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DRAFT ENVIRONMENTAL ASSESSMENT

**REQUEST FOR SECTION 26a APPROVAL  
FOR PEDESTRIAN BRIDGE AT  
SEVEN ISLANDS WILDLIFE REFUGE**

**French Broad River Mile 15.6  
Knox County, Tennessee**

TENNESSEE VALLEY AUTHORITY

OCTOBER 2007

Please provide comments by December 5, 2007 to:

Peter K. Scheffler  
Tennessee Valley Authority  
400 West Summit Hill Drive  
Knoxville, Tennessee 37902  
Phone: (865) 632-8040  
E-mail: [pkscheffler@tva.gov](mailto:pkscheffler@tva.gov)

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## **The Proposed Decision and Need**

Knox County proposes to construct a pedestrian bridge across the French Broad River at River Mile 15.6 on the eastern border of the county with Sevier County. The bridge would connect the eastern side of the Seven Islands Wildlife Refuge with the western side. The location is shown in Figure 1. This 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 county has requested Tennessee Valley Authority (TVA) approval under Section 26a of the TVA Act for the bridge. Thus, the decision before TVA is whether to issue a Section 26a Permit for the bridge.

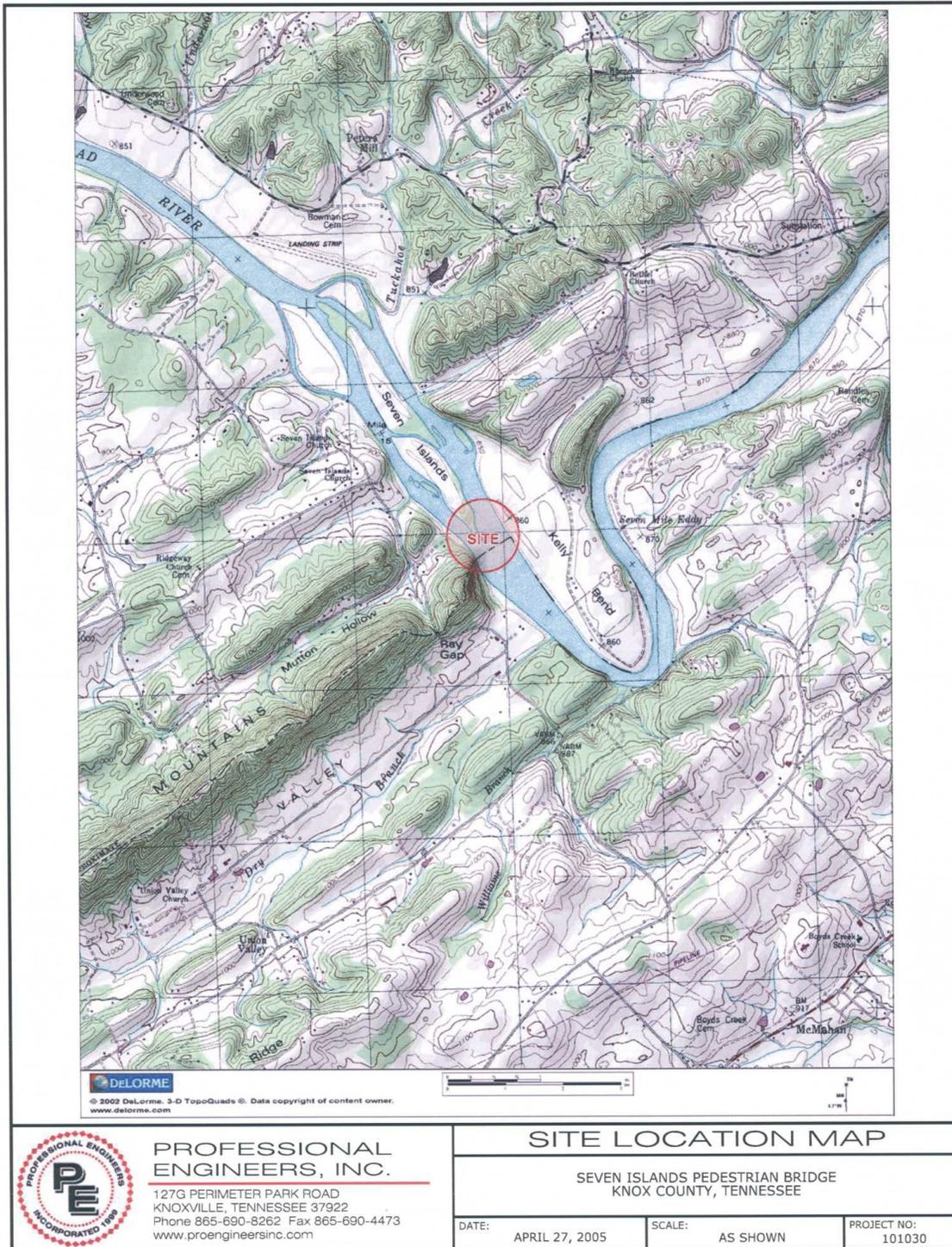
The proposed bridge would be funded by the Knox County Division of Parks and Recreation, the State of Tennessee, and a Transportation Enhancement Grant from the U.S. Federal Highway Administration (FHWA), administered through the Tennessee Department of Transportation (TDOT). The project is being managed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

## **Other Environmental Permits**

The U.S. Army Corps of Engineers (USACE) would need to issue a permit under Section 404 of the Clean Water Act. If less than half an acre were disturbed by the bridge, this would be a Nationwide Permit Number 14. Otherwise, it would need to be an Individual Permit. The Activity Specific Conditions and General Conditions for a Nationwide Permit Number 14 are contained in Appendix 1. The State of Tennessee would need to issue an Aquatic Resource Alteration Permit (ARAP) for the bridge. 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, it would need to be an Individual Permit. The provisions of the General Permit are contained in Appendix 2. The county would need to prepare a Storm Water Pollution Prevention Plan as part of the ARAP. The county has also complied with requirements of the Federal Emergency Management Agency (FEMA) for changes that the bridge would cause in the floodplain in the vicinity of 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, but the county would have to send final plans to USCG to record the location and design.

## **Agencies and Others Consulted**

Because this stretch of the river contains species federally listed as endangered that could be affected by constructing the proposed bridge, TVA is consulting 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 listed 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. These comments are contained in Appendix 3. Because this stretch of the French Broad River is in the Nationwide Rivers Inventory (NRI), the U.S. National Park Service (NPS) was requested to comment on the proposal.



**Figure 1. Location Map**

Knox County placed a notice of their intent to build the 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 the compliance with FEMA requirements, the county had previously sent letters to the 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 for 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 is sending this EA to the USACE, USFWS, NPS, Tennessee Department of Environment and Conservation (TDEC), TDOT, and FHWA for review and comment and is making it available to the public for 60 days to review and comment.

### **Alternatives and Comparison**

This EA evaluates three alternatives: No Action and two Action Alternatives, which differ in the methods for constructing the proposed bridge.

#### Alternative A - No Action

Under the No Action Alternative, TVA would not provide the Section 26a approval. In this case, the proposed bridge could not be built.

#### Alternative B - Issue 26a Approval for Construction of the Pedestrian Bridge Using Barges and Mats

Under Alternative B, TVA would provide the 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 (when Douglas Dam is releasing water from generation using all four turbines) of 848 feet above mean sea level (msl). The bridge would be wheelchair-accessible. Design drawings of the bridge are contained in Appendix 4.

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 have variable heights depending on the river depth at their 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 reservoir 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. Then the base would 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, and shallower parts of the river may be accessed by placing mats on the river bottom and driving equipment across the mats. Preliminary plans suggest a construction period of eight to 12 months. The county intends to build the bridge in 2008, but the start date and duration of construction would depend on when bids can be obtained and on weather and river conditions.

Construction laydown/staging areas 100 feet by 50 feet in size would be located on shore at both ends of the proposed bridge. They would be surfaced with 4 to 6 inches of gravel (1.5-2.5 inches in diameter), which would be removed at the completion of bridge construction. 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 mat.

#### Alternative C - Issue 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 would be in the method used to access the pier sites. Temporary rock causeways/pads 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 alongside 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 this analysis, it is assumed that the construction access causeways would be built so that the top of the causeway would be at an elevation of 852 feet, 4 feet above the maximum generation elevation (848 feet), to allow construction activities to proceed under all likely flow conditions in the French Broad River during the limited time of construction. 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 channel could be as wide as 100 feet depending upon channel depth.

One pad 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.

#### Other Alternatives Not Considered in Detail

Knox County considered two other general alternatives to achieve the goal of connecting both sides of the refuge but determined that they were not feasible.

The first alternative considered was a ferry service, which could transport visitors across the river. This alternative would result in minimal, if any, impact to the aquatic resources at the site but 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 the upstream Douglas Dam. Additionally, this alternative could have negative impacts on the visitor experience. The

necessity of a motorized 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 county also considered building a large span bridge that would completely span the river, with bridge abutments located only at either bank and with no piers located in the river. This alternative was not entertained in detail due to the extremely high costs associated with design and construction.

### **Comparison of Alternatives**

Under the No Action Alternative, there would be no impacts to any aspects of the natural environment or historic properties of the site, 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 costs and the enhanced recreational experience of the wildlife refuge. There would be minor long-term negative impacts on cultural resources, floodplains, visual quality, and river recreation. There would be minor short-term negative impacts from construction on water quality, aquatic organisms (including threatened and endangered species), noise, visual quality, and health and safety.

Alternative C would have the same long-term benefits of reduced driving time and costs and the enhanced recreational experience of the wildlife refuge. There would also be the same minor long-term negative impacts on floodplains, visual quality, and river recreation. There would be larger long-term impacts on cultural resources. There would be larger and potentially adverse short-term impacts from construction on water quality and aquatic organisms. The impact on construction on aquatic organisms, including threatened and endangered species, could be so large that it might persist in the long term and have larger cumulative impacts.

### **Affected Environment and Evaluation of Impacts**

#### **Scope of Environmental Review**

TVA determined that the bridge has potential for adverse effects on endangered aquatic species and other aquatic life, water quality, cultural resources, floodplains, and recreation. Therefore, TVA decided to prepare an environmental assessment (EA) to document the considerations relating to the impacts on these sensitive environmental resources in determining whether to issue Section 26a approval for the bridge.

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 and insignificant. 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, impacts to these other features and existing conditions are not discussed further.

## 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 (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 (5 feet deep at minimum flows) is 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 Douglas 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 summertime, 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 will 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 actually 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 would have an elevation of about 852 feet for 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.

*Water Quality* - The French Broad River is classified by 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 in Sevier County 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.

*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 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 (River Mile 32.3) downstream to its confluence with the Holston River (River Mile 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).

*Fish* - This river segment is a hydropower tailwater, which is subject to daily fluctuations in flow, and until fairly recently suffered from low dissolved oxygen concentrations and lack of minimum flows. Nonetheless, it is currently inhabited by reasonably diverse fish communities. Species diversity has increased since TVA began monitoring in 1987 (TVA unpublished data), and some 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 greatly improved 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 (TVA unpublished data). The IBI scores at Seven Islands (River Mile 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*), and three state-listed fish species, the lake sturgeon (*Acipenser fulvescens*), listed as endangered, and the blue sucker (*Cycleptus elongatus*) and tangerine darter (*Percina aurantiaca*), both considered in need of management by the Tennessee Wildlife Resources Agency (TWRA), are present in this section of the French Broad River. 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 directly impacted by bridge construction. Lake sturgeon and blue sucker occupy the area, but it is unlikely that any important spawning habitat for these species is present in the project area.

*Benthos* - Benthic invertebrate communities (primarily insects and mussels) are also sampled as part of TVA's routine monitoring, and 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.

*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 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 in the vicinity of 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 Associates 2005). In 2007, in response to the public notice for the TDEC permit approval for bridge construction, TWRA conducted the second mussel survey (TVA/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 Douglas tailwater. Based on collections of fairly 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, some pistolgrips, a few pimplebacks, pink heelsplitters, and fragile papershells were found. No listed species were found.

### ***Impacts to the Aquatic Environment***

#### **Alternative A - No Action**

Alternative A would result in no impact on the aquatic environment.

#### **Alternative B - Issue 26a Approval for Construction of the Pedestrian Bridge Using Barges and Mats**

Alternative B would result in impacts on the aquatic environment as discussed below.

*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 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. Soil erosion and sedimentation can cover the stream bottom and threaten aquatic life. Removal of the tree canopy along stream crossings can increase water temperatures, algal growth, dissolved oxygen depletion, and adverse impacts to aquatic biota.

Disturbance of the stream bottom would occur at each one 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. Minimal soil disturbance on the riverbanks, on the islands, and instream areas immediately adjacent to the riverbank would occur. Appropriate best management practices (BMPs) would need

to be employed to minimize soil disturbance and to contain any soils or sediments disturbed by this work.

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 the appendix. TVA has reviewed these standards and determined that they would be adequate for minimizing impacts to water quality.

*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 than 100-foot-wide) corridor along the bridge alignment, the potential for impacts to listed fish species is minimal. Any fish present in disturbed areas would be temporarily displaced but would not be subject to long-term impacts or mortality. Disturbance would only occur during construction, and most instream habitat is expected to return to preconstruction conditions when 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 minimal loss of available habitat. Release of silt and rock cuttings from this activity would be minimal and would not significantly affect downstream 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.

Construction of the proposed pedestrian bridge crossing the French Broad River at Seven Islands is not likely to adversely affect individuals or populations of the federally listed snail darter and would not have a significant adverse effect on the state-listed fish species present in the area.

*Mussels* - Because mussels are sedentary and are restricted to suitable instream habitat within the project area, instream use of heavy equipment 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 (sand, gravel, and rock), which could cover individual mussels and result in physiological stress or mortality. Coffers cells would be installed, pumped dry, drilled, refuse removed, and then filled with concrete. Any mussels present in the footprint of the coffer cell would most likely be destroyed. However, all non-listed mussels found within these footprints would be relocated prior to commencement of construction activities. It is not anticipated that pink muckets would be found within the footprint of the coffer cells or areas affected by vehicle traffic.

Instream equipment could also have indirect effects resulting from sediment being disturbed and introduced into the water column. Significant amounts of suspended sediment may interfere with mussel feeding, and resettlement of suspended sediment could smother individual mussels. As stated above, uncured concrete is highly toxic to aquatic

organisms, including mussels. Appropriate BMPs would be employed to minimize instream sediment effects, and all uncured concrete or grout would be contained.

In addition to the BMPs specified in the General ARAP for Construction and Removal of Minor Road Crossings, the following mitigation would be required for this project to ensure that construction of this pedestrian bridge is not likely 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 for mussels (including individuals of the federally listed pink mucket) 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 significant percentage of the mussels could not be moved out of the area that could be affected by instream construction.)
- If individual(s) of the pink mucket are found during relocation, construction work must halt immediately, and TVA, USACE, and FHWA would be required to initiate formal consultation with USFWS to determine proper measures to minimize impacts to this species. No relocations of pink mucket would be allowed until formal consultation is completed. No further construction activities would be allowed until formal consultation is completed.

These relocation efforts must be performed by agencies, organizations, or private consultants who hold appropriate endangered species permits, but this effort must 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 specific commitments outlined above, if no pink muckets are encountered during relocation efforts, this action is not likely to adversely affect individuals or populations of either the snail darter or the pink mucket. Construction activities would have some short-term (duration of construction activities) impacts 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. No significant effects to aquatic habitat or communities in the French Broad River would occur as a result of construction of this pedestrian bridge.

If pink muckets are found during relocation efforts, TVA, USACE, and FHWA would be required to initiate formal consultation with the USFWS. Provided this consultation is completed to the satisfaction of the USFWS, significant 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.

The overall aquatic communities and benthic communities occupy much larger areas than the small area, which would experience limited impacts from the construction of the

proposed bridge. Therefore, TVA has determined that there would be no measurable impacts on overall general aquatic and benthic communities in the French Broad River.

At the time of the preparation of the draft EA, TVA has informally consulted with the USFWS regarding the potential impacts of Alternative B and has requested concurrence with TVA's determinations.

*Alternative C - Issue 26a Approval for Construction of the Pedestrian Bridge Using Rock Pads*

Alternative C would result in impacts on the aquatic environment as discussed below.

*Water Quality* - In addition to the impacts of the construction of the piers noted above, use of the rock pads for pier construction would temporarily reduce the cross sectional area of the stream. This would increase water velocities, bottom scour, and shoreline erosion in the vicinity of the pads. Eroded and scoured materials would increase turbidity of the water until they 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. Erosion would be limited to a degree by placing fill to armor the head of the island. However, a certain degree of scouring of the bottom and subsequent sedimentation elsewhere would probably be unavoidable. TVA would probably need to release high flows from Douglas Dam to meet power demand, and a number of high-flow events due to storms would probably occur during the construction period.

*Fish and Mussels* - Installation of 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. It is also likely that fill would be lost from the causeway(s) and be deposited in downstream areas.

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 causeway(s). Any materials mobilized by this erosion would be deposited in downstream areas.

River flows would be concentrated at the instream end of the causeway(s), resulting in unavoidable instream impacts. There is the potential to scour all mobile bed load (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. 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.

There is some potential to mitigate for erosion in shoreline areas 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 sediment deposition in these areas, particularly along the downstream side of the causeway. 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 instream 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 as a result of this construction method. 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, there would likely be long-term adverse effects on this habitat. Instream snail darter habitat (including potential spawning sites) would be at least temporarily altered by scouring and sediment deposition. These impacts 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, it is not likely that populations of these two species would be significantly affected by these impacts.

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 instream scouring and deposited in downstream areas that contain unsuitable habitat. Some (or all) mussels present in areas where sediment deposition increases would 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 impacts 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 similarly affected.

If Alternative C were adopted, TVA, USACE, and FHWA would be required to 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 may require significant project modifications and appropriate avoidance and mitigation measures. These modifications and measures could result in substantial increases in project cost and a substantial delay in project completion.

### 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 is increasing social complexity and the appearance of horticulture late in the period. The settlement pattern during this period is 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. Initially the project area was part of Sevier and Knox counties (1792-1933), but presently all of the project area is within Knox County. The Tennessee River and French Broad waterways became a part of a significant 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 Knoxville 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 to the Secessionist movement because of a low slave population and a diverse economy (D'Angelo 2002). Although a number of significant 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, little had changed since the Civil War. Most of the area relied on agriculture and farming. With the development of TVA, in 1933, the economy and life ways 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.

Under Section 106 of the National Historic Preservation Act of 1966, TVA must assess the impact of its undertakings on historic properties. Accordingly, TVA determines the area of potential effect (APE) for historic properties, conducts surveys to record historic properties within the APE, and consults with the SHPO and tribes with current or historic presence in the area of the project to obtain their comments.

For the proposed bridge project, the bridge alignment, parking area, and equipment access roads are considered the APE for archaeological sites. The vicinity within view of the bridge is considered the APE for historic structures. TVA conducted a survey for historic structures. For archaeological structures, Knox County arranged for a Phase I archaeological survey and Phase II site evaluation to be conducted by DuVall and Associates (Pace et al. 2005; Pace and Spice 2006) within the APE. The survey for historic structures identified three historic structures (H-1, H-2, and H-3) within the background view of the bridge. All three structures are farmhouses constructed in the late 19th century and

are considered eligible or potentially eligible for listing on the National Register of Historic Places (NRHP). 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 on the NRHP.

After the archaeological surveys were done, a potential heavy equipment access route was identified, and in July 2007, TVA Cultural Resources staff conducted shovel testing along the proposed route. Due to the potential presence of archaeological resources that may be affected by the heavy equipment, TVA concluded that additional systematic testing would be necessary to determine the nature and extent of archaeological resources present if this route were selected.

### ***Impacts to Cultural Resources***

#### **Alternative A - No Action**

Alternative A would result in no impact to historic properties.

#### **Alternative B - Issue 26a Approval for Construction of the Pedestrian Bridge Using Barges and Mats**

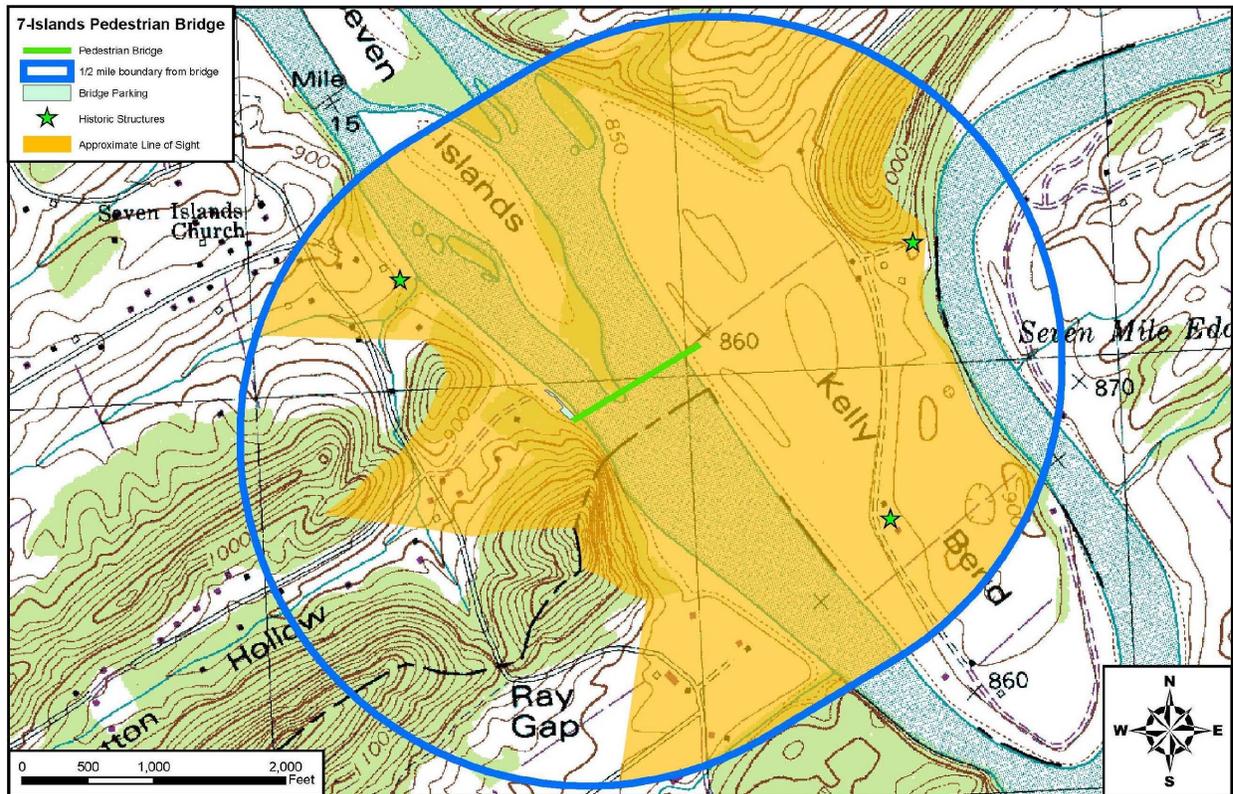
Alternative B would result in impacts to historic properties as discussed below.

Figure 2 shows the areas within which the bridge could be seen and the location of the historic houses. TVA determined that the bridge would be only a minor change to the setting of the historic structures due to its location within the background views, low profile, unobtrusive architectural style, and 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 the historic structures. 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. A copy of the letter is included in Appendix 3.

The agency also consulted with the SHPO and the tribes listed above to determine the effects on the archaeological sites. Through consultation with the SHPO, the sites were determined to be eligible for listing on the NRHP.

TVA worked with Knox County to redesign the bridge to avoid one 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 has been invited to be a signatory to the MOA. The United Keetoowah Band of Cherokee Indians in Oklahoma has agreed to be a concurring party to the MOA. A copy of the MOA is included in Appendix 3).

## 7-Islands Pedestrian Bridge Historic Structures APE



**Figure 2. Historic Structures Within Viewshed**

Under the stipulations set forth in the MOA, additional archaeological investigations (monitoring of the excavation of caisson location) would be conducted during construction.

In addition, if the potential heavy equipment access route were selected, this route would be investigated prior to ground disturbance or use by heavy equipment.

### Alternative C - Issue 26a Approval for Construction of the Pedestrian Bridge Using Rock Pads

The causeway construction would increase erosion along both riverbanks and island during its construction and use. Earlier archaeological testing focused on the refuge side and the TWRA parking area and not the island proper. The archaeological resources present on the island would likely be adversely affected by Alternative C due to the increased erosion that would be caused by selecting this alternative. Additional archaeological testing along the island and both river banks would be necessary to satisfy the requirements of NHPA § 106. Based on the terrain in the vicinity, the area 2 river miles downstream and 400 feet upstream of the causeways (including islands and river bank) could be impacted, covering in total approximately 10 miles of the shoreline.

Activities under this alternative would be undertaken in accordance with the stipulations set forth in the MOA, requiring additional archaeological investigations (monitoring of the excavation of caisson location) during construction. In addition, under NHPA § 106, the potential heavy equipment access route through the refuge on the eastern side of the

bridge may also need to be surveyed prior to ground disturbance or use by heavy equipment.

This alternative may also require additional consultation with the SHPO, Knox County, USACE, and federally recognized tribes. Further, the MOA may need to be amended to address the effects of causeway construction on historic properties (archaeology).

### 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 the contour lines in Figure 1 show, 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.

### ***Impacts to Floodplains***

#### *Alternative A - No Action*

Alternative A would result in no impact to floodplains.

#### *Alternative B - Issue 26a Approval for Construction of the Pedestrian Bridge Using Barges and Mats*

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, 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 River Mile 14.14 downstream of the site and the county line at about River Mile 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. This was 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.

#### *Alternative C - Issue 26a Approval for Construction of the Pedestrian Bridge Using Rock Pads*

Alternative C would result in the same long-term impacts to floodplains as Alternative B. However, the presence of the rock pads in the river during the construction period would reduce the flood storage capacity of the river and thus slightly raise the flood levels over what they would be under Alternative B. Determining the amount of reduction would require complex engineering calculations, which cannot be done until the design of the rock pads is determined.

### Noise Levels

The area is generally quiet. Several working farms in the area are the loudest sources of intermittent noise with their tractors and other work equipment.

## ***Impacts to Noise Levels***

### *Alternative A - No Action*

Alternative A would result in no impact to existing noise levels.

### *Alternative B - Issue 26a Approval for Construction of the Pedestrian Bridge Using Barges and Mats*

Alternative B would cause a noticeable increase in noise levels during construction. Users of the refuge would experience this noise, but the impacts would be temporary for the duration of the construction. There are several houses near the western end of the proposed bridge site whose residents would hear the construction noise. However, because the construction process would be temporary and limited to daylight hours, the impacts would be minor. Equipment motors would have mufflers so that engine noises would be as low as practicable.

### *Alternative C - Issue 26a Approval for Construction of the Pedestrian Bridge Using Rock Pads*

Alternative C would result in greater impacts to noise levels than Alternative B would. In addition to the construction activities to build the piers, there would be the construction noise of building and removing the rock pads. This would include the noise of trucks bringing and removing the gravel and the noise of unloading and loading the gravel. The 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 get the pads placed and removed as soon as possible.

## Recreation

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

The area of the wildlife refuge and the adjacent river is scenic, with 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 area of the bridge site is rural. The topography is varied, with a number of ridges and scenic bluffs. Views from low, flat areas are short, with views from the ridges and bluffs reaching several miles.

The proposed bridge would be located on a segment of the French Broad River that is listed on the NRI. This segment runs from the base of Douglas Dam to the confluence with the Tennessee River. The NRI is a list, maintained and compiled by NPS, of those streams having “outstandingly remarkable values,” and therefore potentially eligible to be considered for status as a National Wild and Scenic River. This segment is recognized for its outstandingly remarkable values of scenery, recreation, geology, fish, wildlife, history, and cultural with the following description in the NRI:

- French Broad, FBRM [French Broad River Mile] 0 to FBRM 32—Archaeological sites; supports game fishery; upper segment is mountainous stream with good whitewater and scenic gorge area; numerous rock gardens, boulder beds, rapids, islands, and ledges; diversity of flora and fauna.

This 32-mile 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 great scenery and allows floaters with limited whitewater skills to access this resource for birding, wildlife observation, and fishing. Throughout this segment, there are three major road crossings and seven designated public access points.

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 1 is a summary of the participation rates for prominent activities. Over half of the 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.

**Table 1. French Broad River Activity Participation Rates**

<b>Activity</b>	<b>Percent Participating</b>	<b>Number of Participants</b>
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 close proximity to the large urban area of Knoxville, Tennessee.

Because the French Broad River is on the NRI, TVA requested comments on the proposed bridge from NPS.

The Seven Islands Wildlife Refuge is designated by Knox County as part of its greenway system.

Existing boating in the vicinity of 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 river. The upstream and downstream shoals and the fluctuations in surface elevation and river current due to intermittent releases from Douglas Dam and storms, as discussed above, make this a tricky section for anyone with a propeller-driven boat 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, being unmotorized, are particularly sensitive to changes in the strength of the current.

There is a small, developed boat launch ramp about a mile 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."

### ***Impacts to Recreation***

#### ***Alternative A - No Action***

Alternative A would result in no change to the character or recreational opportunities of the river blueway or the recreational potential of the wildlife refuge.

#### ***Alternatives B and C - Issue 26a Approval for Construction of the Pedestrian Bridge Using Barges and Mats or Rock Pads***

Issuing the approval to enable building the proposed bridge with barges and mats or rock pads would have substantially similar impacts on recreation.

The bridge would create better recreational access to the Seven Islands Wildlife Refuge and eliminate the need to drive to reach both parts, thus enhancing the recreational experience of the wildlife refuge as a whole.

Under either Alternative B or C, the construction activity and the built bridge would be considered changes in the visual setting of the area. Figure 2 above shows the areas from which the proposed construction and bridge would be seen. They would be most visible to boaters and steadily less visible for viewers farther away in the refuge. (In addition, they would be visible in the background to residents of a number of homes in the vicinity.) Where it would be visible, it would be a low architecturally simple feature with muted colors. (Early designs of the bridge included sail-like masts and shiny stainless steel, but after discussions of the visual impact, the county decided not to include these features.) The bridge would not be lighted, so there would be no increase in night light levels. Therefore, TVA has determined that the impact of the bridge 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. Therefore, TVA has determined that those impacts would also be minor.

During construction, boating in and through the area of the project would be restricted. However, this restriction would not close the entire river at a time and would be temporary, affecting recreational activity only marginally.

The presence of the proposed bridge would detract from the rural/natural character of the French Broad River by reducing the quality of the floating recreation experience through the degradation of scenic quality and the opportunity for solitude while on the river. However, a large power line is presently crossing the river directly upstream from the proposed site. Locating these two unnatural structures near one another would reduce the lineal distance of scenery degradation.

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 already severely limit the use of large boats in this area. Therefore, the restriction of the bridge would be a minor impact.

An impact to navigation would also arise from the channeling and focusing of the flow of water to first one side of the river, then the other. In addition to the flows themselves, a lot of debris floats down the river from runoff during storm events. Such channeling of the flow could create hazardous conditions for boaters during the construction process and may require closing of the river to boat traffic during certain segments of construction.

The proposed design of the bridge, placing nine, 5-foot-wide piers in the water, poses the risk of pinning for crafts that lose control because of higher flows (attractive to rafters, canoeists, and kayakers).

Finally, while the proposed height of the bridge deck above normal elevation (in this case, the top of the generation range, 848 feet above msl) satisfies the navigation guidelines of TVA and USACE for bridge clearances over shallow navigable waters, it may present some potential problems for the pedestrians using the bridge and possibly the bridge structure itself. With low steel at 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, but the bridge may not be of sufficient elevation to accommodate the volume and types of debris associated with flood events on this river. Whole trees, dead cows, docks, and other large items are not uncommon on the French Broad after a significant rainfall event and may prove dangerous to both the bridge structure and even pedestrians on the bridge watching the high water go by, particularly as this is an unsupervised recreation area.

Placement of signs to inform visitors to the refuge and boaters of the hazards related to high water levels and currents would be needed, as well as the ability to close the bridge to pedestrians when water levels are high.

In a letter (contained in Appendix 5) on July 31, 2007, the NPS provided the following comments on how to minimize impacts, primarily to recreation:

1. The bridge should be designed such that it does not stand out aesthetically from its surroundings.
2. Any disruption to riparian vegetation should be replaced/replanted with native vegetation that is characteristic of species found in the immediate project vicinity.
3. Care should be taken to avoid freshwater mussels, fishes, aquatic plants, other aquatic organisms, and their habitat during the construction of bridge supports.
4. Care should be taken to avoid interfering with cultural and historical resources at or near the site.
5. Bridge pilings should be designed in such a way as to minimize the potential pinning of recreation boaters, swimmers, and fishermen during a range of flow conditions.

The design of the proposed bridge, as discussed above, would address the concerns of the NPS with respect to aesthetics. The bridge would blend in with the natural surroundings to the extent practicable. Direct disruptions to riparian vegetation would be minimal, though erosion could increase if rock pads were used. The relocation of mussels and use of mats and barges would minimize impact on aquatic organisms, though use of rock fill would pose major impacts. The provisions of the MOA with the SHPO would minimize impacts on

cultural resources. The orientation of the pier bases and steel supports aligned with the current would partially minimize potential pinning of boaters. Other pier designs such as one with a trapezoidal cross section may reduce the risk of pinning but require customized engineering and design, as there are no general standards for such structures.

#### Cumulative and Indirect Impacts

The proposed bridge as designed with the mitigation measures proposed and constructed with barges and mats would have minor impacts in and of itself. Being a pedestrian bridge whose purpose is to provide opportunities for viewing and experiencing natural settings, the bridge is unlikely to spawn indirect effects such as commercial and residential development. Furthermore, the incremental effect of the bridge when added to other past, present, and reasonably foreseeable future actions would be cumulatively insignificant for Alternative B. For Alternative C, the larger impacts of constructing the bridge using rock pads could result in greater cumulative impacts to endangered species and historic properties.

#### Permit Conditions and Mitigation Measures

In addition to the standard requirements of the ARAP and USACE General Permits, and the TVA 26a Permit, and avoiding one of the known archaeological sites, the following mitigation measures, as discussed above, would be required by TVA:

- Within two weeks prior to the commencement of instream construction, all instream areas for mussels (including individuals of the federally listed pink mucket) 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.
- These relocation efforts may be performed by private consultants who hold appropriate endangered species permits, but this effort must be coordinated with TVA, TWRA, and the USFWS.
- Knox County would conduct additional archaeological evaluation investigations if project plans are revised or if resources potentially eligible for listing on 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, USACE, SHPO, and Knox County. The use of matting at equipment staging areas must 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 that is used within the boundaries of Site 40KN262 would be confined to the matting. Furthermore, construction activities would only be conducted in dry weather conditions.
- Additionally, a temporary barrier or fence would be installed adjacent to Site 40KN287 to avoid allowing any construction equipment within the boundary of the site.
- Appropriate signs would be placed 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.

## References

D'Angelo, J. J. 2002. *Phase I Cultural Resource Survey of Four Tracts Along Fort Loudoun Lake and the French Broad River In Knox County, Tennessee*. Submitted to Tennessee Valley Authority by TRC Garrow Associates Inc.

Gardner, E. 2003. *Tennessee State Recreation Plan*. Tennessee Department of Environment and Conservation.

Green, G., K. Cordell, H. Fleming, and Betz. 2006. *A Report Submitted to the Tennessee Valley Authority by the Outdoor Recreation and Wilderness Assessment Group, Southern Research Station*. Athens, Ga., USDA Forest Service.

Knox County. 2007. "French Broad River Conservation Corridor," *Knox County, Tennessee, A Great American Community*. Retrieved from <http://www.knoxcounty.org/frenchbroad/overview.php> (September 17, 2007).

McArthur, W. J., Jr, 1976. Knoxville's History: An Interpretation. In *Heart of the Valley: A History of Knoxville, Tennessee*, edited by Lucille Deaderick, pp. 1-67. East Tennessee Historical Society, Knoxville.

Pace, R. A. and M. Spice. 2006. *Phase II Archaeological Testing at the Proposed Seven Islands Pedestrian Bridge Crossing, Knox County, Tennessee: 40KN262 and 40KN287*. Submitted to Michael Brady and Associates Inc. Knoxville, Tennessee, by DuVall and Associates Inc.

Pace, R. A., M. Spice, and S. A. McCorkle. 2005. *Phase I Archaeological Survey of the Proposed Seven Islands Pedestrian Bridge Crossing, in Knox County, Tennessee*. Submitted to Michael Brady and Associates Inc., Knoxville, Tennessee, by DuVall and Associates Inc.

Pennington and Associates. 2005. *A Survey of the Freshwater Mussels French Broad River Mile 15.6, Seven Islands, Knox County, Tennessee*. Survey Performed for Professional Engineers Inc., Knoxville, Tennessee, by Pennington and Associates Inc., Cookeville, Tennessee, March 26, 2005.

Tennessee Valley Authority. Unpublished Data. TVA Reservoir Vital Signs Monitoring. Index of Biotic Integrity Data. Prepared by TVA Aquatic Monitoring and Management, Knoxville, Tennessee.

———. 1989. TVA Reservoir Release Manual. Prepared by TVA Engineering Laboratory, Norris, Tennessee

———. 2004. *Reservoir Operations Study Programmatic Environmental Impact Statement*. Prepared in cooperation with the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service.

Tennessee Valley Authority and Tennessee Wildlife Resources Agency. 2007. *Survey and Relocation Effort by TVA and TWRA Staff at Seven Islands, French Broad River 15.6, Knox County, Tennessee*. July 9, 2007.

U.S. Fish and Wildlife Service. 2007. "Endangered and Threatened Wildlife and Plants; Establishment of Nonessential Experimental Population Status for 15 Freshwater Mussels, 1 Freshwater Snail, and 5 Fishes in the Lower French Broad River and the Lower Holston River, Tennessee," Final Rule, 72 *Federal Register* 177, 52434 (September 13, 2007) (to be codified at 50 CFR Pt. 17).

## **Preparers**

### NEPA Project Management

#### **Peter K. Scheffler**

Position: Senior NEPA Specialist, TVA Environmental Stewardship and Policy, Knoxville, Tennessee  
Education: M.S., Planning; M.S. and B.S., Geology; Member of the American Institute of Certified Planners  
Experience: 27 years in Environmental Impact Analysis and Review  
Involvement: NEPA Compliance and Document Preparation

### Other Contributors

#### **John (Bo) T. Baxter**

Position: Senior Aquatic Biologist, TVA Environmental Stewardship and Policy, Knoxville, Tennessee  
Education: M.S. and B.S., Zoology  
Experience: 17 years in Protected Aquatic Species Monitoring, Habitat Assessment, and Recovery; 7 years in Environmental Review  
Involvement: Aquatic Ecology/Threatened and Endangered Species

#### **S. Clay Guerry**

Position: Recreation Representative, TVA Environmental Stewardship and Policy, Lenoir City, Tennessee  
Education: M.S., Zoology, Masters of Parks, Recreation, and Tourism Management; B.S., Biology  
Experience: 2 years in Recreation Planning  
Involvement: Recreation

#### **John M. Higgins**

Position: Water Quality Specialist, TVA River Operations, Chattanooga, Tennessee  
Education: Ph.D., Environmental Engineering; B.S. and M.S., Civil Engineering; Registered Professional Engineer  
Experience: 31 years in Environmental Engineering and Water Resources Management  
Involvement: Surface Water and Wastewater

**A. Eric Howard**

Position: Archaeologist, TVA Environmental Stewardship and Policy, Knoxville, Tennessee  
Education: M.A., Anthropology  
Experience: 10 years in Cultural Resources Federal Compliance Laws; 13 years in Southeastern U.S. and Caribbean Archaeology  
Involvement: Cultural Resources

**M. Carolyn Koroa**

Position: Senior Geographic Analyst, TVA River Operations, Knoxville, Tennessee  
Education: M.S. and B.A., Geography  
Experience: 16 years in Geographic Analysis; 8 years with TVA Navigation Program  
Involvement: Recreation (Boating)

**Roger A. Milstead**

Position: Manager, TVA Flood Risk and Data Management, Knoxville, Tennessee  
Education: B.S., Civil Engineering; Registered Professional Engineer  
Experience: 30 years in Floodplain and Environmental Evaluations  
Involvement: Floodplains

**Deborah L. Rutherford**

Position: Land Use Representative, TVA Environmental Stewardship and Policy, Lenoir City, Tennessee  
Education: B.S., Civil Engineering and Water Resources  
Experience: 13 years in Land Use; 14 years in Geographic Information  
Involvement: Document Preparation