varied, with a number of ridges and scenic bluffs. Although views from low, flat areas are short, the views from the ridges and bluffs may reach several miles.

To the north and west, steep ridges help to frame this section of the river. The Seven Islands area is relatively flat and has scattered hardwoods located along the banks. Most views of the project area would likely be from the river itself by recreationists or

intermittently from local roads to the east and southwest. Views to the northwest and southwest of the riverbanks would be much farther, up to middleground distances (0.5 to 4 miles) in some areas, following leaf fall. There are several homes within the viewshed of the proposed bridge. A power line crosses the river approximately 2,200 feet upstream of the proposed bridge alignment.

### 3.6. Recreation

This section of the French Broad is designated as part of the French Broad River Blueway by Knox County in cooperation with a number of regional organizations (Knox County 2007). The Blueway provides a great experience to the recreational floater. The rural/natural character of this river supports varied scenery and allows floaters with limited whitewater skills to access this resource for birding, wildlife observation, and fishing. There are three major road crossings and seven designated public access points within this segment.

Based on the 2006 National Survey on Recreation and the Environment, estimates have been made of the outdoor recreation participation of the residents of the counties surrounding the French Broad River in Tennessee and North Carolina (Green et al. 2006). Table 3-2 is a summary of the participation rates for prominent activities. Over half of the sample population participates in viewing or photographing natural scenery and wildlife. Nearly half view or photograph birds, and over a third are boaters. Canoeing and kayaking are done by less than 10 percent of the population surveyed.

**Table 3-2. French Broad River Activity Participation Rates**

Activity	Percent Participating	Number of Participants
Boating (any type)	35.7	219,000
Canoeing	8.4	51,000
Kayaking	4.5	28,000
View/photograph natural scenery	66.8	409,000
View/photograph birds	40.5	248,000
View/photograph other wildlife	52.6	322,000

Recreation resource demand in Tennessee has been scored using the total number of possible participants (based on participation data) for each resource. The stream/scenic river resource ranked second (natural habitat area was first) among recreation resources demand. The Tennessee State Recreation Plan 2003-2008 (Gardner 2003) states, "It can be concluded that state policies which encourage or support these types of recreation resources will provide the kinds of recreation opportunities sought by the largest numbers of Tennesseans." The natural character and the associated recreational opportunities offered by the French Broad River are especially important due to its proximity to the large urban area of Knoxville, Tennessee. The Seven Islands Wildlife Refuge is designated by Knox County as part of its greenway system.

Existing boating near the proposed bridge is constrained by several factors. Shoals both upstream and downstream of the Seven Islands Wildlife Refuge create a section of river several miles long, which is typically only accessible by shallow draft vessels such as small, open fishing boats, canoes, kayaks, and rafts. Occasionally, boats with jet propulsion will traverse this section of the river. The upstream and downstream shoals and the

fluctuations in surface elevation and river current due to intermittent releases from Douglas Dam and from storms make this a difficult section for propeller-driven boats to navigate. Many users of the river are locals, and there are day use paddlers who bring their canoes and kayaks to enjoy the mostly rural scenery. Canoes and kayaks are particularly sensitive to changes in the strength of the current.

The Seven Islands launch ramp is located at the upstream boundary of the Seven Islands Wildlife Refuge. This ramp is approximately 2 miles upstream of the proposed bridge site within the shallow navigable waters section created by the shoals. The ramp is posted “For Small Craft Use Only.” Another small ramp, the Claussen ramp, is located on the west bank adjacent to the proposed bridge alignment. Both of these ramps are maintained by Knox County.

### **3.7. Nationwide Rivers Inventory**

The site of the proposed bridge is located in a 32-mile-long segment of the French Broad River that is listed on the NRI. To be eligible for inclusion on the NRI, a river or stream must be free-flowing and possess at least one “outstandingly remarkable value.” “Free-flowing” is defined in Section 16 of the *Wild and Scenic Rivers Act* as “existing or flowing in a natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway.” In order to be assessed as outstandingly remarkable, a river-related value must be a unique, rare, or exemplary natural, recreational, or similar feature that is significant at a comparative regional or national scale (Interagency Wild and Scenic Rivers Coordinating Council 1999). These outstandingly remarkable values include the following: scenery, recreation, geology, fish (including populations and habitat), wildlife (also including populations and habitat), prehistory, history, and “other values.” Additional information about outstandingly remarkable values is provided in Appendix G.

Additionally, eligible river segments may be classified according to the extent of evidence of human activity as one of the following categories:

- *Wild River Areas* – Those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.
- *Scenic River Areas* – Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.
- *Recreational River Areas* – 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.

Rivers on the NRI may be given a preliminary classification according to the criteria summarized in Table 3-3. In situations where the levels of human activity vary within a river reach, the reach may be segmented into more than one class.

**Table 3-3. Classification Criteria for Wild, Scenic, and Recreational River Areas**

Attribute	Wild	Scenic	Recreational
<b>Water Resources Development</b>	Free of impoundment	Free of impoundment	Some existing impoundment or diversion. The existence of low dams, diversions, or other modifications of the waterway is acceptable, provided the waterway remains generally natural and riverine in appearance.
<b>Shoreline Development</b>	Essentially primitive. Little or no evidence of human activity. The presence of a few inconspicuous structures, particularly those of historic or cultural value, is acceptable. A limited amount of domestic livestock grazing or hay production is acceptable. Little or no evidence of past timber harvest. No ongoing timber harvest.	Largely primitive and undeveloped. No substantial evidence of human activity. The presence of small communities or dispersed dwellings or farm structures is acceptable. The presence of grazing, hay production, or row crops is acceptable. Evidence of past or ongoing timber harvest is acceptable, provided the forest appears natural from the riverbank.	Some development. Substantial evidence of human activity. The presence of extensive residential development and a few commercial structures is acceptable. Lands may have been developed for the full range of agricultural and forestry uses. May show evidence of past and ongoing timber harvest.
<b>Accessibility</b>	Generally inaccessible except by trail. No roads, railroads or other provision for vehicular travel within the river area. A few existing roads leading to the boundary of the river area is acceptable.	Accessible in places by road. Roads may occasionally reach or bridge the river. The existence of short stretches of conspicuous or longer stretches of inconspicuous roads or railroads is acceptable.	Readily accessible by road or railroad. The existence of parallel roads or railroads on one or both banks as well as bridge crossings and other river access points is acceptable.
<b>Water Quality</b>	Meets or exceeds federal criteria or federally approved state standards for aesthetics, for propagation of fish and wildlife normally adapted to the habitat of the river, and for primary contact recreation (swimming), except where exceeded by natural conditions.	No criteria prescribed by the [National Wild and Scenic Rivers] Act. The <i>Federal Water Pollution Control Act Amendments of 1972</i> have made it a national goal that all water of the United States be made fishable and swimmable. Therefore, rivers will not be precluded from scenic or recreational classification because of poor water quality at the time of their study, provided a water quality improvement plan exists or is being developed in compliance with applicable federal and state laws.	

Source: Interagency Wild and Scenic Rivers Coordinating Council (1999).

Rivers on the NRI may be designated into the National Wild and Scenic Rivers System in two ways. First, a river may be designated by an act of Congress. Second, the Secretary

of the Interior may designate a river, provided the river is designated into a valid state river protective system and the governor applies for designation. Applications from the states are evaluated and processed by the NPS.

The segment of the French Broad River that is included on the NRI runs from the tailwater immediately below Douglas Dam (i.e., FBRM 32.3) to the French Broad's confluence with the Holston River to form the Tennessee River at FBRM 0. This segment is recognized by the NPS (2009) for its outstandingly remarkable values of scenery, recreation, geology, fish, wildlife, history, and cultural resources. However, this river segment does not have a potential classification (i.e., wild, scenic, or recreational) with respect to inclusion in the National Wild and Scenic Rivers System. This river segment is not a part of the National Wild and Scenic Rivers System.

## CHAPTER 4

### 4.0 ENVIRONMENTAL CONSEQUENCES

In this chapter, the potential effects anticipated from adopting each of the four alternatives are described. The discussion of these effects is organized by environmental characteristic in the same order as they were described in the previous chapter.

#### 4.1. Aquatic Life

##### 4.1.1. *Alternative A*

Adoption of Alternative A would result in no impact on the aquatic environment or to surface water quality because no change from current conditions would occur.

##### 4.1.2. *Alternative B*

Implementation of Alternative B would result in impacts on the aquatic environment. These potential effects are described below.

##### 4.1.2.1. Water Quality

Construction activities along the banks and within the river could disturb bottom sediments and aquatic life. Without proper containment methods, pier construction and the placing of concrete could alter stream pH<sup>2</sup> and introduce potential pollutants to the river. Soil disturbances associated with access roads and other construction activities can potentially result in adverse water quality impacts. Sedimentation from soil erosion or bottom excavation can cover the stream bottom and harm aquatic life.

Disturbance of the stream bottom would occur at each of the nine sites for the piers and in any areas needed to provide access to the river. With use of dewatered cofferdams, concrete would be kept out of the water so that stream pH would not be altered. Minor soil disturbance on the riverbanks, on the island, and in instream areas immediately adjacent to the riverbank would likely occur. Appropriate BMPs would be employed to minimize soil disturbance and to contain any soils or sediments disturbed during construction.

Proper implementation of BMPs, compliance with applicable environmental laws and regulations, and adherence to the provisions of required state permits (e.g., ARAP and Storm Water Construction Permit) are expected to result in only temporary and minor surface water impacts. The relevant standards of the General ARAP for Construction and Removal of Minor Road Crossings are contained in Appendix D. TVA has reviewed these standards and determined that they would be adequate for reducing potential impacts to water quality to minor levels.

##### 4.1.2.2. Fish

Equipment use in the river could directly affect fish species, including the federally listed snail darter and state-listed lake sturgeon, blue sucker, and tangerine darter by disrupting their habitat. Because instream disturbance would be confined to a relatively narrow (less

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<sup>2</sup> pH is a measure of how acidic or alkaline a substance is. Acids have pH values under 7, and alkalis have pH values over 7. If a substance has a pH value of 7, it is neutral—neither acidic or alkaline.

than 100-foot-wide) corridor parallel to the bridge alignment across the width of the river, the potential for impacts to listed fish species is low under this alternative as compared to other methods of instream construction (e.g., construction from a causeway under Alternative C). Any fish present in disturbed areas would be temporarily displaced but would not be subject to long-term impacts or mortality. Disturbance would occur only during construction, and most instream habitat is expected to return to preconstruction conditions after work is completed. Installation of the nine instream piers would permanently alter habitat conditions at these sites, but habitat alteration in these areas represents a minor loss of available habitat. Release of silt and rock cuttings from this activity would be minor and would pose minor effects to downstream fish habitat.

Uncured concrete is highly toxic in aquatic environments and can result in mortality of fish and mussels if large amounts are introduced into the water. To prevent this, all concrete and grouting used during this project would be contained in the dewatered coffer cells. Therefore, no impacts to listed threatened or endangered species are likely to occur from the release of uncured concrete.

Because the amount of instream disturbance using this construction method would be minor, no noticeable effects to snail darters (or other state-listed species) from siltation or direct habitat loss would occur. Snail darters (and state-listed fish species) would avoid areas of instream disturbance while construction activities are ongoing, but would likely return to those disturbed areas following project completion. Habitat loss from the construction of instream piers would be minor (i.e., less than 1 percent of the available habitat). Therefore, construction of the proposed pedestrian bridge crossing the French Broad River at Seven Islands by this method is not likely to adversely affect individuals or populations of the federally listed snail darter and would not have an adverse effect on the state-listed fish species present in the area.

#### **4.1.2.3. Mussels**

Because mussels are sedentary and are restricted to suitable instream habitat, use of heavy equipment in the riverbed can cause direct impacts to mussels. Because individuals of the federally listed pink mucket are present in the area, instream disturbance has the potential to directly affect individuals of this species. Equipment use could result in crushing individuals or displacing material in the riverbed (e.g., sand, gravel, and rock), which could cover individual mussels and result in physiological stress or mortality. During pier construction, coffer cells would be installed, pumped dry, and drilled, the refuse would be removed, and then the cells would be filled with concrete. Any mussels present in the footprint of the coffer cell would most likely be destroyed. However, all nonlisted mussels found within these footprints would be relocated prior to commencement of construction activities. Pink muckets are not likely to be found within the footprint of the coffer cells or within areas affected by construction traffic.

Additionally, use of construction equipment in the water could disturb sediment and introduce suspended material into the water column. In large amounts, suspended sediment may interfere with mussel feeding, and resettlement of suspended sediment can smother individual mussels. As stated above, uncured concrete is toxic to aquatic organisms, including mussels. Appropriate BMPs would be employed to minimize instream sediment effects to the extent practicable, and all uncured concrete or grout would be contained within the coffer cells.

In addition to the BMPs specified in the General ARAP for Construction and Removal of Minor Road Crossings, the following measures would be employed to reduce the potential to adversely affect individuals of the federally listed pink mucket (or any of the other more common mussel species present in the Seven Islands area):

Within two weeks prior to the commencement of instream construction, all instream areas would be surveyed for mussels (including individuals of the federally listed pink mucket). Mussels that would be directly affected by equipment use (including the pier footings and any areas where equipment would be driven) would be relocated to areas of appropriate habitat at least 50 feet from instream disturbance. (As part of the 2007 mussel survey discussed above, several hundred mussels were removed from the bridge alignment. However, due to the large number of mussels and river operating conditions, a sizable percentage of the mussels could not be moved out of the area that could be affected by instream construction.)

If even one individual pink mucket mussel were found during relocation, construction work would be halted immediately, and TVA, USACE, and FHWA would initiate formal consultation with USFWS to determine proper measures to minimize impacts to this species. No relocations of pink mucket and no further construction activities would be allowed until formal consultation is completed. Provided this consultation is completed to the satisfaction of the USFWS, major project modifications and appropriate avoidance and mitigation measures would be mandated. These modifications and measures would result in substantial increases in project cost and a substantial delay in project completion.

These relocation efforts would be performed by agencies, organizations, or private consultants who hold appropriate endangered species permits, and this effort would be coordinated with TVA, TWRA, and the USFWS. TVA would assist TWRA and/or USFWS in relocating mussels. If TWRA or USFWS were not available, the applicant would hire a private consultant with the proper credentials for handling threatened or endangered species.

Given the general conditions for the ARAP and the protective measures outlined above, if no pink muckets are encountered during relocation efforts, this action is not likely to adversely affect individuals or populations of the pink mucket. Construction activities would have some short-term (i.e., for the duration of construction activities) effects on habitat for these species in the French Broad River and would result in the permanent loss of a very small amount of available habitat at the pier locations. Only minor effects to aquatic habitat or communities in the French Broad River would occur from the construction of the pedestrian bridge proposed under Alternative B.

The overall aquatic communities and benthic communities occupy much larger areas than the small area affected by construction activities (i.e., less than 1 percent of the available habitat within the project area). These communities would experience limited impacts from the construction of the proposed bridge. Therefore, TVA has determined that there would be minor impacts on overall general aquatic and benthic communities in the French Broad River.

#### 4.1.3. *Alternative C*

The adoption of Alternative C would result in potential impacts to water quality and to the aquatic environment as discussed below.

#### **4.1.3.1. Water Quality**

In addition to the impacts from the construction of the piers noted above under Alternative B, use of the rock pads for pier construction would temporarily reduce the cross-sectional area of the stream. This would likely increase water velocities, bottom scour, and shoreline erosion near the pads. Eroded and scoured materials would increase turbidity of the water until these materials were deposited downstream of the project area.

Proper implementation of BMPs, compliance with applicable environmental laws and regulations, and adherence to the provisions of required state permits (e.g., ARAP and Storm Water Construction Permit) are expected to limit the direct effects of construction on water quality. For example, use of proper containment methods and placement of only clean rock and gravel for the pads would introduce minimal additional silt and sand to be deposited downstream in the river. Nevertheless, a certain amount of scouring of the bottom and subsequent sedimentation elsewhere would likely be unavoidable due to the need to release high flows from Douglas Dam to meet peak power demand and the likelihood of high-flow storm events during the construction period.

#### **4.1.3.2. Fish and Mussels**

Installation of rock fill would cover areas of the river bottom between 50 and 100 feet wide along the route of the causeway(s). These areas would be unavailable for use by fish, and any mussels present in these areas would be buried by placement of fill. Even if the majority of fill were removed following the completion of construction, long-term alteration of instream habitat would result from placement of this fill. However, due to the size of the riprap that would be used, the rock fill is not likely to be dislodged from the causeway during construction, and any downstream deposition is expected to be minor.

Because water flow would be diverted and concentrated in areas along the shoreline, there would be substantially increased erosion in these shoreline areas and particularly at the head of Seven Islands. Depending upon the extent of channel blockage and the amount and direction of flow diversion, shoreline erosion effects could extend some distance downstream from the causeways. Any materials mobilized by this erosion would be deposited downstream.

River flows would be concentrated at the stream end (rather than at the landward end) of the causeway(s), resulting in unavoidable instream impacts. There is the potential to scour all mobile bed load<sup>3</sup> (i.e., rock, sand, gravel, and silt) from these areas and expose the underlying bedrock or hardpan. Any mussels present in these areas would likewise be displaced and deposited in downstream areas along with the streambed materials. Movement and the subsequent deposition of this material downstream would likely result in burying mussels present in those areas and would likely alter habitat characteristics necessary for use by the fish species present in those areas.

Although erosion of shoreline areas could be reduced by stabilizing these areas prior to construction of the causeway, instream erosion effects and habitat alterations due to scouring are likely unavoidable.

Placement of the causeway(s) in the river would result in a slowing of current in areas on the upstream and downstream side of the causeway. This would result in increased

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<sup>3</sup> Bed load is solid material that moves along a stream bottom, in contrast to lighter material carried in suspension or solution by the current.

sediment deposition in these areas, particularly along the downstream side. Sediment deposition may smother any mussels present in these areas and would alter habitat conditions as long as a barrier to flow is present. Fine sediment deposition would promote the growth of vegetation in these areas and may result in long-term alteration of stream habitat. Removal would allow flushing of some of the deposited sediment from these areas, but there is potential for long-term habitat alteration in these areas.

The federally listed snail darter would be subject to unavoidable impacts under Alternative C due to the construction methods used. Large areas (greater than 0.5 acre) of habitat likely used by the species would be covered by placement of fill. Even if the majority of fill were removed following construction, long-term adverse effects on this habitat are likely. Instream snail darter habitat (including potential spawning sites) would at least be temporarily altered by scouring and sediment deposition. These changes are likely to adversely affect the population of snail darters present in the Seven Island area of the French Broad River. These impacts would likely result in the incidental “take” of snail darters as defined under regulations implementing the *Endangered Species Act*. Habitat used by the tangerine darter would be similarly affected. Because blue sucker and lake sturgeon are large, highly mobile fish, populations of these two species are likely to be affected only minimally by scouring or sediment deposition in the area of the bridge.

Any mussels present in areas directly affected by placement of fill (potentially including pink mucket) would be buried. Mussels in areas adjacent to the causeway(s) may be displaced by scouring and deposited in downstream areas that contain unsuitable habitat. Some (or all) mussels present in areas where sediment deposition increases could potentially be smothered by these deposits. Even if the majority of fill material were removed following construction, there would likely be long-term alterations to the instream habitat in these areas. These alterations are likely to adversely affect pink mucket mussels present in the Seven Island area of the French Broad River. These impacts would likely result in the incidental “take” of pink mucket mussels as defined under regulations implementing the *Endangered Species Act*. Nonlisted mussels present in the area would be affected similarly.

If Alternative C were adopted, TVA, USACE, and FHWA would initiate formal consultation with the USFWS, culminating in the issuance of a Biological Opinion by the USFWS. The reasonable and prudent measures necessary to minimize the incidental take could require major project modifications and appropriate avoidance and mitigation measures.

#### 4.1.4. *Alternative D*

##### 4.1.4.1. **Water Quality**

The bridge design under Alternative D calls for spanning the river and would not involve the placement of any structures or construction equipment in the river. Thus, the potential scouring and sediment deposition caused by the causeways under Alternative C would not occur. Similarly, the direct physical disturbance of the river bottom to construct the bridge piers would not occur under Alternative D. The potential for sediment to enter the river during construction of the abutments under Alternative D is comparable to that expected under the other action alternatives.

Alternative D involves additional excavation to bury the bridge anchors. These excavations would occur well inland, i.e., approximately 155 feet on the west bank and about 350 feet on the east bank (see Section 2.1.4). The excavated material would be piled adjacent to

the pit during construction. Much of the material removed would be used to refill the hole. Thus, there is a potential for off-site movement of soil material during heavy rain events. To prevent this, storm water would be diverted away from the abutment excavations and from excavation areas associated with the main cable stays by using BMPs as documented in the *Tennessee Erosion and Sediment Control Handbook* (TDEC 2002). Additionally, the construction contractor would be required to install a silt fence down gradient of any excavation area in accordance with BMPs (see Section 4.9).

Excavated material would be removed from the work area and stockpiled outside of drainageways and away from steep slopes, at least 150 feet from the river or would be removed from the site for beneficial use elsewhere. The stockpile site would be stabilized to prevent the movement of material from the stockpile to the river. Surplus excavated material would not be left in the stockpile indefinitely.

In the event that storm water or groundwater accumulates in the excavations, the construction contractor would be required to establish a temporary aboveground dewatering structure in accordance with BMPs (TDEC 2002). The area around the abutments and the main cable stays would be stabilized with suitable vegetative cover. Once this is done, all materials used for erosion control and the collected sediment would be removed from the work area and properly disposed. With these measures in place to prevent entry of soil material into the water and because there would be no instream disturbance, any potential effects to surface water quality would be minor.

#### **4.1.4.2. Fish and Mussels**

Implementation of Alternative D would not involve any physical bottom disturbance or changes in flow patterns resulting from construction activities. Appropriate BMPs would be used to control off-site movement of soil and rock materials from excavated and stockpile areas on the riverbanks. Thus, the adoption of Alternative D is not likely to affect aquatic life adversely. Construction of the proposed bridge under Alternative D is not likely to adversely affect the pink mucket mussel, the snail darter, or their habitat in the French Broad River. TVA has informed USFWS of this determination, and USFWS concurred with the determination in a letter of July 22, 2009 (see Appendix A). Thus, TVA's responsibilities under Section 7 of the *Endangered Species Act* are satisfied with respect to this alternative.

## **4.2. Terrestrial Life**

There are no known populations of threatened or endangered plant species occurring within or around the proposed pedestrian bridge at Seven Islands. Therefore, no adverse effects to rare botanical resources, including listed plant species, are expected to occur under Alternative A, B, C, or D.

### **4.2.1. Alternative A**

Under the No Action Alternative, TVA would not issue Section 26a approval, and the bridge would likely not be constructed. Therefore, no impacts are expected to the forested area on the west bank of the French Broad River or to the fields on the east bank of the river under this alternative. In addition, the introduction and spread of exotic invasive species is not anticipated from the adoption of the No Action Alternative. Adoption of Alternative A would result in no effect on the terrestrial life, including listed terrestrial animal or plant species, in the area because no change from current conditions would occur.

#### 4.2.2. *Alternatives B and C*

Construction of the proposed bridge under Alternative B or C would involve a relatively minor amount of ground disturbance on the riverbank (see Section 2.1.2). Most of this clearing would be at the bridge abutment at each riverbank, while a small amount of clearing and surface disturbance would be required for construction access roads and laydown areas. Vegetative cover in these areas would be reestablished with native plants or noninvasive species following construction. Thus, potential loss of wildlife cover and habitat would be minor and temporary under either of these two alternatives. Because of the minor amount of vegetative disturbance and the fact that the bats tend to forage over water, there would be no effects to gray bats or their habitats under these two alternatives.

Under Alternative B or C, construction of the bridge abutment located on the west bank of the river would involve the removal of vegetation and could affect a small portion of the adjacent forested area. This clearing of forested habitat under Alternative B or C would increase forest edge habitat on the west side of the French Broad River. Overall, the amount of forest conversion would be minor on a regional basis. Some species, such as several neotropical migrant songbirds, are dependent on large forested areas and are negatively affected by forest conversion. Conversely, several animal species require early successional habitats. However, most species that would be affected by these changes are locally and regionally common. Thus, the overall effects to terrestrial animals from clearing under Alternative B or C would be minor.

No caves and no heron colonies are known to occur within 3 miles of the project area. Construction of the proposed bridge under Alternative B or C is expected to result in minor direct or indirect impacts to terrestrial wildlife or habitats.

There is no suitable habitat in the immediate area of the proposed bridge for hellbender, Tennessee cave salamander, northern pine snake, common barn owl, sharp-shinned hawk, peregrine falcon, and common moorhen. None of these listed species would be affected under Alternative B or C. Some marginally suitable foraging habitat exists for the gray bat along the river, and nearby fields provide marginal habitat for the southeastern shrew. Thus, bridge construction under Alternative B or C is not expected to affect or decrease the availability of any of these habitats to either species, and neither species would be affected.

One currently active bald eagle nest is located approximately 0.5 mile downstream of the project area. Bridge construction may involve removal of some individual trees on the island, along both shorelines, and upslope into the upland deciduous forest. However, because no bald eagle nests occur within the project area, and because abundant roosting trees occur in the area, the proposed action alternative is not expected to affect this nesting pair or other bald eagles. Construction and operation of the bridge is not expected to result in impacts to bald eagle foraging habitat.

No designated critical habitats for federally listed terrestrial animal species are known from Knox County, Tennessee. Implementation of Alternative B or C would result in only minor direct, indirect, or cumulative adverse impacts to protected terrestrial animals or their habitats.

#### 4.2.3. *Alternative D*

Construction of the bridge support towers, along with the cable stays and buried anchors, would require clearing and excavation on both banks of the river. On the eastern side of the river, the excavation would occur in an open area (see Figures 1-2 and 1-3). However,

on the western bank, the necessary excavations, including areas for stockpiling the excavated fill, would occur on a forested hillside. In this area, approximately an acre of clearing would be necessary.

Construction of the abutment on the west bank under Alternative D would adversely affect the terrestrial communities associated with the nearby limestone ledges and the adjacent forested area. However, the cleared area would be restricted to the area in the immediate “footprint” of the anchors, the support cables, and the support tower bases. To prevent the introduction of exotic invasive species, disturbed areas would be revegetated with native or noninvasive plant species. Any riprap used for bank stabilization would be clean and weed free. Thus, potential effects to the local terrestrial life, including the introduction and spread of invasive nonnative species, would be minor.

Because there are no known populations of federally or state-listed plant species occurring in the immediate area of the proposed suspension bridge, there would be no effects to rare botanical resources under Alternative D. Because of the limited amount of clearing, there would be no potential effects to the federally listed as endangered gray bat or to its foraging habitat from the construction of the proposed pedestrian suspension bridge under Alternative D.

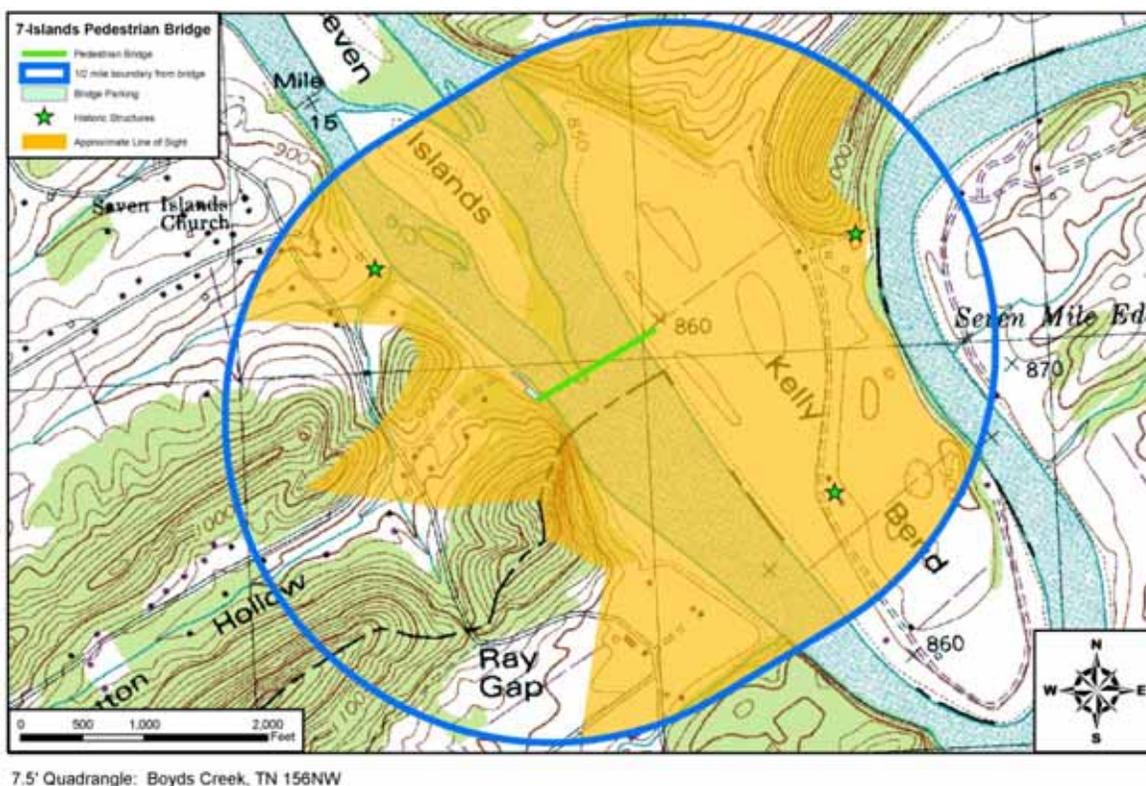
### **4.3. Cultural Resources**

#### *4.3.1. Alternative A*

Adoption of Alternative A would result in no impact to historic properties because none of the proposed actions would occur, and the area around the site of the proposed bridge would remain unchanged.

#### *4.3.2. Alternative B*

Implementation of Alternative B would result in potential impacts to historic properties. The areas within which the bridge could be seen (i.e., the viewshed of the proposed bridge) and the location of the historic structures (H1, H2, and H3) are provided as Figure 4-1. TVA determined that the bridge design under Alternative B would be only a minor change to the setting of the historic structures due to its location within the background views, its low profile, its unobtrusive architectural style, and its finished steel with a natural look, which over time would acquire a rust appearance due to weathering. Thus, there would be no adverse effects on nearby historic structures eligible for listing in the NRHP under Alternative B. TVA consulted with the Tennessee SHPO regarding this determination. In a letter dated May 4, 2007, the SHPO concurred with TVA that there would be no adverse effects on the historic structures under Alternative B (see Appendix A).



**Figure 4-1. Historic Structure Viewshed From Proposed Bridge Site**

TVA also consulted with the SHPO and appropriate Indian tribes to determine the potential effects of the project on two archaeological sites. Through consultation with the SHPO, these sites were determined to be eligible for listing in the NRHP.

TVA worked with Knox County to redesign the bridge to avoid one archaeological site. However, the other site would be adversely affected by the excavation and placement of a caisson for the bridge, and the heavy equipment access route has not been finalized. To address the minimization of adverse effects through phased survey compliance, a memorandum of agreement (MOA) was executed between TVA, Knox County, and the SHPO. The USACE was invited to be a signatory to the MOA. The United Keetoowah Band of Cherokee Indians in Oklahoma agreed to be a concurring party to the MOA. A copy of the MOA is included in Appendix H).

Under the stipulations set forth in the MOA, additional archaeological investigations (i.e., monitoring of the excavation of caisson location) would be conducted during construction. Compliance with the MOA requirements would ensure that TVA's responsibilities under Section 106 of the *National Historic Preservation Act* (NHPA) have been met and that any impacts to eligible archaeological sites would be properly avoided or mitigated.

#### 4.3.3. *Alternative C*

The placement of causeways associated with Alternative C could increase erosion along both riverbanks and along the island during the construction period of the proposed bridge. Earlier archaeological testing focused on the refuge side and the TWRA parking area rather than on the island proper. The archaeological resources present on the island would likely

be adversely affected under Alternative C due to the increased erosion inherent under this alternative. Additional archaeological testing along the island and both riverbanks would be necessary to satisfy the requirements of Section 106 of the NHPA. Based on the terrain in the vicinity, an area 2 river miles downstream and 400 feet upstream of the causeways (including islands and riverbank) could be impacted, covering a total of approximately 10 shoreline miles.

Activities under this alternative would be undertaken in accordance with the stipulations set forth in the MOA, requiring additional archaeological investigations (and monitoring of the excavation of caisson location) during construction. Implementation of this alternative may also require additional consultation with the SHPO, Knox County, USACE, and federally recognized tribes. Should this alternative be adopted, the MOA would be amended to address the effects of causeway construction on historic properties. As under Alternative B, compliance with the MOA requirements would ensure that TVA's responsibilities under Section 106 of NHPA have been met and that any impacts to eligible archaeological sites would be properly avoided or mitigated.

For the same reasons explained under Alternative B, implementation of Alternative C would have no adverse effects on the identified historic structures.

#### *4.3.4. Alternative D*

Construction of a suspension bridge under Alternative D would involve more extensive landward excavation than construction under the other two action alternatives. If this alternative were adopted, TVA would require the applicant to comply with the stipulations in the MOA. These stipulations could require additional archaeological investigations and the monitoring of excavated areas during construction. As under the other action alternatives, compliance with the MOA requirements would ensure that TVA's Section 106 responsibilities have been met and that any impacts to eligible archaeological sites would be properly avoided or mitigated.

For the same reasons explained under Alternative B, implementation of Alternative D would have no adverse effects on the identified historic structures. The SHPO concurred with this determination (see Appendix A – e-mail from Joseph Garrison dated July 21, 2009).

## **4.4. Floodplains**

### *4.4.1. Alternative A*

Under Alternative A, there would be no impact to floodplains or floodplain functions because current conditions would not change.

### *4.4.2. Alternative B*

Adoption of Alternative B would result in the construction of the bridge in the floodplain. The bottom of the deck of the bridge would be at elevation 856.5, which is 1 foot above the 100-year flood elevation. The Knox County floodplain manager has confirmed that this would conform to the county floodplain regulations. The county has also determined that the presence of the bridge would alter the existing floodplain slightly between FBRM 14.14 downstream of the site and the county line at about FBRM 16.5 upstream of the site. The floodway would be widened a maximum of approximately 300 feet at the upstream point and narrowed approximately 600 feet at the downstream point. These alterations were approved by FEMA. Permitting the proposed bridge would be consistent with Executive Order 11988 Floodplain Management because bridges are repetitive actions in the 100-

year floodplain, and the county would implement measures to minimize impacts to the floodplain. The bridge would not encourage development elsewhere in the floodplain of the river.

#### 4.4.3. *Alternative C*

Implementation of Alternative C would result in the essentially the same long-term impacts to floodplains as those anticipated under Alternative B. However, the presence of the rock causeways in the river during the construction period would likely reduce the flood storage capacity of the river, potentially causing the flood levels to be raised over what they would be under Alternative B.

#### 4.4.4. *Alternative D*

The proposed suspension bridge design calls for the abutments and support cables to be located at an elevation above the 500-year flood elevation. The deck bottom of the suspension bridge proposed under Alternative D would be located at least 1 foot above the 100-year flood elevation (855.5). Because the deck would arch slightly, the clearance at midspan would be well above the 100-year flood elevation. Thus, adoption of Alternative D would not pose any effects to floodplains or their function.

### 4.5. **Aesthetic Quality**

#### 4.5.1. *Alternative A*

The selection of Alternative A would not result in the generation of any additional noise beyond existing levels because the proposed project would not be undertaken, and there would be no change from the current conditions. Additionally, scenic quality would not be affected. Thus, there would be no changes in the aesthetic qualities of the area from the adoption of the No Action Alternative.

#### 4.5.2. *Alternative B*

The adoption and implementation of Alternative B would cause a noticeable increase in noise levels during construction. Users of the refuge would experience this noise, but the effects would be temporary for the duration of the construction. There are several houses near the western end of the proposed bridge site, and these residents would hear the construction noise. However, because the construction process would be temporary and limited to daylight hours, the overall noise-related effects would be minor.

Under Alternative B, the construction activity and, later, the presence of the bridge itself would be considered changes in the visual setting of the area. The areas from which the proposed construction and bridge could be seen are shown in Figure 4-1. The bridge design under Alternative B and the associated construction activities would be most visible to boaters and steadily less visible for viewers farther away in the refuge. However, they would be visible in the background to residents of a number of nearby homes.

The proposed bridge design under Alternative B would be visible as a low, architecturally simple feature with muted colors. The bridge would not be lighted, so there would be no increase in night light levels. Details of the bridge would be absorbed into larger patterns in middleground distances and beyond. At distances in the foreground (0 feet to 0.5 mile), the bridge would appear as a contrasting architectural element depending upon the viewer's viewing position and the duration of the view. This contrast would likely not be adverse when contrasting the broadly horizontal bridge in the landscape to the wide expanse of river and its heavily vegetated shoreline. Therefore, TVA has determined that the potential

impact of the bridge design under Alternative B on visual quality would be minor. Construction equipment would be more noticeable than the bridge itself, but the construction and related impacts would be temporary. Thus, potential effects to aesthetic quality would be minor if Alternative B were adopted.

#### 4.5.3. *Alternative C*

Construction activities under Alternative C would likely result in somewhat greater noise levels than those expected under Alternative B. As with Alternative B, construction of the piers would generate noise. However, under Alternative C, there would be the construction noise resulting from the building and removing the rock pads and causeways. This would include the noise of trucks bringing and removing the rock and the noise of unloading and loading the necessary rock and gravel. Truck noise would be concentrated at the start and end of the construction process but might extend beyond normal work hours due to the need to place and remove pads and causeways expeditiously.

Because the bridge design under Alternative C would be the same as that under Alternative B, the potential visual effects of the proposed bridge under Alternative C would likely be the same as those expected under Alternative B.

#### 4.5.4. *Alternative D*

Potential noise-related impacts under Alternative D would likely be comparable to or perhaps less than those expected under Alternative B or C. Because of the design and because no rock or gravel for causeway construction would be necessary, there would likely be much less truck traffic under this alternative than under B or C. Primary noise sources under Alternative D would be from equipment used to excavate the footings for the support towers and the anchoring system. This noise would be temporary, as it would be confined to the construction period. Overall, noise-related impacts expected under Alternative D would likely be minor.

Under Alternative D, construction of a pedestrian suspension bridge would cause a change in the local visual character, potentially lowering scenic integrity from high to moderate with little change in scenic attractiveness. Because the support structures on each bank would likely be from 80 to 100 feet high (but no more than 135 feet), the proposed suspension bridge would present a higher profile than the design proposed under Alternative B or C. However, because the suspension bridge would not involve the construction of piers in the river, it would likely appear less massive than the alternate designs. These visual changes would likely be lessened by the use of naturally rusting steel structural elements or a commitment to use natural background colors on the bridge finish such as dark brown, gray, or green. Additionally, any area subject to vegetation disturbance would be revegetated with native noninvasive plants characteristic of species found in the immediate project vicinity.

Adoption of Alternative D would likely result in a greater potential for visual disturbance than Alternative B or C. However, these visual impacts would likely not lower the scenic class level by two levels or more.

## 4.6. Recreation

Important aspects of a recreation experience that could be affected by the proposed bridge include the visual quality of the area, the physical interference with recreational activities, and the presence of potential safety hazards to recreationists.

#### 4.6.1. *Alternative A*

Under the No Action Alternative (Alternative A), there would be no change to the visual character or recreational opportunities afforded by the French Broad River Blueway. Likewise, there would be no change in the recreational potential of the wildlife refuge because there would be no change from current conditions. However, access to the refuge from the west bank of the French Broad River would remain restricted under Alternative A. Thus, adoption and implementation of Alternative would result in minor effects to local recreational facilities or opportunities.

#### 4.6.2. *Alternatives B and C*

Adoption of Alternative B or C and the subsequent construction of the proposed bridge would have similar potential impacts on recreation potential. Under either alternative, the bridge would improve recreational access to the Seven Islands Wildlife Refuge and would eliminate the need to drive to reach both parts of the refuge.

During construction, boating in the immediate project area would likely be restricted somewhat. However, this restriction would not close off the entire river channel at one time. Because this situation would be temporary, recreational activity would be affected only marginally.

The presence of a bridge as proposed under Alternative B or C would detract from the rural and natural character of the French Broad River. This could reduce the quality of the floating recreation experience through the degradation of scenic quality and the opportunity for solitude while on the river. A large power line crosses the river directly upstream of the proposed bridge site. Because these two unnatural structures would be located near one another, the visual effect would be localized to this immediate stretch of the river.

The 8.5-foot clearance between the bridge and normal high river water level would limit the size of boats that could pass under the bridge during times of high flow. However, the shoals upstream and downstream of the bridge site and the restriction of use of the boat ramp currently limit the use of large boats in this area. Therefore, the restriction on recreational boating imposed by the bridge would be a minor cumulative impact.

Under Alternative C, ongoing construction would effectively block one side of the river channel at the bridge site, then the other (see Section 2.1.3). This blockage and the diversion of the flow to the other side of the channel could affect recreational navigation during the construction period. In addition to the flows themselves, debris floats down the river from runoff following storm events. Such channeling of the flow could potentially create hazardous conditions for boaters during construction and could require closure of the river to recreational boat traffic at certain times during construction. Under Alternatives B and C, the placement of nine 5-foot-wide piers in the river channel could pose the risk of pinning<sup>4</sup> small watercraft such as canoes, kayaks, and rafts. Control of such crafts can be lost during high-flow periods, events that tend to be attractive to rafters, canoeists, and kayakers. The current design with rounded piers is the preferred shape for deflecting debris and avoiding pinning of light watercraft.

Although the proposed height of the bridge deck above normal river elevation (848 feet) satisfies the navigation guidelines of TVA and USACE for bridge clearances over shallow

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<sup>4</sup> "Pinning" refers to the entrapment or entrainment of a light recreational watercraft such as a raft, canoe, or kayak against a structure in the stream by the current.

navigable waters, it may present some potential problems for the pedestrians using the bridge and, possibly, the bridge structure itself. With the lower part of the bridge at an elevation of 856.5 feet, the bridge would sit only 1 foot above the 100-year flood elevation of 855.5 feet. This conforms to county floodplain regulations; however, the bridge may not be of sufficient elevation to accommodate the volume and types of debris associated with flood events on the French Broad. Debris such as whole trees, docks, and other large items can float down the French Broad after a large rainfall event. Such items may prove dangerous to pedestrians on the bridge. Knox County would place appropriate signs at the bridge, elsewhere in the refuge, and along the river to alert boaters and visitors to the hazards of high river elevations and currents (see Section 4.9).

#### 4.6.3. *Alternative D*

The suspension bridge design proposed under Alternative D would eliminate some of the potential adverse effects to recreational opportunities that could occur under the other two action alternatives. Because the bridge would span the river channel, the potential for pinning recreational watercraft would be eliminated. Construction of the proposed bridge under Alternative D would not involve placement of equipment in the river or the modification of stream flows. Thus, recreational use of the river during bridge construction would likely continue. The 8.5-foot clearance between the deck of the bridge and the normal high water level would be adequate to allow small craft to pass under the bridge unimpeded. Under this alternative, the bridge deck would be at least 1 foot above the 100-year flood elevation of 855.5 feet. The bridge would likely arch in the center of the span; therefore, there would be some additional clearance away from the riverbanks. As with the other two action alternatives, the availability of a pedestrian bridge at the proposed location would allow additional access to the Seven Islands Wildlife Refuge. Thus, implementation of Alternative D would have minor effects to affect local recreational use and opportunities.

### 4.7. **Nationwide Rivers Inventory**

#### 4.7.1. *Alternative A*

Because there would be no changes in the character of this reach of the French Broad River, there would be no effects to its status on the NRI or to its ability to be included in the National Wild and Scenic Rivers System as a wild, scenic, or recreational river area under Alternative A.

#### 4.7.2. *Alternatives B and C*

The location of the proposed bridge is on a river segment that is listed on the NRI. Thus, the construction of the proposed bridge subsequent to the adoption and implementation of either Alternative B or C could affect an NRI stream.

Because of the small cross-sectional area posed by the bridge piers relative to the total cross-section of the river channel, the placement of a pier-type pedestrian bridge at FBRM 15.6 as described under Alternative B or C would not affect stream flow to a noticeable extent. Although there would be a temporary diversion of the channel during construction under Alternative C, such a bridge would not cause any long-term diversion or an impoundment of the waterway. Thus, adoption of either Alternative B or C and the subsequent construction of the proposed pedestrian bridge under either alternative would not involve the destruction or alteration of all or part of the free-flowing nature of the river.

The construction and presence of a bridge under either Alternative B or C could introduce visual, audible, or other sensory intrusions that are out of character with the river. Thus, the

proposed action could potentially adversely<sup>5</sup> affect the natural, cultural, or recreational values of the NRI river segment. A bridge at the proposed location would be visible to users of the river for a distance of approximately a mile upstream and perhaps, a mile or less, downstream. Thus, any visual effects would be restricted to the local area of the bridge. Potential visual effects under Alternatives B and C are described in Sections 4.5.2 and 4.5.3, respectively. Potential noise-related effects would be experienced during bridge construction, but little to no noise effects are expected after construction.

Potential effects to water quality anticipated under Alternatives B and C are described in Sections 4.1.2.1 and 4.1.3.1, respectively. Use of appropriate BMPs during construction, coupled with compliance with permit requirements would likely result in only minor effects to surface water quality during construction under either alternative. Potential effects to water quality following construction are expected to be minimal. Thus, TVA action and the subsequent construction of the pedestrian bridge under Alternative B or C would not cause a deterioration of water quality in this reach of the French Broad River.

The property on both banks of the river where the bridge abutments would be placed is currently owned by Knox County. Construction of the proposed bridge would not require the disposal of any land by the county or by TVA. Thus, construction of a bridge under Alternative B or C would not involve the transfer or sale of property adjacent to an inventoried river.

The outstandingly remarkable values (ORVs) associated with the NRI reach of the French Broad are scenery, recreation, geology, fish, wildlife, history, and cultural resources. Potential effects to these ORVs under Alternatives B and C have been described in more detail previously. Although there would be some effects to aesthetic character, these would be minor. Potential effects to recreation would likewise be minor during construction of the proposed pedestrian bridge under either alternative. However, over the long term, the bridge would benefit recreational opportunities by providing additional and more convenient public access to the Seven Islands Wildlife Refuge. Geology and wildlife ORVs would not be affected by the proposed bridge under either alternative. Fish and other aquatic life would be affected by the construction of a pier-type bridge under Alternative B or C. Because of the amount of bottom disturbance associated with construction under Alternative C, this alternative has the highest potential among the action alternatives to affect aquatic life directly. Although there are historic structures near the proposed bridge, the presence of the bridge would not adversely affect these resources (see Section 4.3.2). Adherence to the stipulations of the MOA (see Section 4.3.2) executed between TVA, Knox County, and the SHPO during construction would ensure that potential adverse effects to archaeological resources would be avoided or mitigated.

The placement of a pedestrian bridge at Seven Islands would not obstruct stream flow or affect the free-flowing nature of this segment of the river.

Although there would be some effects to the ORVs associated with the French Broad, the proposed action under Alternative B or C would not result in an effect severe enough or extensive enough to eliminate any of these ORVs. The proposed bridge under Alternative B or C has the potential for adverse effects on the values of a potential wild, scenic, or

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<sup>5</sup> According to the Council on Environmental Quality (1980), bridges and fords are types of developments that generally have the potential for adverse effects on the values of a potential wild, scenic, or recreational river.

recreational river. However, these potential effects would not be severe enough to foreclose the eligibility of the affected river segment, i.e., that area immediately upstream and downstream of the proposed bridge, for inclusion in the National Wild and Scenic Rivers System.

Further, if the affected segment of the French Broad were ever designated for inclusion in the national Wild and Scenic Rivers System, the construction of the proposed bridge under Alternative B or C would not result in the foreclosure of options to classify the segment as wild, scenic, or recreational. The segment of the French Broad listed on the NRI does not have a preliminary categorization as “wild,” “scenic,” or “recreational.” The characteristics associated with these categorizations are described in Table 3-3. Based on the definitions for these categorizations, this river segment, including the segment at Seven Islands, does not appear to meet the criteria for being considered as “wild” or “scenic.” The most reasonable and likely classification for the segment is “recreational,” and construction of the proposed bridge under Alternative B or C likely would not foreclose the ability of the segment to be classified as “recreational” if this segment is later included in the national Wild and Scenic Rivers System.

Various mitigative options were considered to reduce or avoid potential effects to the river segment. The possibility of relocating the bridge alignment upstream or downstream was considered but was deemed infeasible (see Section 2.1.5). Other measures to reduce the visual effect of the bridge included using naturally rusting steel for the structural members or using neutral tones to paint the bridge, as well as not lighting the bridge (see Section 4.8). These measures would tend to reduce the visual contrast presented by the bridge. However, none of these measures would eliminate these potential effects.

#### 4.7.3. *Alternative D*

As stated above, the proposed bridge is on a river segment that is listed on the NRI. Thus, the construction of the proposed bridge subsequent to the adoption and implementation of Alternative D would affect an NRI stream.

The suspension bridge proposed under Alternative D would not alter or divert the flow of the river because the bridge would span the river. Because there would be no support structures located in the river channel and construction equipment would be kept out of the river, no effects to stream flow or a change to the free-flowing nature of the river are anticipated under this alternative.

The suspension-type bridge proposed under Alternative D would present a taller and, perhaps, a more noticeable profile than the design proposed under the other two action alternatives. Thus, the impact on the scenery ORV would be somewhat greater under this alternative.

As under Alternatives B and C, there would be minor impacts to the recreation ORV during construction, but over the long term, the recreation ORV would be enhanced by additional and more convenient public access to the wildlife refuge. In contrast to Alternatives B and C, the fish ORV would not be negatively affected under this alternative because of the suspension design. Geology and wildlife ORVs would not be affected by the proposed bridge under Alternative D. Potential effects to cultural resources are described in Section 4.3.4.

Construction of a suspension-type bridge has advantages over the pier-type bridge under Alternatives B and C in that the suspension bridge design does not involve placement of equipment, fill, or piers in the water. Appropriate BMPs would be employed during construction to minimize the introduction of soil or storm water runoff into the river. Thus, under Alternative D, there would be minimal effects to water quality and, as noted above, no potential effects to aquatic life, including listed aquatic species.

As stated above, the bridge abutments would be placed on county property. Construction and operation of a bridge under Alternative D would not involve the transfer or sale of property adjacent to an inventoried river.

The placement of a pedestrian bridge at Seven Islands would not obstruct stream flow or affect the free-flowing nature of this segment of the river. Although there would be some effects to the ORVs associated with the French Broad, the proposed action under Alternative D would not result in any effect severe enough or extensive enough to eliminate any of these ORVs. The construction of the bridge under Alternative D has the potential for adverse effects on the values of the river, but these potential effects would not be severe enough to foreclose the eligibility of the affected river segment for inclusion in the national Wild and Scenic Rivers System.

The bridge structure proposed under Alternative D would contribute somewhat to the presence of human activity. However, for reasons stated in Section 4.7.2, the placement of a suspension-type pedestrian bridge at Seven Islands would not foreclose options to classify this or any other portion of the subject 32-mile segment of the French Broad River as either wild or scenic should it ever be designated for inclusion into the National Wild and Scenic Rivers System because this reach would most likely be classified as “recreational” in any event.

Mitigation options similar to those described in Section 4.7.2 were considered in an effort to reduce or avoid potential adverse visual and aesthetic effects. For reasons stated earlier (see Section 2.1.5), relocating the bridge alignment upstream or downstream is infeasible. However, the steel support towers would be allowed to rust naturally or painted with colors that blend with the natural landscape, and the bridge would not be lighted. These measures would tend to reduce overall potential visual effects.

The adoption of Alternative D would affect a segment of the French Broad River included on the NRI and could indirectly cause adverse effects on the natural, cultural, and recreational values of that river segment. However, the presence of the proposed pedestrian bridge would not result in noteworthy effects to this segment of the French Broad with respect to its status on the NRI or its ability to be included in the National Wild and Scenic Rivers System.

#### **4.8. Cumulative Impacts**

The proposed bridge as designed with the mitigation measures proposed and constructed with barges and mats described under Alternative B would have minor impacts in and of itself. Because the proposed pedestrian bridge would provide additional opportunities for viewing and experiencing natural settings, the presence of the bridge is unlikely to spawn indirect effects such as commercial and residential development. However, the availability of a bridge and the additional access afforded could possibly result in increased use of the refuge. The incremental effect of the bridge when added to other past, present, and reasonably foreseeable future actions would be cumulatively minor under Alternative B.

Under Alternative C, the potentially greater impacts of constructing the bridge using rock pads could result in greater potential cumulative impacts to endangered species and to historic properties. Because the suspension-type bridge design proposed under Alternative D would tend to avoid physical impacts to the river, no cumulative effects to water quality or aquatic life are expected from the adoption of this alternative.

#### **4.9. Summary of TVA Commitments and Proposed Mitigation Measures**

In addition to the requirements of any necessary permits, the General and Standard Conditions contained in the TVA 26a approval, and avoidance of the known archaeological sites, the following mitigation measures would be required by TVA. These measures would be included as conditions of the Section 26a approval.

- Knox County would comply with the stipulations of the MOA pursuant to 36 Code of Federal Regulations Part 800 signed by Knox County on September 17, 2007.
- Knox County would conduct additional archaeological evaluation investigations if project plans are revised or if resources potentially eligible for listing in the NRHP are identified during the investigations of the access corridor or equipment staging area.
- To allow for certain construction activities within the boundary of Site 40KN262, special construction considerations may be agreed upon by TVA, the Tennessee SHPO, and Knox County. The use of matting at equipment staging areas shall be of a design that is acceptable to the MOA signatories. This matting would disperse the size, weight, and pressure of the equipment during use to minimize impacting the ground below. All equipment used within the boundaries of Site 40KN262 shall be confined to the matting. Furthermore, construction activities shall be conducted only in dry weather conditions.
- Knox County would ensure that for the duration of construction, a temporary barrier or fence is installed adjacent to Site 40KN287 to prevent the entrance of any construction equipment within the boundary of the site.
- Knox County would place appropriate signs at the bridge, elsewhere in the refuge, and along the river to alert boaters and visitors to the hazards of high river elevations and currents.
- Knox County would ensure that appropriate BMPs are implemented during construction to avoid erosion and sedimentation or the entrance of sediment or other pollutants into surface water or groundwater.
- Any support structures shall not exceed 135 feet in height above ground level.
- All disturbed areas shall be revegetated with native or noninvasive plant species.
- Any rock used for bank stabilization shall be clean and free of weed seeds or parts.
- Areas where vegetation has been disturbed or removed shall be revegetated with native species characteristic of the project vicinity.
- With the exception of cables, exposed surfaces of the pedestrian bridge shall be either naturally rusting steel or painted a natural background color such as dark brown, gray, or green.
- Upon completion of construction activities, Knox County will provide a written report to TVA verifying the completion of the above mitigation measures.

## CHAPTER 5

### 5.0 LIST OF PREPARERS

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Involvement: Project Coordination

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## CHAPTER 6

### 6.0 LIST OF AGENCIES AND ORGANIZATIONS RECEIVING COPIES

The following agencies were provided with copies of the draft environmental assessment

#### **Federal Agencies**

Appalachian National Scenic Trail, Harpers Ferry, West Virginia  
 Great Smoky Mountains National Park, Gatlinburg, Tennessee  
 U.S. Army Corps of Engineers, Memphis, Tennessee  
 U.S. Army Corps of Engineers, Nashville, Tennessee  
 U.S. Department of the Interior, Washington, D.C.  
 U.S. Fish and Wildlife Service, Cookeville, Tennessee

#### **State Agencies**

Division of Air Pollution Control, Nashville, Tennessee  
 Division of Recreation Educational Services, Nashville, Tennessee  
 Division of Water Pollution Control, Nashville, Tennessee  
 East Tennessee Development District, Alcoa, Tennessee  
 First Tennessee Development District, Johnson City, Tennessee  
 Greater Nashville Regional Council, Nashville, Tennessee  
 Memphis Area Association of Governments, Memphis, Tennessee  
 Northwest Tennessee Development District, Martin, Tennessee  
 South Central Tennessee Development District, Columbia, Tennessee  
 Southeast Tennessee Development District, Chattanooga, Tennessee  
 Southwest Tennessee Development District, Jackson, Tennessee  
 Tennessee Department of Agriculture, Nashville, Tennessee  
 Tennessee Department of Economic Development, Nashville, Tennessee  
 Tennessee Department of Environment and Conservation, Nashville, Tennessee  
 Tennessee Department of Transportation, Nashville, Tennessee  
 Tennessee Division of Archaeology, Nashville, Tennessee  
 Tennessee Historical Commission, Nashville, Tennessee  
 Tennessee Wildlife Resources Agency, Nashville, Tennessee  
 Upper Cumberland Development District, Cookeville, Tennessee

Upon the signing of a finding of no significant impact, the final environmental assessment will be posted on the TVA Web site. Additionally, the following agencies, organizations, and federally recognized tribes will be provided with copies of the document.

#### **Federal Agencies**

National Park Service, Southern Appalachian Field Office, Chattanooga, Tennessee  
 U.S. Army Corps of Engineers, Nashville, Tennessee  
 U.S. Fish and Wildlife Service, Cookeville, Tennessee

#### **Tribes**

Choctaw Nation of Oklahoma, Durant, Oklahoma  
 United Keetoowah Band of Cherokee Indians in Oklahoma, Tahlequah, Oklahoma

**State Agencies**

East Tennessee Development District, Alcoa, Tennessee

Tennessee Department of Environment and Conservation, Water Pollution Control,  
Nashville, Tennessee

Tennessee Department of Transportation, Nashville, Tennessee

Tennessee Historical Commission, Nashville, Tennessee

Tennessee Wildlife Resources Agency, Nashville, Tennessee

## CHAPTER 7

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