

April 2013

Draft Economic Analysis of Critical
Habitat Designation for the Fluted
Kidneyshell and Slabside
Pearlymussel

Final Report

Prepared for

U.S. Fish and Wildlife Service

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EXECUTIVE SUMMARY

ES.1 Purpose of the Economic Analysis

RTI International, under contract to the U.S. Fish and Wildlife Service (Service), conducted a draft economic analysis of the proposed rule designating critical habitat for the fluted kidneyshell (*Ptychobranthus subtentum*) and slabside pearlymussel (*Pleuonaia dolabelloides*). The purpose of the economic analysis is to estimate the foreseeable incremental economic impacts of the critical designation relative to baseline economic impacts of the species listing and other regulations providing protection to the species. The economic analysis provides the Service with information to make determinations about possible exclusions to the proposed critical habitat designation. Under Section 4(b)(2) of the Endangered Species Act of 1973, as amended (the Act), the Secretary of the Interior may exclude any area from critical habitat if the benefits of exclusion outweigh the benefits of inclusion, as long as the exclusion will not result in the extinction of the species. The analysis also meets other requirements of the Act; Executive Orders 12866, 12630, and 13211; and the Regulatory Flexibility Act, Unfunded Mandates Reform Act, and all related amendments.

ES.2 Proposed Critical Habitat

On October 4, 2012, the Service proposed to list the fluted kidneyshell and slabside pearlymussel as endangered and designate a combined 1,380 river miles as critical habitat for these species (U.S. Fish and Wildlife Service, 2012b). The critical habitat consists of 37 units. Fourteen of these units are designated only for the fluted kidneyshell, 3 units only for the slabside pearlymussel, and 10 units for both species. The fluted kidneyshell's critical habitat is proposed to encompass 1,181 river miles and 24 units across Alabama, Kentucky, Tennessee, and Virginia. The slabside pearlymussel's proposed critical habitat would contain 970 river miles and 13 units across Alabama, Mississippi, Tennessee, and Virginia (figure ES-1).

ES.3 Methods

The purpose of the economic analysis is to estimate the incremental costs and benefits of the proposed critical habitat designation. The listing of the species, as well as other Federal, State, and local laws, may provide protection to the critical habitat areas even in the absence of the critical habitat designation. Costs associated with these baseline protections are not quantified in this analysis but are described qualitatively to provide context to the incremental costs of critical habitat designation. The incremental costs of critical habitat designation are those that only occur because of the critical habitat designation. Direct incremental costs result from additional effort directly related to provisions in the Act, while indirect incremental costs result

from additional effort related to the critical habitat designation resulting from other Federal, State, or local laws.

To determine the incremental costs of critical habitat, we projected future consultations related to proposed critical habitat units based on the consultation history for previously listed co-occurring aquatic species within habitat unit study areas, as well as other relevant data sources. The study area for each critical habitat unit was defined as the area upstream of the critical habitat unit within its subbasin (8-digit Hydrologic Cataloging Unit [HUC-8]), including upstream sinks, based on NHDPlus catchments and flowlines (figure ES-1). We included the area upstream of the Hiwassee River unit in North Carolina in the study area because of its proximity to the critical habitat unit; however, no relevant consultations have occurred relating to co-occurring aquatic species in the Hiwassee as a result of the presence of the Apalachia Dam. Based on guidance from the Service, we excluded portions of two study areas based on State boundaries where sufficient distance exists between the boundary and the habitat unit that upstream consultations are unlikely to consider impacts to the critical habitat units. For the Nolichucky, we excluded the portion in North Carolina from the study area. For the Hiwassee, we included the portion in North Carolina based on its proximity to the habitat unit but excluded the portion further upstream in Georgia.

We considered impacts to eight categories of economic activity:

- road maintenance and construction
- commercial, industrial, residential, and associated utility development
- mining
- agricultural and recreational development
- dam operation
- State water quality standards
- Federal land management
- restoration and conservation

For each economic activity, we estimated the direct incremental administrative time and expected project modification costs from discussions with stakeholders including the Service, other Federal and State agencies, and project proponents. We projected estimated incremental costs over the next 20 years, using a discount rate of 7 percent for costs in future years.

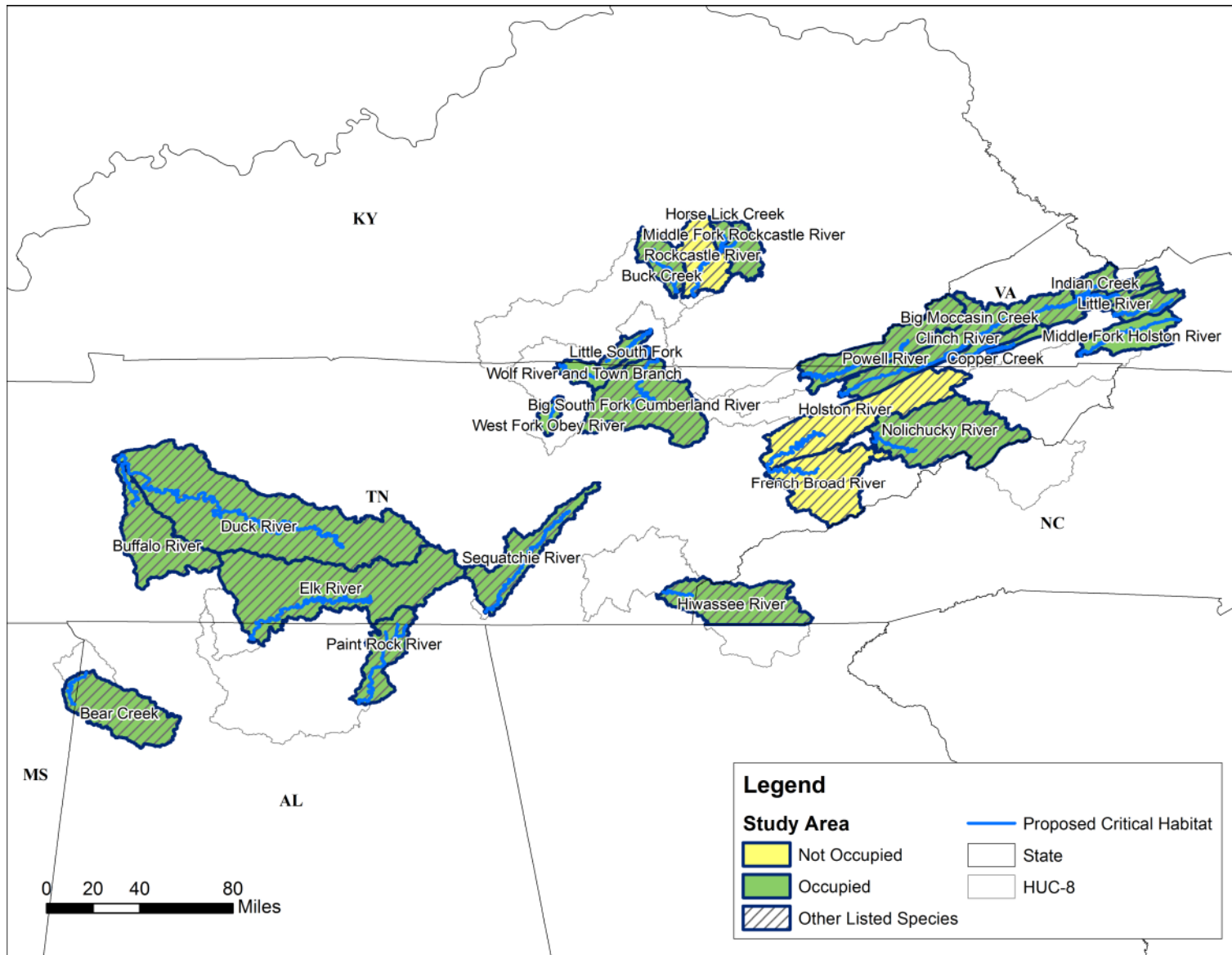


Figure ES-1. Proposed Critical Habitat Units and Study Areas

Undiscounted costs and costs discounted using a 3 percent discount rate are presented for comparison.

In occupied proposed critical habitat units, consultations would be required to analyze impacts to the species. In addition, any project modifications required to avoid jeopardizing the species would be sufficient to avoid adverse modification of the critical habitat. Thus, for future consultations in occupied units, the estimated incremental cost is the additional administrative time during consultations to consider impacts to habitats as well as the species. For future consultations in three unoccupied units (the Rockcastle River, Holston River, and French Broad River units), we considered the entire administrative consultation cost and associated project modifications as incremental to the listing based on Service guidance. These three units are occupied by other listed mussels for which there are existing consultation requirements, and, based on stakeholder discussions, any project modifications required for the fluted kidneyshell and slabside pearl mussel would also be required for these other species. Therefore, we also discuss the implications of considering other listed mussels as part of the baseline.

ES.4 Key Findings

We estimate that the critical habitat designation will result in direct incremental costs of \$3.5 million over the next 20 years (table ES-1), with an additional \$0.4 million in indirect incremental costs associated with water quality permitting for road maintenance and construction in Kentucky in the unoccupied Rockcastle River unit. The majority of direct incremental costs, 55 percent, are estimated to result from future consultations for road maintenance and construction projects. Over three-quarters of the incremental costs are estimated to result from consultations in the three unoccupied units. If consultations and project modifications associated with the other listed species in these units were considered part of the baseline, we estimate that direct incremental costs would be approximately \$989,000 over the next 20 years with no indirect incremental costs.

ES.5 Unquantified Impacts

Indirect economic impacts associated with time delays and a misperception of the regulatory burden imposed by the proposed critical habitat designation, as well as the benefits associated with the proposed rule, were not quantified in the current analysis because of the lack of available data. These impacts are discussed qualitatively in the analysis.

Table ES-1. Estimated Direct Incremental Costs of the Proposed Critical Habitat Designation by Study Area and Economic Activity over 20 Years Using a 7% Discount Rate (\$1,000s)

Unit ID	Unit Location	Road Maintenance and Construction	Commercial, Industrial, Residential, and Associated Utility Development	Mining	Agricultural and Recreational Development	Federal Management Plan Administration	Dam Operation	State Water Quality Standards	Restoration and Conservation	Total
FK1	Horse Lick Creek, KY	\$0.00	\$1.14	\$0.00	\$0.93	\$0.15	\$0.00	\$0.08	\$2.80	\$5.10
FK2	Middle Fork Rockcastle River, KY	\$3.58	\$2.78	\$0.00	\$0.93	\$0.15	\$0.00	\$0.08	\$2.00	\$9.52
FK3	Rockcastle River, KY	\$494.70	\$214.02	\$10.65	\$23.27	\$2.13	\$0.00	\$0.08	\$74.71	\$819.56
FK4	Buck Creek, KY	\$22.29	\$4.01	\$0.00	\$0.40	\$0.15	\$0.00	\$0.08	\$5.19	\$32.12
FK5	Rock Creek, KY	\$0.00	\$3.04	\$0.00	\$2.80	\$0.30	\$0.00	\$0.11	\$2.30	\$8.54
FK6	Little South Fork Cumberland River, KY	\$3.58	\$0.61	\$0.00	\$0.40	\$0.21	\$0.00	\$0.11	\$5.22	\$10.14
FK7	Big South Fork Cumberland River, KY, TN	\$39.69	\$21.10	\$46.32	\$4.39	\$0.96	\$0.00	\$0.11	\$6.82	\$119.39
FK8	Wolf River and Town Branch, TN	\$2.81	\$0.38	\$0.00	\$0.40	\$0.03	\$0.00	\$0.11	\$2.30	\$6.03
FK9	West Fork Obey River, TN	\$0.98	\$1.05	\$0.00	\$0.00	\$0.03	\$0.00	\$0.03	\$0.30	\$2.39
FK10	Indian Creek, VA	\$19.69	\$8.05	\$0.62	\$0.00	\$1.09	\$0.00	\$0.38	\$6.39	\$36.23
FK11	Little River, VA	\$0.00	\$3.27	\$0.00	\$0.00	\$1.09	\$0.00	\$0.38	\$0.00	\$4.74
FK12, SP1	North Fork Holston River, VA	\$0.00	\$4.18	\$0.00	\$0.00	\$1.09	\$0.00	\$0.38	\$0.00	\$5.65
FK13, SP2	Middle Fork Holston River, VA	\$12.94	\$3.76	\$0.00	\$0.00	\$1.09	\$0.00	\$0.95	\$0.00	\$18.75

(continued)

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Table ES-1. Estimated Incremental Costs of the Proposed Critical Habitat Designation by Study Area and Economic Activity over 20 Years Using a 7% Discount Rate (\$1,000s) (continued)

Unit ID	Unit Location	Road Maintenance and Construction	Commercial, Industrial, Residential, and Associated Utility Development	Mining	Agricultural and Recreational Development	Federal Management Plan Administration	Dam Operation	State Water Quality Standards	Restoration and Conservation	Total
FK14, SP3	Big Moccasin Creek, VA	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.38	\$0.00	\$0.38
FK15	Copper Creek, VA	\$6.46	\$0.00	\$0.00	\$0.93	\$0.00	\$0.00	\$0.38	\$0.93	\$8.70
FK16, SP4	Clinch River, TN, VA	\$36.59	\$68.67	\$50.00	\$0.93	\$1.51	\$0.00	\$1.54	\$16.99	\$176.23
FK17, SP5	Powell River, TN, VA	\$13.11	\$7.35	\$19.92	\$3.46	\$1.81	\$0.00	\$1.17	\$7.19	\$54.00
FK18, SP6	Nolichucky River, TN	\$11.09	\$8.64	\$0.00	\$1.60	\$0.39	\$0.85	\$0.11	\$0.53	\$23.21
FK19	Holston River, TN	\$439.44	\$425.67	\$0.00	\$14.70	\$0.37	\$5.67	\$0.03	\$19.55	\$905.43
FK20	French Broad River, TN	\$658.52	\$276.65	\$0.00	\$0.00	\$2.58	\$5.67	\$0.11	\$34.25	\$977.78
FK21, SP7	Hiwassee River, TN	\$0.00	\$1.93	\$0.00	\$0.00	\$0.88	\$0.85	\$0.03	\$0.53	\$4.22
SP8	Sequatchie River, TN	\$0.00	\$6.57	\$4.79	\$1.60	\$0.03	\$0.00	\$0.03	\$1.90	\$14.92
SP9	Paint Rock River, AL	\$4.34	\$0.00	\$0.00	\$0.00	\$0.03	\$0.00	\$0.03	\$5.09	\$9.49
FK22, SP10	Elk River, AL, TN	\$14.88	\$17.15	\$0.00	\$6.39	\$0.05	\$6.40	\$0.03	\$3.72	\$48.63
SP11	Bear Creek, AL, MS	\$14.51	\$0.00	\$0.00	\$0.00	\$1.02	\$0.85	\$0.00	\$8.21	\$24.59
FK23, SP12	Duck River, TN	\$139.60	\$22.99	\$0.00	\$9.58	\$7.02	\$0.85	\$0.03	\$11.71	\$191.79
FK24, SP13	Buffalo River, TN	\$3.50	\$1.59	\$0.00	\$3.19	\$0.03	\$0.00	\$0.03	\$1.90	\$10.25
Total		\$1,942.30	\$1,104.59	\$132.31	\$75.90	\$24.22	\$21.15	\$6.79	\$220.51	\$3,527.77

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ES.6 Sources of Uncertainty

Estimating the impact of a regulation on future outcomes is inherently uncertain. Administrative time for consultations and associated project modifications are project dependent and exhibit wide variability. Although we relied on expert opinion and publicly available sources to estimate these costs, they are not definitive. The timing of future projects affects the present value of the cost estimates, as a result of discounting future costs, but the precise timing is uncertain. We assumed annual costs distributed across the time frame are proportional to future population projections for consultations related to road maintenance and construction as well as commercial, industrial, residential, and associated utility development. All other consultations were distributed evenly over the time period, with the exception of known formal consultation reinitiations. The quantity and type of future consultations will be influenced by economic, demographic, political, and biological variables that cannot be forecasted precisely.

SECTION 1 INTRODUCTION

1.1 Purpose of the Economic Analysis

RTI International, under contract to the U.S. Fish and Wildlife Service (Service), conducted a draft economic analysis of the proposed rule designating critical habitat for the fluted kidneyshell (*Ptychobranchnus subtentum*) and slabside pearlymussel (*Pleuonaia dolabelloides*). The economic analysis provides the Service with information to make determinations about possible exclusions to the proposed critical habitat designation. Under Section 4(b)(2) of the Endangered Species Act of 1973, as amended (the Act), the Secretary of the Interior may exclude any area from critical habitat if the benefits of exclusion outweigh the benefits of inclusion, as long as the exclusion will not result in the extinction of the species. The analysis also meets other requirements of the Act; Executive Orders 12866, 12630, and 13211; and the Regulatory Flexibility Act, Unfunded Mandates Reform Act, and all related amendments.

To support these determinations, we estimated the incremental impacts of the critical habitat's protection from adverse modification relative to the baseline associated with the protections afforded by the listing of the fluted kidneyshell and slabside pearlymussel as endangered (the listing), other Federal and State laws (e.g., the Clean Water Act), and conservation activities since the listing.

1.2 Fluted Kidneyshell, Slabside Pearlymussel, and Proposed Critical Habitat

On October 4, 2012, the Service proposed to list the fluted kidneyshell and slabside pearlymussel as endangered and designate a combined 1,380 river miles as critical habitat for these species (table 1-1). The critical habitat consists of 37 critical habitat units. Fourteen of these units are designated only for the fluted kidneyshell, 3 units only for the slabside pearlymussel, and 10 units for both species. The fluted kidneyshell's critical habitat is proposed to encompass 1,181 river miles and 24 units across Alabama, Kentucky, Tennessee, and Virginia. The slabside pearlymussel's proposed critical habitat will contain 970 river miles and 13 units across Alabama, Mississippi, Tennessee, and Virginia (figure 1-1).

Table 1-1. Attributes of Proposed Critical Habitat Units

Unit	Location	State	Unit Allocated For	Occupied by Fluted Kidneyshell	Occupied by Slabside Pearlymussel	Private Ownership (miles)	Federal, State, County, City Ownership (miles)	Total Length (miles)
FK1	Horse Lick Creek	KY	Fluted kidneyshell	Yes	No	2.3	10.1	12.4
FK2	Middle Fork Rockcastle River	KY	Fluted kidneyshell	Yes	No	3.7	4	7.7
FK3	Rockcastle River	KY	Fluted kidneyshell	No	No	7.3	36.2	43.5
FK4	Buck Creek	KY	Fluted kidneyshell	Yes	No	37.1	0.8	37.9
FK5	Rock Creek	KY	Fluted kidneyshell	Yes	No	0.9	11	11.9
FK6	Little South Fork Cumberland River	KY	Fluted kidneyshell	Yes	No	38	2.7	40.7
FK7	Big South Fork Cumberland River	KY	Fluted kidneyshell	Yes	No	1	55.9	56.9
FK8	Wolf River & Town Branch	TN	Fluted kidneyshell	Yes	No	24	3.5	27.5
FK9	West Fork Obey River	TN	Fluted kidneyshell	Yes	No	12	0	12
FK10	Indian Creek	VA	Fluted kidneyshell	Yes	No	4.2	0	4.2
FK11	Little River	VA	Fluted kidneyshell	Yes	No	31.3	0	31.3
FK12, SP1	North Fork Holston River	VA	Both species	Yes	Yes	41.3	0.5	41.8
FK13, SP2	Middle Fork Holston River	VA	Both species	Yes	Yes	55.3	0	55.3
FK14, SP3	Big Moccasin Creek	VA	Both species	No	Yes	20.6	0	20.6
FK15	Copper Creek	VA	Fluted kidneyshell	Yes	No	34.5	0	34.5
FK16, SP4	Clinch River	TN, VA	Both species	Yes	Yes	159.2	4	163.2
FK17, SP5	Powell River	TN, VA	Both species	Yes	Yes	94.7	0.2	94.9
FK18, SP6	Nolichucky River	TN	Both species	No	Yes	31.6	0.6	32.2
FK19	Holston River	TN	Fluted kidneyshell	No	No	52.9	0	52.9

(continued)

Table 1-1. Attributes of Proposed Critical Habitat Units (continued)

Unit	Location	State	Unit Allocated For	Occupied by Fluted Kidneyshell	Occupied by Slabside Pearlymussel	Private Ownership (miles)	Federal, State, County, City Ownership (miles)	Total Length (miles)
FK20	French Broad River	TN	Fluted kidneyshell	No	No	33.8	1.1	34.9
FK21, SP7	Hiwassee River	TN	Both species	No	Yes	0	15.2	15.2
SP8	Sequatchie River	TN	Slabside pearlymussel	No	Yes	94.1	0	94.1
SP9	Paint Rock River	AL	Slabside pearlymussel	No	Yes	74.1	3.6	77.7
FK22, SP10	Elk River	AL, TN	Both species	No	Yes	101.2	0.9	102.1
SP11	Bear Creek	AL, MS	Slabside pearlymussel	No	Yes	22.5	3.8	26.3
FK23, SP12	Duck River	TN	Both species	Yes	Yes	176.5	39.4	215.9
FK24, SP13	Buffalo River	TN	Both species	No	Yes	31	0	31
Total						1,185	194	1,379

Source: U.S. Fish and Wildlife Service. 2012b. "Endangered and Threatened Wildlife and Plants Endangered Species Status for the Fluted Kidneyshell and Slabside Pearlymussel and Designation of Critical Habitat; Proposed Rule." 77 *Federal Register* 60804 (Oct. 4, 2012).

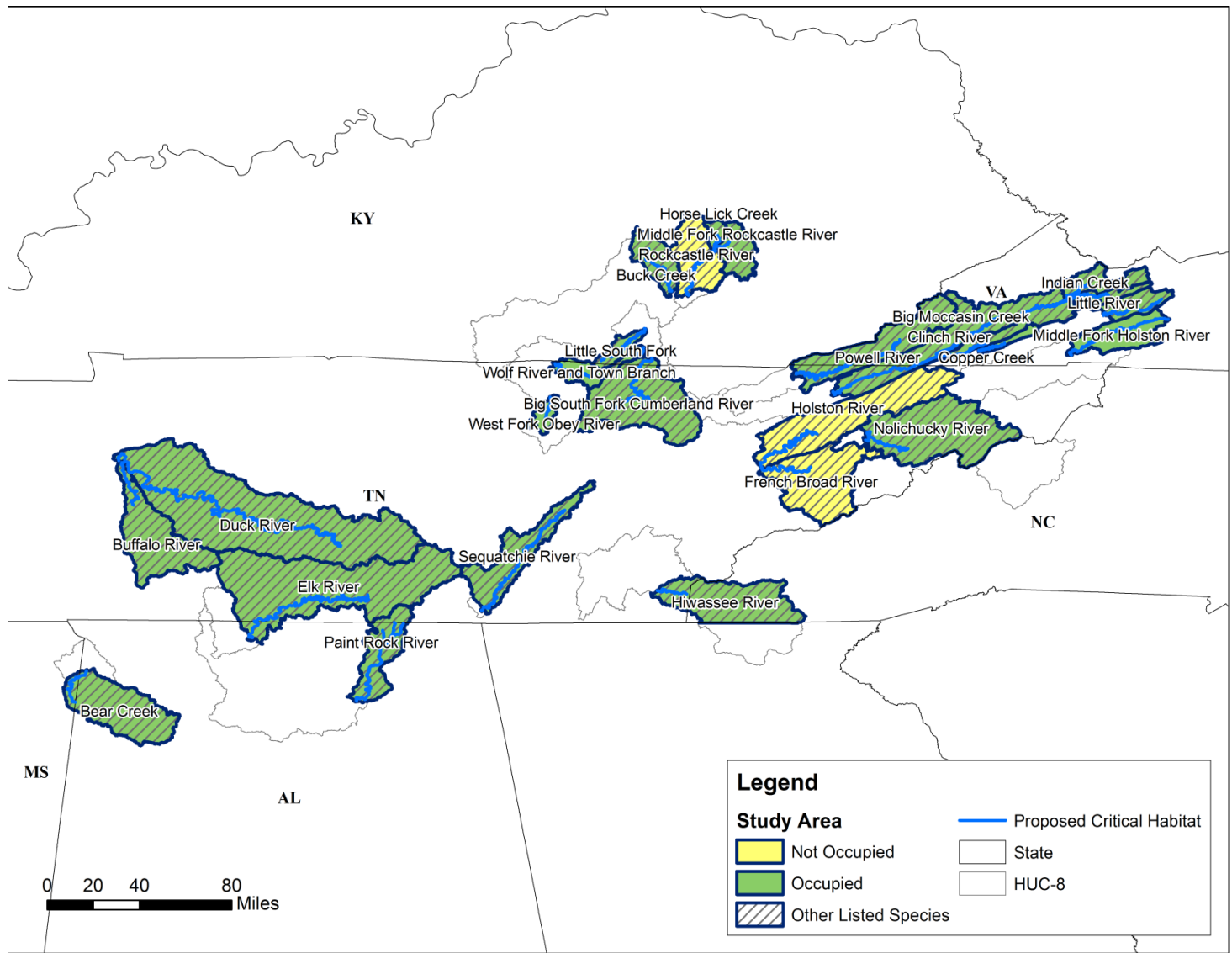


Figure 1-1. Proposed Critical Habitat Units and Study Areas

The proposed critical habitat is based on known historical and extant occurrence records for the species. All proposed units for the slabside pearlymussel are currently occupied by the species; however, 8 of the 24 units designated for the fluted kidneyshell are currently unoccupied by the species. These unoccupied units are either occupied by the slabside pearlymussel (5 of the 8 units) or contain previously listed species, including other mussel species as well as fish and snail species. Only 2 units (Wolf River & Town Branch and West Fork Obey River) of the proposed critical habitat do not already contain records of currently listed species. However, these 2 units are currently occupied by the fluted kidneyshell.

A majority of the riparian land adjacent to the proposed habitat is under private ownership. For the fluted kidneyshell, 84 percent of the critical habitat is under private ownership, while the remaining 16 percent is owned by Federal, State, county, or local governments (table 1-1). The slabside pearlymussel critical habitat has a higher level of private ownership at 93 percent. Over the total 1,380 river miles of critical habitat, only 254 river miles are owned by Federal, State, county, or local governments (12 percent), and the remaining adjacent riparian land is under private ownership. The lands under Federal, State, county, or local control are managed conservation areas that provide some level of protection to aquatic species and habitat.

As members of the family Unionidae, the fluted kidneyshell and slabside pearlymussel have similar life histories and associated habitat requirements with some subtle differences. Both species are filter feeders and siphon phytoplankton, detritus, and bacteria out of the water column for sustenance. The mussels rely on specific host fish to carry their larvae, called glochidia, and act as hosts for juvenile mussels. If the fish host drops juveniles in an unsuitable stream bottom where the mussels are unable to attach to a substrate (sand, gravel, or for the slabside pearlymussel, cobble), the mussels will die. The fluted kidneyshell's habitat includes the riffles and shoals of large creeks to small rivers with a moderate to swift current, while the slabside pearlymussel habitat range includes riffles and shoals of large creeks to moderate-sized rivers with moderate currents. The mussels need water with a pH between 6.0 and 8.5, oxygen content above 5.0 mg/L, and low to moderate amounts of fine sediment.

Based on this information, the Service has defined five primary constituent elements (PCEs) of habitat that support life history processes of the mussels:

1. appropriate geomorphology of stream habitat
2. proper stream bed material composition
3. natural hydrologic flow

4. sufficient water quality and water chemistry
5. presence of fish hosts

The fluted kidneyshell and slabside pearlymussel exist today in less than half of streams in their historical range. The decline of the mussels can largely be attributed to the degradation of their habitats. The main actions that affect the five PCEs are impoundments, stream channel alterations, water pollution from point and nonpoint sources, and sedimentation.

The remainder of the report is organized as follows: Section 2 presents the analysis methodology, section 3 provides a description of each of the study areas in the analysis and relevant consultation history, section 4 presents the findings of the economic analysis by economic activity and habitat unit, and section 5 discusses qualitatively the benefits associated with the proposed critical habitat designation. The regulatory flexibility and significant energy impact screening analyses are presented in appendix A. Appendix B contains additional results calculated using different discount rates.

SECTION 2 METHODOLOGY

2.1 Economic Impacts of the Act

2.1.1 Direct Efficiency Impacts

Threatened and endangered species and their designated critical habitats are afforded a number of protections under the Act. These protections require the commitment of resources for their administration and compliance that could serve other productive purposes within the economy. Thus, the protections and their associated costs represent the direct efficiency impacts of the Act.

Section 9 of the Act prohibits the take (as well as the import, export, and interstate or foreign trade) of any listed species. Take is defined in the Act as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.” To prevent the take of the fluted kidneyshell and slabside pearlymussel, actions within the study area may require different management actions such as maintaining adequate flow releases from dams, requiring constructed bridges to clear span streams instead of placing piers in the channel, and obtaining a permit from the Service under Section 10 of the Act if take occurs but is incidental to an otherwise lawful activity and does not appreciably reduce the likelihood of survival and recovery of the species.

Section 7(a)(2) specifies that actions with a Federal nexus, defined as actions authorized, funded, or carried out by a Federal agency, must be carried out in such a way that the actions are “not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with affected States, to be critical...” To determine if the action will jeopardize the species (jeopardy) or adversely modify critical habitat (adverse modification), the responsible Federal agency or designated nonfederal representative (action agency) must consult with the Service through formal or informal consultation if its action could affect a Federally listed species or its designated critical habitat. During consultation processes with the Service, a Federal action agency may choose to modify its proposed action to lessen the potential effects to a listed species or its designated critical habitat or incorporate conservation measures to offset potential effects.

Section 4(f) of the Act provides for creating recovery plans for endangered and threatened species. These plans support voluntary conservation actions that, for the purposes of

economic analysis, could be considered direct costs of the Act. Because the fluted kidneyshell and slabside pearlymussel are currently proposed to be listed as endangered, no recovery plan has been developed for these species.

2.1.2 Indirect Efficiency Impacts

Indirect costs are costs that are attributable to the listing or designation but are not implemented through the Act. These include the enforcement of existing Federal and local laws that afford protection to the species; conservation efforts taken independent of a recovery plan or recommendations from the Service; and time delays, regulatory uncertainty, and stigma resulting from listing or designation.

2.1.3 Distributional Impacts

Although estimating the value of resources directly and indirectly used to comply with protections of the Act allows one to estimate the economic efficiency impacts, it does not provide information about how these impacts are distributed throughout society. One economic sector may be affected disproportionately compared with others. Although quantitatively estimating the regional distributional impact of the listing and designation is beyond the scope of this analysis, we address the distributional impacts qualitatively.

Of particular importance are the distributional impacts to small entities. To small entities, the fixed costs of regulatory compliance can be onerous relative to their larger competitors and, thus, harm their competitive position in the market. The Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA), requires that a regulatory flexibility screening analysis be conducted to estimate if a proposed regulation will have a significant impact on a substantial number of small entities (SISNOSE). If a SISNOSE is determined, then a full regulatory flexibility analysis must be prepared.

2.1.4 Benefits

Although the primary benefit of the listing and designation is the continued viability and recovery of the species, conservation efforts directly and indirectly associated with the listing and designation preserve ecosystems that provide valuable services to the public. Functioning ecosystems naturally filter air and water and provide habitat for other organisms. Land not covered by impermeable surfaces within the watershed retains storm water, providing flood control. Green space set aside from development improves nearby property values, provides recreational opportunities, and moderates the microclimate of an area. Nature preserves allow for educational and volunteer opportunities. These benefits associated with the proposed critical

habitat designation and existing conservation efforts in study areas are described qualitatively in section 5 of this report.

2.1.5 Sources of Uncertainty

Estimating the impact of a regulation on future outcomes is inherently uncertain. Administrative time for consultations and associated project modifications are project dependent and exhibit wide variability. Although we relied on expert opinion and publicly available sources to estimate these costs, these are not definitive. The timing of future projects affects the present value of the cost estimates, because of the time value of money, but the precise timing is uncertain. We assumed annual costs distributed across the time frame are proportional to future population projections for consultation related to road maintenance and construction as well as commercial, industrial, residential, and associated utility development. All other consultations are distributed evenly over the time period, with the exception of known formal consultation reinitiations. The quantity and type of future consultations will be influenced by economic, demographic, political, and biological variables, which cannot be forecasted precisely.

2.2 Incremental Analysis

The establishment of critical habitat for an endangered species may create an incremental regulatory burden and an increase in associated costs relative to the baseline of listing the species as endangered or threatened. The baseline costs include all direct and indirect costs described in section 2.1 attributable to the listing, while incremental costs are those direct and indirect costs associated with the designation. Although there are alternative interpretations across Federal courts regarding whether the economic analysis should consider baseline and incremental impacts co-extensively, most Federal courts have found that the incremental impacts costs are those that must be considered in the decision whether to include or exclude an area from the critical habitat designation under Section 4(b)(2) of the Act (U.S. Department of the Interior, 2008).

Only actions with a Federal nexus are potentially affected by the designation of critical habitat. Designation of critical habitat could result in Section 7 consultations if an action conducted by, funded by, or permitted by a Federal agency or its designated delegate would affect designated critical habitat. Designation of critical habitat within the occupied habitat units will not result in additional consultations because, in almost every case, an action that would affect critical habitat would also affect the listed species present. However, it would result in administrative costs to address the designated critical habitat in the consultation. In occupied units, any project modifications required during consultations to avoid jeopardizing the species

would be sufficient to avoid adverse modification of the critical habitat. In the three unoccupied units, the full cost of consultations and project modifications is assumed to be incremental to the critical habitat designation based on Service guidance. These three units unoccupied by the fluted kidneyshell or slabside pearlymussel are occupied by other listed mussels with existing consultation requirements. We discuss the implications of considering the presence of other listed mussels as part of the baseline in the analysis.

Indirect incremental costs include the costs of conservation efforts attributable solely to the designation of critical habitat, such as those triggered by State laws in areas designated as critical habitat, as well as the stigma and regulatory uncertainty associated with land designated as critical habitat. Although critical habitat designation only affects activities with a Federal nexus, misperception of the regulatory burden imposed by critical habitat designation may result in costs (table 2-1).

Table 2-1. Baseline and Incremental Impacts of Critical Habitat Designation

Category	Baseline	Incremental
Costs		
Consultation	<u>Direct</u> : Costs of consultation with the Service to consider impacts to listed species.	<u>Direct</u> : Additional costs of consultation with the Service to consider impacts to critical habitat.
Project modifications	<u>Direct</u> : Costs of modifying projects to meet consultation requirements (jeopardy standard).	<u>Direct</u> : Additional costs of modifying projects to meet adverse modification requirements.
Additional impacts	<u>Direct</u> : Change in land values and use patterns or other costs directly resulting from the species listing. <u>Indirect</u> : Costs of additional compliance and conservation efforts not required by the Act and attributed to the listing.	<u>Indirect</u> : Costs of additional compliance and conservation efforts not required by the Act and attributed to the critical habitat designation. Other costs borne by private or public entities such as time delays, regulatory uncertainty, and the stigma resulting from the critical habitat designation.
Benefits		
Species conservation and related beneficial impacts	Benefits of species conservation achievements attributable to the species listing. Other benefits resulting from species conservation activities undertaken in response to the species listing.	Benefits of species conservation achievements attributable to the critical habitat designation. Other benefits resulting from species conservation activities undertaken in response to the critical habitat designation.

2.3 Study Area Definition

The study area for each critical habitat unit is defined as the area upstream of the critical habitat unit within its subbasin (8-digit Hydrologic Cataloging Unit [HUC-8]), including upstream sinks, based on NHDPlus catchments and flowlines (figure 1-1). We included the area upstream of the Hiwassee River unit in North Carolina because of its proximity to the critical habitat unit; however, no relevant consultations have occurred relating to co-occurring aquatic species in the Hiwassee as a result of the presence of the Apalachia Dam. Based on guidance from the Service, we excluded portions of two study areas based on State boundaries where sufficient distance exists between the boundary and the habitat unit that upstream consultations are unlikely to consider impacts to the critical habitat units. For the Nolichucky, we excluded the portion in North Carolina from the study area. For the Hiwassee, we included the portion in North Carolina based on its proximity to the habitat unit but excluded the portion further upstream in Georgia.

2.4 Data Collection and Analysis

Relevant consultation history was developed based on queries of the Tracking and Integrated Logging System (TAILS) database maintained by the Service to record consultation activity. Service Field Office staff in the study area States provided the results of TAILS queries for all consultations that considered the fluted kidneyshell and slabside pearlymussel as candidates, as well as co-occurring listed aquatic species. State field offices have been using TAILS since 2006; however, Virginia records begin in 2007. We then worked with field staff to assign each consultation to a relevant study area or study areas, excluding consultations outside of the study areas. When consultations related to multiple study areas, the consultation was divided evenly among the relevant study areas. Examples include a consultation relating to a study area upstream of other study areas, a Federal management plan for a National Forest intersecting multiple study areas, or statewide consultations. For instance, if a consultation related to bridge maintenance in the Little River study area, which is also part of the Clinch River study area as an upstream tributary, the consultation would be allocated as 0.5 consultations for both the Little River and the Clinch River. If a consultation related to prescribed burns throughout Daniel Boone National Forest Stearns Ranger District, which includes the Rock Creek, Little South Fork Cumberland River, and Big South Fork Cumberland River study areas, the consultation would be divided evenly across the three study areas and attributed as 0.33 consultations in each study area.

After developing the relevant consultation history, a total of 11 formal and 471 informal consultations across five States (no consultations in North Carolina considered potential effects

to co-occurring species in proposed habitat units), we assigned each consultation to one of the following economic activities:

- road maintenance and construction
- commercial, industrial, residential, and associated utility development
- mining
- agricultural and recreational development
- dam operation
- State water quality standards
- Federal land management
- restoration and conservation

We then contacted stakeholders to discuss their experiences with the relevant consultation history to develop estimates of future administrative time spent per consultation by the Service, the action agency, and project proponents, as well as expected costs of project modifications by economic activity. We received information from the following Federal and State agencies:

- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers (the Corps)
- Tennessee Valley Authority (TVA)
- National Park Service (NPS)
- U.S. Forest Service
- Office of Surface Mining, Reclamation, and Enforcement
- Alabama Department of Transportation
- Kentucky Transportation Cabinet
- Tennessee Department of Environment and Conservation
- Tennessee Department of Economic and Community Development
- Tennessee Wildlife Resources Agency

- Virginia Department of Transportation

2.5 Administrative Costs of Consultations

We estimated the cost of employment by sector and occupation using the 2011 national average hourly wage by occupation, national average benefits by occupation, and estimates of other overhead expenses (table 2-2). This cost-of-employment estimate was then applied to stakeholder estimates of administrative time required for consultations by economic activity. To estimate the incremental time spent considering impacts to critical habitat in occupied units, the Service recommended using 10 percent of administrative time. Other stakeholders considered 10 percent to be on the lower range of expected time spent on considering impacts to critical habitat during consultations in occupied areas. Virginia's Department of Transportation indicated that the time spent considering critical habitat in occupied areas would be between 10 and 15 percent (Personal communication, January 23, 2013), and the Corps indicated that the fraction of time would be between 10 and 20 percent (Personal communication, January 25, 2013). Based on this input from stakeholders, we assumed that 15 percent of administrative time is required to consider impacts to critical habitat in occupied units.

2.6 Project Modification Costs

To estimate the cost of project modifications adopted during future consultations, we contacted stakeholders involved in previous consultations for information regarding the types of project modifications adopted by economic activity and their estimated costs. This personal communication is the best available data to estimate project modification costs. Where stakeholder estimates differ, we exercised our best professional judgment to reconcile their estimates. When we were unable to obtain data from stakeholders with direct knowledge of expected project modification costs, we reviewed possible ranges of costs with other relevant stakeholders to develop the best estimate based on available information.

2.7 Projecting and Discounting Future Impacts

The Office of Management and Budget recommends setting the time horizon for projecting costs and benefits of regulations based on a judgment of what constitutes the foreseeable future, stating "For most agencies, a standard time period of analysis is 10 to 20 years, and rarely exceeds 50 years" (Office of Management and Budget, 2011). We projected the incremental costs of the designation 20 years into the future, from 2013 to 2032. All projected monetary values in the report were discounted using a 7 percent discount rate (Office of Management and Budget, 2003b). Appendix B contains summary tables of undiscounted results and results discounted at a 3 percent discount rate.

Table 2-2. Cost of Administrative Time for Consultations by Sector and Occupation (2011)

Sector—Occupation	Mean Hourly Wage	Total Benefits as Percentage of Wage	Overhead Rate as Percentage of Wage	Benefits and Overhead Loading Factor	Cost of Employment
Federal—Wildlife Biologist	\$37.30	36.25%	16.35% ^a	1.53	\$56.92
Federal—Civil Engineer	\$41.80	36.25%	16.35% ^a	1.53	\$63.79
State—Environmental Engineer	\$32.55	46.15%	17.00%	1.63	\$53.10
State—Civil Engineer	\$35.88	46.15%	17.00%	1.63	\$58.54
Private—Civil Engineer	\$40.35	40.35%	17.00%	1.57	\$63.49

^a Federal overhead factor is 12 percent for both wage and benefits, adjusted here to reflect percentage of wage.

Sources: Office of Management and Budget. 2003a. “Performance of Commercial Activities (OMB Circular A-76).” Available at http://www.whitehouse.gov/omb/circulars_a076_a76_incl_tech_correction. Accessed November 7, 2012.

Rice, C. 2002. “Wage Rates for Economic Analysis of the Toxics Release Inventory Program.” Washington, DC: U.S. EPA, Office of Pollution Prevention and Toxics, Economic and Policy Analysis Branch.

U.S. Bureau of Labor Statistics. 2012a. “Employer Cost for Employee Compensation, 2011 Total Benefits for Professional and Related Occupations.” Series ID: CMU2030000120000D & CMU3030000120000D. Available at <http://www.bls.gov/ncs/ect>. Accessed October 30, 2012.

U.S. Bureau of Labor Statistics. 2012b. “Occupational Employment Statistics: May 2011 National Industry-Specific Occupational Employment and Wage Estimates.” Available at <http://www.bls.gov/oes/current/oessrci.htm>. Accessed October 30, 2012.

SECTION 3 STUDY AREAS

For each proposed critical habitat unit, we defined the study area as the upstream catchments within the subbasin (HUC-8) containing the critical habitat unit, including upstream sinks. Two units—the Nolichucky (FK18, SP6) and Hiwassee (FK21, SP7) Rivers—have study areas that extend beyond the five States containing critical habitat units. Based on guidance from the Service, we excluded portions of the two study areas based on State boundaries where sufficient distance exists between the boundary and the habitat unit that upstream consultations are unlikely to consider impacts to the critical habitat units. For the Nolichucky, we excluded the portion in North Carolina from the study area. For the Hiwassee, we included the portion in North Carolina based on its proximity to the habitat unit but excluded the portion further upstream in Georgia.

This section details several aspects of each study area to inform the economic analysis: 2010 human population and employment by sector, human population projections to 2032, gravel and rock mining operations, major permitted dischargers into study area waterways from the U.S. Environmental Protection Agency’s (EPA’s) Facility Registry System (FRS), incorporated places,¹ intersecting Federal lands, primary and secondary roadways, and a description of the relevant consultation history attributable to each unit.

The 2010 study area population estimates are based on all census block groups that intersect the study area (U.S. Census Bureau, 2011). Because block group boundaries do not conform to the ecological boundaries, these values are overestimates of the population directly inside of the study areas. Block groups intersected by multiple study areas were included in the totals for each study area, so totals cannot be summed across study areas. The population within block groups intersecting all study areas was 1.6 million in 2010 (table 3-1). Of this total, 1.1 million live in Tennessee, representing 18 percent of Tennessee’s total 2010 human population.

¹ The U.S. Census defines an incorporated places as “a type of governmental unit incorporated under state law as a city, town (except the New England states, New York, and Wisconsin), borough (except in Alaska and New York), or village and having legally prescribed limits, powers, and functions.”

Table 3-1. 2010 State and Study Area Population

State	Study Area	Total	Percentage in Study Area
Alabama	98,282	4,779,736	2%
Kentucky	90,034	4,339,367	2%
Mississippi	9,127	2,967,297	0%
North Carolina	38,031	9,535,483	0%
Tennessee	1,110,020	6,346,105	18%
Virginia	215,435	8,001,024	3%
Total	1,560,929	35,969,012	3%

Employment by sector was estimated similarly using employment data from the American Community Survey (U.S. Census Bureau, 2012a) for block groups that intersect the study areas (table 3-2). In the block groups that intersect the study areas, employment in the manufacturing sector is above all of the State averages, while employment in the information and finance sectors is below the State averages.

Population projections are based on the most recent county-level projections provided by each State (Kentucky State Data Center, 2012; Mississippi Institutions of Higher Learning, 2012; North Carolina Office of State Budget and Management, 2011; Tennessee Advisory Commission on Intergovernmental Relations, 2012; Virginia Employment Commission, 2012). Each block group was assumed to grow at the rate of the county as a whole. For each State, we relied on available data for the year closest to 2032 as the basis for our projections and linearly interpolated and/or extrapolated to produce population projections from 2013 and 2032. We estimated that the study areas will grow by 14 percent between 2013 and 2032 (table 3-3). The population in 18 of the proposed habitat units is expected to grow by less than 10 percent; however, the populations in the French Broad River and Duck River study areas are expected to grow by 26 percent and 25 percent, respectively.

The location of intersecting Federal lands and gravel and rock mining operations is based on data from the U.S. Geological Survey National Atlas (U.S. Geological Survey, 2005). Incorporated places and primary and secondary roadways came from the 2010 census Topologically Integrated Geographic Encoding and Referencing (TIGER) spatial data (U.S. Census Bureau, 2012b). FRS geospatial data (U.S. Environmental Protection Agency, 2012) were used to identify major National Pollutant Discharge Elimination System (NPDES)-permitted facilities in study areas.

Table 3-2. Study Area Employment by Sector

NAICS	Sector	Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	13,171	2%
21	Mining, Quarrying, and Oil and Gas Extraction	6,605	1%
22	Utilities	8,360	1%
23	Construction	58,060	9%
31–33	Manufacturing	122,389	18%
42	Wholesale Trade	16,772	2%
44–45	Retail Trade	85,025	13%
48–49	Transportation and Warehousing	26,963	4%
51	Information	9,957	1%
52	Finance and Insurance	23,046	3%
53	Real Estate and Rental and Leasing	9,912	1%
54	Professional, Scientific, and Technical Services	20,666	3%
55	Management of Companies and Enterprises	401	0%
56	Administrative and Support and Waste Management and Remediation Services	24,137	4%
61	Educational Services	53,455	8%
62	Health Care and Social Assistance	85,327	13%
71	Arts, Entertainment, and Recreation	8,834	1%
72	Accommodation and Food Services	42,326	6%
81	Other Services (except Public Administration)	32,819	5%
92	Public Administration	28,722	4%
Total		676,947	100%

Relevant consultation history was developed based on queries of the Tracking and Integrated Logging System (TAILS) database maintained by the Service to record consultation activity. State field offices have been using TAILS since 2006; however, Virginia records begin in 2007. Consultations related to multiple study areas were divided evenly among the relevant study areas. Examples include a consultation relating to a study area upstream of other study areas, a Federal management plan for a National Forest intersecting multiple study areas, or statewide consultations. For instance, if a consultation related to bridge maintenance in the Little River study area, which is also part of the Clinch River study area as an upstream tributary, the consultation was allocated as 0.5 consultations for both the Little River and the Clinch River. If a consultation related to prescribed burns throughout Daniel Boone National Forest Stearns Ranger

Table 3-3. 2010 Population by Study Area with Projections to 2013 and 2032

Unit ID	Name	2010 Population	2013 Population	2032 Population	2013–2032 Percentage Change
FK1	Horse Lick Creek	6,863	6,876	6,958	1%
FK2	Middle Fork Rockcastle River	26,951	27,144	28,368	5%
FK3	Rockcastle River ^a	64,452	65,330	70,892	9%
FK4	Buck Creek	27,372	28,021	32,129	15%
FK5	Rock Creek	6,304	6,342	6,583	4%
FK6	Little South Fork Cumberland River	7,862	7,921	8,297	5%
FK7	Big South Fork Cumberland River	55,769	56,373	60,197	7%
FK8	Wolf River and Town Branch	11,317	11,391	11,860	4%
FK9	West Fork Obey River	10,707	10,905	12,158	11%
FK10	Indian Creek	38,507	38,897	41,368	6%
FK11	Little River	14,588	14,729	15,621	6%
FK12, SP1	North Fork Holston River	13,530	13,600	14,043	3%
FK13, SP2	Middle Fork Holston River	55,813	56,042	57,494	3%
FK14, SP3	Big Moccasin Creek	10,985	11,068	11,594	5%
FK15	Copper Creek	13,674	13,720	14,012	2%
FK16, SP4	Clinch River ^b	141,328	141,987	146,160	3%
FK17, SP5	Powell River	75,593	76,306	80,824	6%
FK18, SP6	Nolichucky River	164,859	168,427	191,025	13%
FK19	Holston River	248,838	253,884	285,841	13%
FK20	French Broad River	169,273	176,498	222,253	26%
FK21, SP7	Hiwassee River	46,409	47,495	54,375	14%
SP8	Sequatchie River	55,491	56,137	60,229	7%
SP9	Paint Rock River	37,144	38,045	43,754	15%
FK22, SP10	Elk River	185,665	190,211	219,005	15%
SP11	Bear Creek	62,188	63,002	68,160	8%
FK23, SP12	Duck River	335,604	349,260	435,751	25%
FK24, SP13	Buffalo River	45,320	45,261	44,888	-1%
Total		1,612,500	1,650,408	1,890,493	15%

Note: Population totals do not equal the sum of population estimates for unique study areas. The population in block groups that intersect multiple study areas are included in each study area.

^a The population for the Rockcastle River study area includes the population in the study areas upstream, Horse Lick Creek and Middle Fork Rockcastle River.

^b The population for the Clinch River study area includes the population in the study areas upstream, Indian Creek, Little River, and Copper Creek.

District, which includes the Rock Creek, Little South Fork Cumberland River, and Big South Fork Cumberland River study areas, the consultation was divided evenly across the three study areas and attributed as 0.33 consultations in each study area.

3.1 Horse Lick Creek (FK1), Middle Fork Rockcastle River (FK2), and Rockcastle River (FK3)

The Rockcastle River study area, which includes both the upstream Horse Lick Creek and Middle Fork Rockcastle River study areas, covers 461,527 acres that overlap portions of Clay, Jackson, Laurel, Pulaski, and Rockcastle Counties in Kentucky (figure 3-1). Although all of these units are occupied by other listed mussels (e.g., the Cumberland bean, *Villosa trabalis*),² none of the units have been previously designated critical habitat for other species.³ Populations of the fluted kidneyshell are found in both the Horse Lick Creek and Middle Fork Rockcastle River units but not in the Rockcastle River unit.

The 2010 human population in these study areas was 64,542—10 percent in the Horse Lick Creek study area and 42 percent in the Middle Fork Rockcastle River study area. The population in these areas is projected to grow by 9 percent or less from 2013 to 2032 (table 3-3). Employment in these areas is predominantly in the manufacturing, retail trade, and health care sectors (table 3-4).

² U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

³ Rockcastle River was excluded from the 2004 Designation of Critical Habitat for Five Endangered Mussels in the Tennessee and Cumberland River Basins to support establishment of nonessential experimental populations (U.S. Fish and Wildlife Service, 2004).

Table 3-4. Employment by Sector in Horse Lick Creek, Middle Fork Rockcastle River, and Rockcastle River

NAICS	Sector	Horse Lick Creek		Middle Fork Rockcastle River		Rockcastle River	
		Employment	Percentage	Employment	Percentage	Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	47	2%	150	2%	361	1%
21	Mining, Quarrying, and Oil and Gas Extraction	50	2%	239	3%	336	1%
22	Utilities	13	1%	140	1%	225	1%
23	Construction	253	10%	740	8%	1,796	7%
31–33	Manufacturing	595	24%	1,912	20%	3,956	16%
42	Wholesale Trade	24	1%	250	3%	691	3%
44–45	Retail Trade	253	10%	1,082	11%	3,421	14%
48–49	Transportation and Warehousing	11	0%	422	4%	984	4%
51	Information	20	1%	145	2%	430	2%
52	Finance and Insurance	76	3%	133	1%	431	2%
53	Real Estate and Rental and Leasing	23	1%	86	1%	170	1%
54	Professional, Scientific, and Technical Services	26	1%	192	2%	610	3%
55	Management of Companies and Enterprises	0	0%	0	0%	0	0%
56	Administrative and Support and Waste Management and Remediation Services	97	4%	383	4%	992	4%
61	Educational Services	225	9%	1,097	12%	2,509	10%
62	Health Care and Social Assistance	372	15%	1,136	12%	3,268	14%
71	Arts, Entertainment, and Recreation	0	0%	0	0%	156	1%
72	Accommodation and Food Services	218	9%	476	5%	1,491	6%
81	Other Services (except Public Administration)	49	2%	417	4%	1,066	4%
92	Public Administration	110	4%	476	5%	1,228	5%
Total		2,462	100%	9,476	100%	24,121	100%

A large percentage of these study areas is located within the Daniel Boone National Forest. There are no incorporated places in the Horse Lick Creek study area, and McKee is the only incorporated place in the Middle Fork Rockcastle River study area. Livingston, London, and Mount Vernon are incorporated places in the Rockcastle River study area. There is one crushed stone mine in the Middle Fork Rockcastle River study area and two in the Rockcastle River study area. There are no major NPDES-permitted facilities in these study areas.

The Horse Lick Creek and Middle Fork Rockcastle River study areas have totals of 21 and 140 miles of primary and secondary roads, respectively, including stretches of U.S. Highway 421. The remaining Rockcastle River study area has 298 miles of primary and secondary roads, including a 69-mile portion of I-75 that intersects the Rockcastle River habitat unit.

There have been no formal consultations since 2006 related to these study areas. Most informal consultations associated with Horse Lick Creek and Middle Fork Rockcastle River were associated with statewide consultations. There were 21 consultations for the Rockcastle River study area, including water supply improvements and bridge repairs (table 3-5).

Table 3-5. Relevant Consultation History for the Horse Lick Creek, Middle Fork Rockcastle River, and Rockcastle River Study Areas

Economic Activity	Informal		
	Horse Lick Creek	Middle Fork Rockcastle River	Rockcastle River
Agricultural and Recreational Development	0.58	0.58	1.58
Commercial, Industrial, Residential, and Associated Utility Development	0.71	1.71	6.71
Federal Land Management	0.93	0.93	1.93
Mining	0.00	0.00	1.00
Road Maintenance and Construction	0.00	0.50	4.50
State Water Quality Standards	0.50	0.50	0.50
Restoration and Conservation	1.75	1.25	5.08
Total	4.47	5.47	21.30

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

3.2 Buck Creek (FK4)

The Buck Creek study area is 170,377 acres overlapping portions of Lincoln, Pulaski, and Rockcastle Counties in Kentucky (figure 3-1). The Buck Creek unit is occupied by the fluted

kidneyshell, as well as other listed mussels (e.g., the Cumberland bean, *Villosa trabalis*).⁴ The entire habitat unit was designated as critical habitat for the oyster mussel (*Epioblasma capsaeformis*) and Cumberlandian combshell (*Epioblasma brevidens*) in 2004 (U.S. Fish and Wildlife Service, 2004).

The 2010 human population in the Buck Creek study area was 27,372 and is expected to grow by 15 percent from 2013 to 2032 (table 3-3). Employment in the study area is predominantly in the manufacturing, retail trade, and health care sectors (table 3-6).

Table 3-6. Employment by Sector in the Buck Creek Study Area

NAICS	Sector	Buck Creek	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	340	3%
21	Mining, Quarrying, and Oil and Gas Extraction	141	1%
22	Utilities	151	1%
23	Construction	920	8%
31–33	Manufacturing	1,962	17%
42	Wholesale Trade	249	2%
44–45	Retail Trade	1,660	15%
48–49	Transportation and Warehousing	571	5%
51	Information	234	2%
52	Finance and Insurance	286	3%
53	Real Estate and Rental and Leasing	82	1%
54	Professional, Scientific, and Technical Services	184	2%
55	Management of Companies and Enterprises	0	0%
56	Administrative and Support and Waste Management and Remediation Services	281	3%
61	Educational Services	1,242	11%
62	Health Care and Social Assistance	1,815	16%
71	Arts, Entertainment, and Recreation	39	0%
72	Accommodation and Food Services	352	3%
81	Other Services (except Public Administration)	304	3%
92	Public Administration	423	4%
Total		11,236	100%

⁴ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

The Buck Creek study area includes Eubank, KY, and overlaps with a small portion of the Daniel Boone National Forest proclamation boundary. There are two crushed stone mines in the study area and no major NPDES-permitted facilities. There are 182 miles of primary and secondary roads, including 16 miles of U.S. Highway 27.

There have been no formal consultations since 2006 related to these study areas. Informal consultations associated with Buck Creek include consultations with the Daniel Boone National Forest, a water line extension and new electric transmission line, streambank stabilization projects, and Kentucky statewide consultations (table 3-7).

Table 3-7. Relevant Consultation History for the Buck Creek Study Area

Economic Activity	Informal
Agricultural and Recreational Development	0.25
Commercial, Industrial, Residential, and Associated Utility Development	2.38
Federal Land Management	0.93
State Water Quality Standards	0.50
Restoration and Conservation	3.25
Total	7.30

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

3.3 Rock Creek (FK5)

The Rock Creek study area covers 36,037 acres and overlaps portions of McCreary and Wayne Counties in Kentucky, as well as Fentress, Pickett, and Scott Counties in Tennessee (figure 3-2). The proposed habitat unit is occupied by the fluted kidneyshell, as well as other listed mussels (e.g., the Cumberland elktoe, *Alasmidonta atropurpurea*).⁵ In 2004, the Rock Creek habitat unit was designated as critical habitat for the Cumberland elktoe (*Alasmidonta atropurpurea*) (U.S. Fish and Wildlife Service, 2004).

The 2010 human population in the Rock Creek study area was 6,304 and is projected to grow by 4 percent from 2013 to 2032 (table 3-3). The percentage of employment in the agricultural sector in the study area (8 percent) is above average in Kentucky and Tennessee (table 3-8).

⁵ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

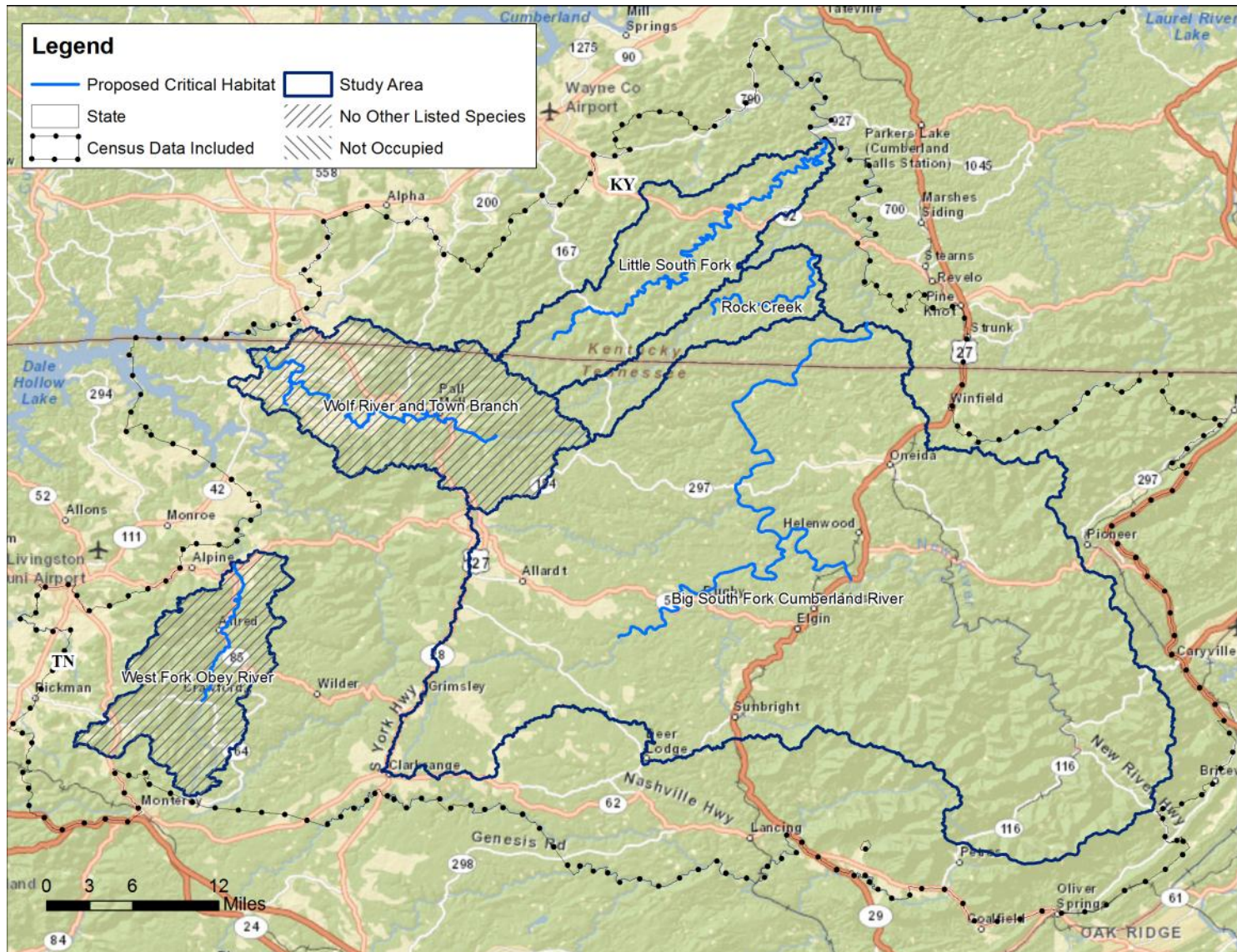


Figure 3-2. Rock Creek, Little South Fork Cumberland River, Big South Fork Cumberland River, Wolf River and Town Branch, and West Fork Obey River Study Areas

Table 3-8. Employment by Sector in the Rock Creek Study Area

NAICS	Sector	Rock Creek	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	184	8%
21	Mining, Quarrying, and Oil and Gas Extraction	59	2%
22	Utilities	15	1%
23	Construction	338	14%
31-33	Manufacturing	281	12%
42	Wholesale Trade	0	0%
44-45	Retail Trade	282	12%
48-49	Transportation and Warehousing	143	6%
51	Information	14	1%
52	Finance and Insurance	93	4%
53	Real Estate and Rental and Leasing	11	0%
54	Professional, Scientific, and Technical Services	33	1%
55	Management of Companies and Enterprises	0	0%
56	Administrative and Support and Waste Management and Remediation Services	20	1%
61	Educational Services	161	7%
62	Health Care and Social Assistance	371	16%
71	Arts, Entertainment, and Recreation	35	1%
72	Accommodation and Food Services	115	5%
81	Other Services (except Public Administration)	121	5%
92	Public Administration	115	5%
Total		2,391	100%

The Rock Creek study area overlaps both the Big South Fork National River and Recreation Area and the Daniel Boone National Forest. There are 16 miles of primary and secondary roads in the study area but no incorporated places, mines, or major NPDES-permitted facilities. Since 2006, no formal consultations have occurred in the Rock Creek study area.

Previous informal consultations within the study area include a waterline improvement project and recreational access improvement (table 3-9).

Table 3-9. Relevant Consultation History for the Rock Creek Study Area

Name	Informal
Agricultural and Recreational Development	1.75
Commercial, Industrial, Residential, and Associated Utility Development	1.88
Federal Land Management	1.78
Restoration and Conservation	1.44
State Water Quality Standards	0.69
Total	7.53

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

3.4 Little South Fork Cumberland River (FK6)

The Little South Fork Cumberland River study area covers 75,503 acres and overlaps portions of McCreary and Wayne Counties in Kentucky, as well as Fentress, Pickett, and Scott Counties in Tennessee (figure 3-2). The proposed habitat unit is occupied by the fluted kidneyshell, as well as other listed mussels (e.g., the Cumberland bean, *Villosa trabalis*).⁶

The 2010 human population in the Little South Fork Cumberland River study area was 7,862 and is projected to grow by 5 percent from 2013 to 2032 (table 3-3). The percentage of employment in the agricultural sector in the study area (10 percent) is above average in Kentucky and Tennessee (table 3-10).

The Little South Fork Cumberland River study area includes areas in the Daniel Boone National Forest. There are 28 miles of primary and secondary roads in the study area but no incorporated places, mines, or major NPDES-permitted facilities. Since 2006, no previous formal consultations have occurred in the Little South Fork Cumberland River study area. Previous informal consultations within the study area include a bridge replacement project and prescribed fire and invasive species management plans within the Daniel Boone National Forest (table 3-11).

⁶ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

Table 3-10. Employment by Sector in the Little South Fork Cumberland River Study Area

NAICS	Sector	Little South Fork Cumberland River	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	295	10%
21	Mining, Quarrying, and Oil and Gas Extraction	12	0%
22	Utilities	0	0%
23	Construction	429	14%
31-33	Manufacturing	541	18%
42	Wholesale Trade	26	1%
44-45	Retail Trade	346	11%
48-49	Transportation and Warehousing	189	6%
51	Information	14	0%
52	Finance and Insurance	113	4%
53	Real Estate and Rental and Leasing	11	0%
54	Professional, Scientific, and Technical Services	53	2%
55	Management of Companies and Enterprises	0	0%
56	Administrative and Support and Waste Management and Remediation Services	55	2%
61	Educational Services	237	8%
62	Health Care and Social Assistance	353	12%
71	Arts, Entertainment, and Recreation	22	1%
72	Accommodation and Food Services	109	4%
81	Other Services (except Public Administration)	70	2%
92	Public Administration	139	5%
Total		3,014	100%

Table 3-11. Relevant Consultation History for the Little South Fork Cumberland River Study Area

Name	Informal
Agricultural and Recreational Development	0.25
Commercial, Industrial, Residential, and Associated Utility Development	0.38
Federal Land Management	1.28
Restoration and Conservation	3.27
Road Maintenance and Construction	1.00
State Water Quality Standards	0.69
Total	6.87

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

3.5 Big South Fork Cumberland River (FK7)

The Big South Fork Cumberland River study area covers 611,153 acres and overlaps portions of McCreary County in Kentucky, as well as Anderson, Campbell, Fentress, Morgan, Pickett, and Scott Counties in Tennessee (figure 3-2). The proposed habitat unit is occupied by the fluted kidneyshell, as well as other listed mussels (e.g., the Cumberland bean, *Villosa trabalis*).⁷ In 2004, the Big South Fork Cumberland River habitat unit was designated as critical habitat for the oyster mussel (*Epioblasma capsaeformis*), Cumberlandian combshell (*Epioblasma brevidens*), and Cumberland elktoe (*Alasmidonta atropurpurea*) (U.S. Fish and Wildlife Service, 2004).

The 2010 human population in the Big South Fork Cumberland River study area was 55,769 and is projected to grow by 7 percent from 2013 to 2032 (table 3-3). Employment in the study area is predominantly in the manufacturing and health care sectors (table 3-12).

The Big South Fork Cumberland River study area overlaps both the Big South Fork National River and Recreation Area and the Daniel Boone National Forest. There are 152 miles of primary and secondary roads in the study area, including 28 miles of U.S. Highway 27. The study area includes six incorporated places, including Oneida, Huntsville, and Sunbright, TN. There is one sand and gravel mine in the study area but no major NPDES-permitted facilities.

⁷ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

Since 2006, no formal consultations have occurred in the Big South Fork study area. Some of the informal consultations included coal mining permits for mines upstream of the Big South Fork Cumberland River, reclamation of abandoned oil and natural gas wells in the Big South Fork National River and Recreation Area, road construction, and water supply projects (table 3-13).

Table 3-12. Employment by Sector in the Big South Fork Cumberland River Study Area

NAICS	Sector	Big South Fork Cumberland River	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	836	4%
21	Mining, Quarrying, and Oil and Gas Extraction	345	2%
22	Utilities	293	1%
23	Construction	2,450	11%
31–33	Manufacturing	3,431	16%
42	Wholesale Trade	329	2%
44–45	Retail Trade	2,246	11%
48–49	Transportation and Warehousing	1,047	5%
51	Information	307	1%
52	Finance and Insurance	634	3%
53	Real Estate and Rental and Leasing	143	1%
54	Professional, Scientific, and Technical Services	464	2%
55	Management of Companies and Enterprises	12	0%
56	Administrative and Support and Waste Management and Remediation Services	620	3%
61	Educational Services	1,796	8%
62	Health Care and Social Assistance	3,337	16%
71	Arts, Entertainment, and Recreation	187	1%
72	Accommodation and Food Services	841	4%
81	Other Services (except Public Administration)	1,106	5%
92	Public Administration	897	4%
Total		21,321	100%

Table 3-13. Relevant Consultation History for the Big South Fork Cumberland River Study Area

Name	Informal
Agricultural and Recreational Development	2.75
Commercial, Industrial, Residential, and Associated Utility Development	12.88
Federal Land Management	5.78
Mining	29.00
Restoration and Conservation	4.27
Road Maintenance and Construction	11.00
State Water Quality Standards	0.69
Total	66.37

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

3.6 Wolf River and Town Branch (FK8)

The Wolf River and Town Branch study area is 93,817 acres and overlaps portions of Fentress and Pickett Counties in Tennessee, as well as portions of Clinton and Wayne Counties in Kentucky (figure 3-2). The habitat unit is occupied by the fluted kidneyshell but no other listed aquatic species.⁸

The 2010 human population in these study areas was 11,317 and is projected to grow by 4 percent or less from 2013 to 2032 (table 3-3). The percentage of employment in the agriculture, forestry, fishing, and hunting sector, at 7 percent, is above average for Tennessee and Kentucky (table 3-14).

The study area contains one incorporated place, Byrdstown, TN; 50 miles of primary and secondary roads; one crushed stone mine; and no major NPDES-permitted facilities. There have been no formal or informal consultations since 2006 for projects within the Wolf River and Town Branch study area. The only informal consultations attributable to this study area are statewide consultations that are evenly distributed across all study areas. Because the habitat unit is not occupied by any other listed species, there may have been projects between 2006 and 2012 that would have required a consultation if the fluted kidneyshell had been listed during that time period (table 3-15).

⁸ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

Table 3-14. Employment by Sector in the Wolf River and Town Branch Study Area

NAICS	Sector	Wolf River and Town Branch	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	301	7%
21	Mining, Quarrying, and Oil and Gas Extraction	109	2%
22	Utilities	15	0%
23	Construction	562	12%
31-33	Manufacturing	866	19%
42	Wholesale Trade	45	1%
44-45	Retail Trade	364	8%
48-49	Transportation and Warehousing	140	3%
51	Information	141	3%
52	Finance and Insurance	173	4%
53	Real Estate and Rental and Leasing	14	0%
54	Professional, Scientific, and Technical Services	108	2%
55	Management of Companies and Enterprises	0	0%
56	Administrative and Support and Waste Management and Remediation Services	92	2%
61	Educational Services	308	7%
62	Health Care and Social Assistance	660	15%
71	Arts, Entertainment, and Recreation	25	1%
72	Accommodation and Food Services	196	4%
81	Other Services (except Public Administration)	174	4%
92	Public Administration	219	5%
Total		4,512	100%

Table 3-15. Relevant Consultation History for the Wolf River and Town Branch Study Area by State

Economic Activity	Informal
Agricultural and Recreational Development	0.25
Commercial, Industrial, Residential, and Associated Utility Development	0.38
Federal Land Management	0.19
Restoration and Conservation	1.44
State Water Quality Standards	0.69
Total	2.94

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

3.7 West Fork Obey River (FK9)

The West Fork Obey River study area covers 61,474 acres overlapping portions of Fentress, Overton, Pickett, and Putnam Counties in Tennessee (figure 3-2). The habitat unit is occupied by the fluted kidneyshell but no other listed aquatic species.⁹

The 2010 human population in this study area was 10,707 and is projected to grow by 11 percent from 2013 to 2032 (table 3-3). Employment in the study area is predominantly in the manufacturing and health care sectors (table 3-16).

There are 17 miles of primary and secondary roads within the West Fork Obey River study area, including the State Highway 85 bridge of the proposed habitat unit. There are no incorporated areas, Federal lands, or major NPDES-permitted facilities identified in this study area.

There have been no formal or informal consultations since 2006 for projects within the West Fork Obey River study area. The only informal consultations attributable to this study area are statewide consultations that are evenly distributed across all study areas. Because the habitat unit is not occupied by any other listed species, there may have been projects between 2006 and 2012 that would have required a consultation if the fluted kidneyshell had been listed during that time period (table 3-17).

⁹ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

Table 3-16. Employment by Sector in the West Fork Obey River Study Area

NAICS	Sector	West Fork Obey River	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	202	4%
21	Mining, Quarrying, and Oil and Gas Extraction	9	0%
22	Utilities	93	2%
23	Construction	614	13%
31-33	Manufacturing	946	20%
42	Wholesale Trade	57	1%
44-45	Retail Trade	363	8%
48-49	Transportation and Warehousing	280	6%
51	Information	14	0%
52	Finance and Insurance	136	3%
53	Real Estate and Rental and Leasing	39	1%
54	Professional, Scientific, and Technical Services	51	1%
55	Management of Companies and Enterprises	0	0%
56	Administrative and Support and Waste Management and Remediation Services	31	1%
61	Educational Services	429	9%
62	Health Care and Social Assistance	682	15%
71	Arts, Entertainment, and Recreation	37	1%
72	Accommodation and Food Services	126	3%
81	Other Services (except Public Administration)	296	6%
92	Public Administration	218	5%
Total		4,623	100%

Table 3-17. Relevant Consultation History for the West Fork Obey River Study Area

Economic Activity	West Fork Obey River
Federal Land Management	0.19
Restoration and Conservation	0.19
State Water Quality Standards	0.19
Total	0.56

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

3.8 Indian Creek, Little River, Copper Creek, and Clinch River (FK10, FK11, FK15, FK16, SP4)

The study area includes the Clinch River study area and the upstream tributaries including the Indian Creek, Little River, and Copper Creek study areas. The study areas encompass 944,643 acres across Claiborne, Grainger, Hancock, and Hawkins Counties in Tennessee, as well as Dickenson, Lee, Russell, Scott, Smyth, Tazewell, Washington, and Wise Counties and Norton City in Virginia (figures 3-3 and 3-4). These habitat units are all occupied by the fluted kidneyshell, and the Clinch River habitat unit is occupied by the slabside pearl mussel. All of these proposed units are occupied by other listed mussels (e.g., the purple bean mussel, *Villosa perpurpurea*, in the Indian Creek, Copper Creek, and Clinch River habitat units and the littlewing pearl mussel, *Pegias fabula*, in the Little River habitat unit).¹⁰ In 2004, the Indian Creek, Copper Creek, and Clinch River habitat units were designated as critical habitat for the Cumberlandian combshell (*Epioblasma brevidens*), rough rabbitsfoot (*Quadrula cylindrica strigillata*), purple bean mussel (*Villosa perpurpurea*), and oyster mussel (*Epioblasma capsaeformis*) (U.S. Fish and Wildlife Service, 2004).

The 2010 human population in these study areas was 141,328. The study area populations are projected to grow by 6 percent or less from 2013 to 2032 (table 3-3). The percentage of employment in the mining sector, 7 percent, is above average for Tennessee and Virginia (table 3-18).

There are 16 incorporated places in these study areas, including Richland and Tazewell, VA, in the Indian Creek study area; Nickelsville, VA, in the Copper Creek study area; and Coeburn, Lebanon, St. Paul, and Wise, VA, in the downstream Clinch River study area. There are 529 miles of primary and secondary roads within the Clinch River study area, including 130 in the Indian Creek study area, 38 in the Little River study area, and 36 miles in the Copper Creek study area. There are two major NPDES-permitted facilities in the Indian Creek study area (Richlands Regional Wastewater Treatment Facility and Tazewell Wastewater Treatment Plant) and one major NPDES-permitted facility in the downstream Clinch River study area (Coeburn-Norton-Wise Regional Wastewater Treatment Facility). The George Washington and Thomas Jefferson National Forests overlap areas in the Indian Creek, Little River, and Clinch River study areas.

¹⁰ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

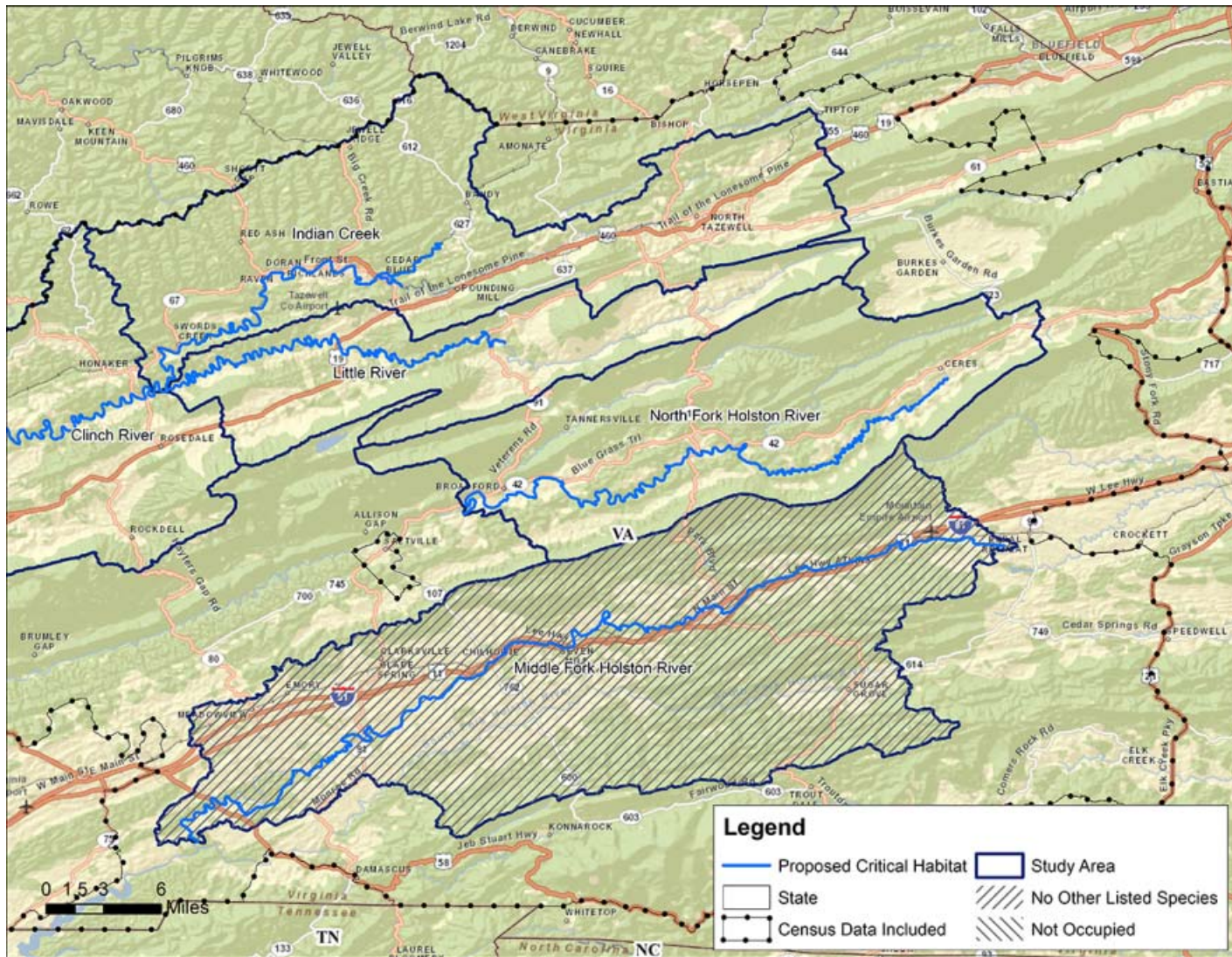


Figure 3-3. Indian Creek, Little River, North Fork Holston, and Middle Fork Holston Study Areas

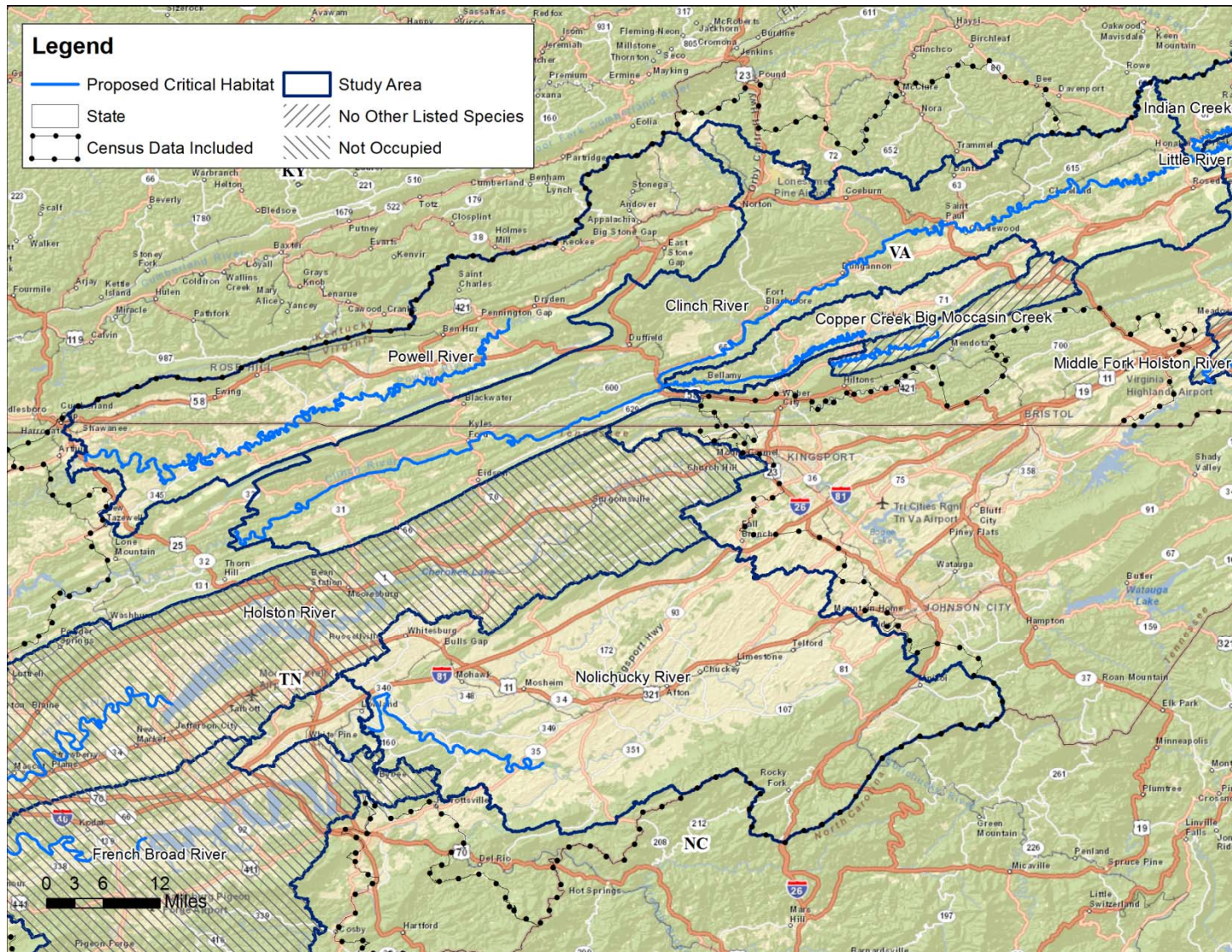


Figure 3-4. Big Moccasin Creek, Copper Creek, Clinch River, Powell River, and Nolichucky River Study Areas

Table 3-18. Employment by Sector in the Indian Creek, Little River, Copper Creek, and Clinch River Study Areas

NAICS	Sector	Indian Creek		Little River		Copper Creek		Clinch River	
		Employment	Percentage	Employment	Percentage	Employment	Percentage	Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	185	1%	61	1%	328	6%	1,192	2%
21	Mining, Quarrying, and Oil and Gas Extraction	1,197	8%	211	4%	109	2%	3,538	7%
22	Utilities	177	1%	60	1%	52	1%	636	1%
23	Construction	1,067	7%	485	9%	405	8%	4,416	8%
31–33	Manufacturing	1,158	8%	581	11%	905	17%	6,363	12%
42	Wholesale Trade	259	2%	80	2%	52	1%	1,111	2%
44–45	Retail Trade	2,526	17%	972	19%	529	10%	7,460	14%
48–49	Transportation and Warehousing	732	5%	200	4%	319	6%	2,151	4%
51	Information	410	3%	76	1%	57	1%	1,107	2%
52	Finance and Insurance	633	4%	175	3%	168	3%	1,541	3%
53	Real Estate and Rental and Leasing	278	2%	90	2%	24	0%	619	1%
54	Professional, Scientific, and Technical Services	431	3%	126	2%	98	2%	1,433	3%
55	Management of Companies and Enterprises	0	0%	0	0%	0	0%	0	0%
56	Administrative and Support and Waste Management and Remediation Services	571	4%	218	4%	158	3%	2,150	4%
61	Educational Services	1,246	8%	389	8%	398	8%	4,710	9%
62	Health Care and Social Assistance	1,946	13%	640	12%	664	13%	6,917	13%
71	Arts, Entertainment, and Recreation	37	0%	40	1%	9	0%	351	1%
72	Accommodation and Food Services	1,011	7%	164	3%	374	7%	3,306	6%
81	Other Services (except Public Administration)	644	4%	227	4%	129	2%	2,290	4%
92	Public Administration	740	5%	352	7%	397	8%	3,042	6%
Total		15,248	100%	5,147	100%	5,175	100%	54,333	100%

There have been six formal consultations related to the Clinch River study area since 2006. Two of the formal consultations related to restoration and conservation: a stream restoration project at Kyle’s Ford in Tennessee and a project to restore freshwater mussel populations in the Upper Clinch. Two formal consultations concerned utility development: one for the Scott County Public Service Authority and another for the Town of St. Paul. The remaining two formal consultations concerned the Jewell Ridge natural gas pipeline and the use of fire retardant on U.S. Forest Service lands (table 3-19).

Table 3-19. Relevant Consultation History for the Indian Creek, Little River, Copper Creek, and Clinch River Study Areas

Consultation Type	Economic Activity	Indian Creek	Little River	Copper Creek	Clinch River
Formal	Commercial, Industrial, Residential, and Associated Utility Development	0.25	0.25	0.00	2.25
	Federal Land Management	0.17	0.17	0.00	0.17
	Restoration and Conservation	0.50	0.00	0.00	1.50
Informal	Agricultural and Recreational Development	0.00	0.00	0.50	0.50
	Commercial, Industrial, Residential, and Associated Utility Development	3.00	0.50	0.00	19.50
	Federal Land Management	0.17	0.17	0.00	2.17
	Mining	0.33	0.00	0.00	26.83
	Road Maintenance and Construction	1.50	0.00	0.50	2.00
	State Water Quality Standards	2.00	2.00	2.00	8.00
	Restoration and Conservation	1.00	0.00	0.50	1.50
Total		8.92	3.08	3.50	64.42

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

3.9 North Fork Holston River (FK12, SP1)

The North Fork Holston River study area covers 126,391 acres in Bland, Russell, Smyth, Tazewell, and Wythe Counties in southwestern Virginia (figure 3-3). The habitat unit lies within the Tennessee River system and is occupied by the fluted kidneyshell and slabside pearl mussel, as well as other listed mussels (e.g., the littlewing pearl mussel, *Pegias fabula*).¹¹

¹¹ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

The 2010 human population in the North Fork Holston River study area was 13,530 and is projected to grow by approximately 3 percent between 2013 and 2032 (table 3-3). Employment in the agriculture, forestry, fishing, and hunting sector in the study area is above the Virginia average (table 3-20).

Table 3-20. Employment by Sector in the North Fork Holston River Study Area

Sector	North Fork Holston River	
	Employment	Percentage
Agriculture, Forestry, Fishing and Hunting	246	5%
Mining, Quarrying, and Oil and Gas Extraction	117	2%
Utilities	7	0%
Construction	506	10%
Manufacturing	1,082	21%
Wholesale Trade	89	2%
Retail Trade	562	11%
Transportation and Warehousing	191	4%
Information	61	1%
Finance and Insurance	145	3%
Real Estate and Rental and Leasing	28	1%
Professional, Scientific, and Technical Services	100	2%
Management of Companies and Enterprises	0	0%
Administrative and Support and Waste Management and Remediation Services	36	1%
Educational Services	493	9%
Health Care and Social Assistance	629	12%
Arts, Entertainment, and Recreation	50	1%
Accommodation and Food Services	113	2%
Other Services (except Public Administration)	383	7%
Public Administration	398	8%
Total	5,236	100%

The study area contains portions of the George Washington and Jefferson National Forests. There are 49 miles of primary and secondary roads within the study area and no major NPDES-permitted facilities, mines, or incorporated places. Previous consultations related to the North Fork Holston River study area included the formal consultation regarding the Jewell Ridge natural gas pipeline and an informal consultation related to the Smyth County Water Treatment Plant (table 3-21).

Table 3-21. Relevant Consultation History for the North Fork Holston Study Area River Study Area

Economic Activity	Formal	Informal
Commercial, Industrial, Residential, and Associated Utility Development	0.25	1.00
Federal Land Management	0.17	0.17
State Water Quality Standards	0.00	2.00
Total	0.42	3.17

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

3.10 Middle Fork Holston River (FK13, SP2)

The Middle Fork Holston River study area includes Bland, Grayson, Smyth, Washington, and Wythe Counties in Virginia (figure 3-3). The study area lies within the Tennessee River system and covers 232,569 acres. The habitat unit is occupied by the fluted kidneyshell and slabside pearl mussel. Although there are historical records of other listed aquatic species in the habitat unit (e.g., the littlewing pearl mussel, *Pegias fabula*), they are assumed to be extirpated.^{12, 13}

The 2010 human population in the Middle Fork Holston River study area was 55,813 and is expected to grow by 3 percent between 2013 and 2032 (table 3-3). Employment in this unit is predominantly in the manufacturing, health care and social assistance, and retail industries (table 3-22). The 20 percent employment percentage in manufacturing in the Middle Fork Holston River study area is above the State average.

Parts of the George Washington and Jefferson National Forests intersect the study area. The incorporated towns of Glade Spring, Chilhowie, and Marion, VA, fall within the study area. There is one major NPDES-permitted facility (Marion Wastewater Treatment Plant), two crushed stone mines, and one common clay and shale mine in the study area. One hundred fifty-five miles of primary and secondary road fall within the study area, including two I-81 bridges directly over the habitat unit. The previous consultation history includes sewer system improvements in Chilhowie (table 3-23).

¹² U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

¹³ U.S. Fish and Wildlife Service Virginia Ecological Services Southwest Virginia Field Office. November 26, 2012. Personal communication with Ross Loomis, RTI International.

Table 3-22. Employment by Sector in Middle Fork Holston River Study Area

NAICS	Sector	Middle Fork Holston River	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	599	2%
21	Mining, Quarrying, and Oil and Gas Extraction	131	1%
22	Utilities	210	1%
23	Construction	1,487	6%
31–33	Manufacturing	4,921	20%
42	Wholesale Trade	491	2%
44–45	Retail Trade	2,803	12%
48–49	Transportation and Warehousing	586	2%
51	Information	278	1%
52	Finance and Insurance	752	3%
53	Real Estate and Rental and Leasing	270	1%
54	Professional, Scientific, and Technical Services	782	3%
55	Management of Companies and Enterprises	41	0%
56	Administrative and Support and Waste Management and Remediation Services	586	2%
61	Educational Services	2,250	9%
62	Health Care and Social Assistance	3,605	15%
71	Arts, Entertainment, and Recreation	392	2%
72	Accommodation and Food Services	1,193	5%
81	Other Services (except Public Administration)	1,457	6%
92	Public Administration	1,368	6%
Total		24,202	100%

Table 3-23. Relevant Consultation History for the Middle Fork Holston Study Area River Study Area

Economic Activity	Formal	Informal
Federal Land Management	0.17	0.17
Commercial, Industrial, Residential, and Associated Utility Development	0.00	2.00
Road Maintenance and Construction	0.00	1.00
State Water Quality Standards	0.00	5.00
Total	0.17	8.17

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

3.11 Big Moccasin Creek (FK14, SP3)

The Big Moccasin Creek study area covers 42,286 acres across Russell, Scott, and Washington Counties in Virginia within the Tennessee River system (figure 3-4). The unit is occupied by the slabside pearl mussel. Although there are historical records of other listed aquatic species in the habitat unit (e.g., the littlewing pearl mussel, *Pegias fabula*), they are assumed to be extirpated.^{14, 15}

Table 3-24. Employment by Sector in Big Moccasin Creek Study Area

NAICS	Sector	Big Moccasin Creek	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	262	5%
21	Mining, Quarrying, and Oil and Gas Extraction	77	2%
22	Utilities	62	1%
23	Construction	431	9%
31–33	Manufacturing	840	17%
42	Wholesale Trade	91	2%
44–45	Retail Trade	613	12%
48–49	Transportation and Warehousing	408	8%
51	Information	136	3%
52	Finance and Insurance	106	2%
53	Real Estate and Rental and Leasing	21	0%
54	Professional, Scientific, and Technical Services	37	1%
55	Management of Companies and Enterprises	0	0%
56	Administrative and Support and Waste Management and Remediation Services	333	7%
61	Educational Services	296	6%
62	Health Care and Social Assistance	723	14%
71	Arts, Entertainment, and Recreation	15	0%
72	Accommodation and Food Services	163	3%
81	Other Services (except Public Administration)	201	4%
92	Public Administration	181	4%
Total		4,996	100%

¹⁴ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

¹⁵ U.S. Fish and Wildlife Service Virginia Ecological Services Southwest Virginia Field Office. November 26, 2012. Personal communication with Ross Loomis, RTI International.

The 2010 human population in the Big Moccasin Creek study area is 10,985 and is expected to grow by 5 percent from 2013 to 2032 (table 3-3). Employment within the agriculture, forestry, fishing, and hunting sector is above average for the State (table 3-24).

There are 18 miles of primary and secondary roads within the study area, 12 of which are U.S. Highway 58 Alternate. No incorporated places, mines, or major NPDES-permitted facilities are located in the study area. The two previous consultations attributable to Big Moccasin Creek concerned statewide water quality standards.

3.12 Powell River (FK17, SP5)

The Powell River study area encompasses 442,977 acres in Claiborne and Hancock Counties in Tennessee, and Lee, Scott, and Wise Counties and Norton City in Virginia (figure 3-4). The habitat unit is occupied by the fluted kidneyshell, slabside pearl mussel, and other listed mussels (e.g., the oyster mussel, *Epioblasma capsaeformis*).¹⁶ In 2004, the Powell River habitat unit was designated as critical habitat for the Cumberlandian combshell (*Epioblasma brevidens*), rough rabbitsfoot (*Quadrula cylindrica strigillata*), purple bean mussel (*Villosa perpurpurea*), and oyster mussel (*Epioblasma capsaeformis*) (U.S. Fish and Wildlife Service, 2004). The 2010 human population in the Powell River study area was 75,593 and is expected to grow by 6 percent from 2013 to 2032 (table 3-3). Employment in the mining sector exceeds the average for both States (table 3-25).

The study area includes 10 incorporated places including Appalachia, Big Stone Gap, and Nickelsville, VA, as well as portions of the George Washington and Jefferson National Forests and Cumberland Gap National Historical Park. There are 338 miles of primary and secondary roads within the Powell River study area, including 82 along U.S. Hwy 58. One major NPDES-permitted facility and four crushed stone mines fall inside the study area. Previous consultations in the Powell River study area included the formal consultation regarding the Rt. 833 bridge replacement project and several informal consultations regarding coal mining permits among others (table 3-26).

¹⁶ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

Table 3-25. Employment by Sector in Powell River Study Area

NAICS	Sector	Powell River	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	411	2%
21	Mining, Quarrying, and Oil and Gas Extraction	1,662	6%
22	Utilities	273	1%
23	Construction	1,824	7%
31–33	Manufacturing	3,106	11%
42	Wholesale Trade	425	2%
44–45	Retail Trade	3,757	14%
48–49	Transportation and Warehousing	970	4%
51	Information	182	1%
52	Finance and Insurance	741	3%
53	Real Estate and Rental and Leasing	360	1%
54	Professional, Scientific, and Technical Services	776	3%
55	Management of Companies and Enterprises	0	0%
56	Administrative and Support and Waste Management and Remediation Services	785	3%
61	Educational Services	2,761	10%
62	Health Care and Social Assistance	4,085	15%
71	Arts, Entertainment, and Recreation	127	0%
72	Accommodation and Food Services	1,771	7%
81	Other Services (except Public Administration)	1,148	4%
92	Public Administration	1,969	7%
Total		27,133	100%

3.13 Nolichucky River (FK18, SP6)

The Nolichucky River study area covers 684,654 acres in Cocke, Greene, Hamblen, Hawkins, Unicoi, and Washington Counties, Tennessee (figure 3-4). The habitat unit is occupied by the slabside pearlymussel and other listed mussels (e.g., the spectaclecase, *Cumberlandia monodonta*).¹⁷ A portion of the Nolichucky River habitat unit was designated as critical habitat for the Cumberlandian combshell (*Epioblasma brevidens*) and oyster mussel (*Epioblasma capsaeformis*) in 2004 (U.S. Fish and Wildlife Service, 2004).

¹⁷ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

Table 3-26. Relevant Consultation History for the Powell River Study Area

Economic Activity	Formal	Informal
Agricultural and Recreational Development	0.00	2.00
Commercial, Industrial, Residential, and Associated Utility Development	0.00	4.00
Federal Land Management	0.17	0.35
Mining	0.00	10.83
Road Maintenance and Construction	1.00	0.00
Restoration and Conservation	0.00	1.19
State Water Quality Standards	0.00	6.19
Total	1.17	24.56

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

Table 3-27. Employment by Sector in Nolichucky River Study Area

NAICS	Sector	Nolichucky River	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	929	1%
21	Mining, Quarrying, and Oil and Gas Extraction	45	0%
22	Utilities	537	1%
23	Construction	5,294	7%
31–33	Manufacturing	15,523	22%
42	Wholesale Trade	1,697	2%
44–45	Retail Trade	8,440	12%
48–49	Transportation and Warehousing	3,425	5%
51	Information	907	1%
52	Finance and Insurance	2,531	4%
53	Real Estate and Rental and Leasing	785	1%
54	Professional, Scientific, and Technical Services	1,575	2%
55	Management of Companies and Enterprises	34	0%
56	Administrative and Support and Waste Management and Remediation Services	2,638	4%
61	Educational Services	5,203	7%
62	Health Care and Social Assistance	10,949	15%
71	Arts, Entertainment, and Recreation	679	1%
72	Accommodation and Food Services	3,950	6%
81	Other Services (except Public Administration)	3,171	4%
92	Public Administration	2,694	4%
Total		71,006	100%

The 2010 human population in the Nolichucky River study area was 164,859 and is expected to grow by 13 percent between 2013 and 2032 (table 3-3). The manufacturing and health care sectors are the greatest sources of employment in this study area (table 3-27).

The study area includes the Tennessee Valley Authority’s (TVA’s) Nolichucky Dam and portions of Cherokee National Forest. Two crushed stone mines and two major NPDES-permitted facilities are found in the proposed habitat unit, and one of each is located in Greeneville, TN. Ten incorporated places are within the study area, including Bulls Gap, Greeneville, Jonesborough, and Tusculum, TN. There are 429 miles of primary and secondary roads, including 37 miles of I-81 and 36 miles of I-26. Previous consultations included the SR-340 bridge over Little Chucky Creek, the Greene County waterline extension project, and TVA’s Nolichucky Reservoir flood remediation project (table 3-28).

Table 3-28. Relevant Consultation History for the Nolichucky River Study Area

Economic Activity	Formal	Informal
Agricultural and Recreational Development	0.00	1.00
Commercial, Industrial, Residential, and Associated Utility Development	0.00	5.17
Dam Operation	0.14	1.00
Federal Land Management	0.00	2.35
Restoration and Conservation	0.00	0.35
Road Maintenance and Construction	0.00	3.00
State Water Quality Standards	0.00	0.69
Total	0.14	13.56

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

3.14 Holston River (FK19)

The Holston River study area encompasses 639,718 acres in Grainger, Greene, Hamblen, Hancock, Hawkins, Jefferson, Knox, Sevier, Sullivan, Union, and Washington Counties in Tennessee and Scott County in Virginia (figure 3-5). The fluted kidneyshell does not occupy this unit, which falls inside the Tennessee River system, but other listed mussels do (e.g., the sheepnose, *Plethobasus cyphus*).^{18, 19}

¹⁸ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

¹⁹ Holston River was excluded from the 2004 Designation of Critical Habitat for Five Endangered Mussels in the Tennessee and Cumberland River Basins to support establishment of nonessential experimental populations (U.S. Fish and Wildlife Service, 2004).

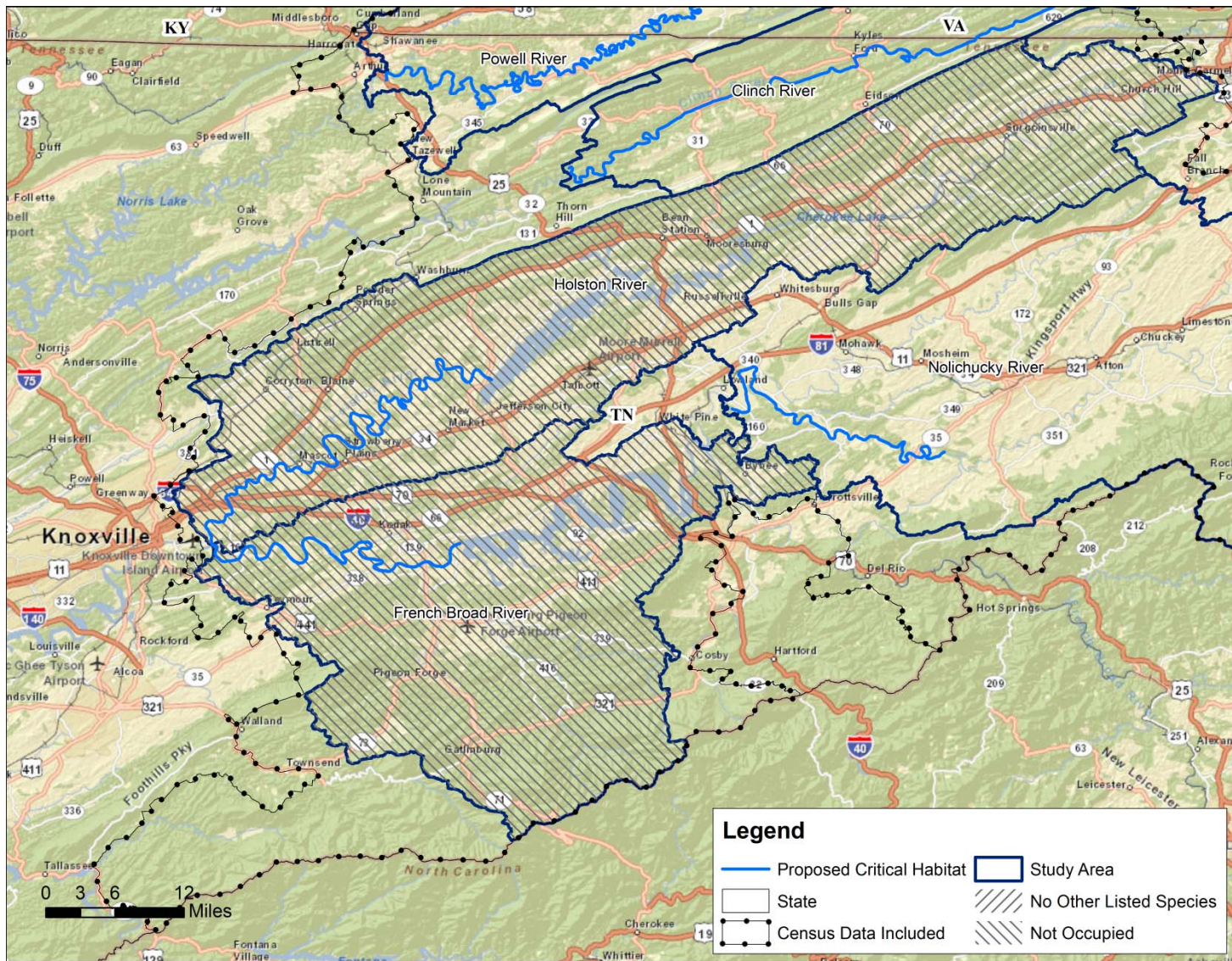


Figure 3-5. Holston River and French Broad River Study Areas

The 2010 human population for the Holston River study area was 248,838 and is expected to grow by 13 percent from 2013 to 2032 (table 3-3). The manufacturing sector accounts for 20 percent of employment in the study area (table 3-29). The habitat unit is downstream of Cherokee Dam operated by TVA. There are 14 incorporated places in the study area, including Knoxville, Jefferson City, Morristown, and Rogersville, TN. Four crushed stone mines and one lime plant fall within the study area, two of which are located in Chesney, TN. There are six major NPDES-permitted facilities and 395 miles of total road including the I-40 bridge over the habitat unit. Previous consultations included the Long Bend Road bridge replacement, Hawkins County waterline extension, and industrial and residential developments (table 3-30).

Table 3-29. Employment by Sector in Holston River Study Area

NAICS	Sector	Holston River	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	1,430	1%
21	Mining, Quarrying, and Oil and Gas Extraction	313	0%
22	Utilities	1,613	1%
23	Construction	8,772	8%
31–33	Manufacturing	21,892	20%
42	Wholesale Trade	3,721	3%
44–45	Retail Trade	13,721	13%
48–49	Transportation and Warehousing	4,533	4%
51	Information	1,550	1%
52	Finance and Insurance	3,411	3%
53	Real Estate and Rental and Leasing	1,283	1%
54	Professional, Scientific, and Technical Services	2,907	3%
55	Management of Companies and Enterprises	64	0%
56	Administrative and Support and Waste Management and Remediation Services	3,864	4%
61	Educational Services	8,082	7%
62	Health Care and Social Assistance	13,555	13%
71	Arts, Entertainment, and Recreation	1,348	1%
72	Accommodation and Food Services	6,571	6%
81	Other Services (except Public Administration)	5,522	5%
92	Public Administration	3,721	3%
Total		107,873	100%

Table 3-30. Relevant Consultation History for the Holston River Study Area

Economic Activity	Formal	Informal
Agricultural and Recreational Development	0.00	1.00
Commercial, Industrial, Residential, and Associated Utility Development	0.00	13.17
Dam Operation	0.14	0.00
Federal Land Management	0.00	0.35
Restoration and Conservation	0.00	1.35
Road Maintenance and Construction	0.00	7.00
State Water Quality Standards	0.00	0.19
Total	0.14	23.06

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

3.15 French Broad River (FK20)

The French Broad River study area includes 509,390 acres within Blount, Cocke, Hamblen, Jefferson, Knox, and Sevier Counties in Tennessee (figure 3-5). The unit is unoccupied by the fluted kidneyshell but is occupied by other listed mussels (e.g., the pink mucket, *Lampsilis abrupta*).^{20, 21}

The 2010 human population in the French Broad River study area was 169,273 and is expected to grow 26 percent between 2013 and 2032 (table 3-3). Employment levels in tourism-related sectors, including arts, entertainment, recreation, accommodations, and food services, are above the State average and the highest percentages among the study areas (table 3-31).

The habitat unit is downstream of Douglas Dam, operated by TVA, and the study area also intersects the Great Smoky Mountains National Park. There are 10 incorporated places in the study area, including Dandridge, Knoxville, Pigeon Forge, and Sevierville, TN. There are three crushed stone mines and three major NPDES-permitted facilities located in the study area, as well as 305 miles of primary and secondary roads. Previous consultations within the study area included a Sevier County water line extension project and several residential and commercial developments (table 3-32).

²⁰ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

²¹ The French Broad River was excluded from the 2004 Designation of Critical Habitat for Five Endangered Mussels in the Tennessee and Cumberland River Basins to support establishment of nonessential experimental populations (U.S. Fish and Wildlife Service, 2004).

Table 3-31. Employment by Sector in French Broad River Study Area

NAICS	Sector	French Broad River	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	581	1%
21	Mining, Quarrying, and Oil and Gas Extraction	184	0%
22	Utilities	1,067	1%
23	Construction	7,188	9%
31–33	Manufacturing	8,043	10%
42	Wholesale Trade	2,152	3%
44–45	Retail Trade	11,670	15%
48–49	Transportation and Warehousing	3,011	4%
51	Information	1,039	1%
52	Finance and Insurance	3,177	4%
53	Real Estate and Rental and Leasing	2,252	3%
54	Professional, Scientific, and Technical Services	2,286	3%
55	Management of Companies and Enterprises	44	0%
56	Administrative and Support and Waste Management and Remediation Services	3,702	5%
61	Educational Services	6,164	8%
62	Health Care and Social Assistance	7,067	9%
71	Arts, Entertainment, and Recreation	3,056	4%
72	Accommodation and Food Services	9,532	12%
81	Other Services (except Public Administration)	3,697	5%
92	Public Administration	2,889	4%
Total		78,801	100%

Table 3-32. Relevant Consultation History for the French Broad River Study Area

Economic Activity	Formal	Informal
Commercial, Industrial, Residential, and Associated Utility Development	0.00	8.17
Dam Operation	0.14	0.00
Federal Land Management	0.00	2.35
Restoration and Conservation	0.00	2.35
Road Maintenance and Construction	0.00	10.00
State Water Quality Standards	0.00	0.69
Total	0.14	23.56

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

3.16 Hiwassee River (FK21, SP7)

The Hiwassee River covers 485,541 acres located entirely within the Cherokee National Forest in Polk and Monroe Counties in Tennessee and Cherokee and Clay Counties in North Carolina (figure 3-6). This unit is part of the Tennessee River system and is occupied by the slabside pearl mussel, as well as other listed mussels (e.g., the Cumberland bean, *Villosa trabalis*).²²

The 2010 human population in the Hiwassee River study was 46,409 and is expected to grow 14 percent from 2013 to 2032 (table 3-3). The health care and construction sectors are the two largest employers in the study area (table 3-33).

The study area intersects Cherokee National Forest, Nantahala National Forest, and three TVA reservoirs (Apalachia, Hiwassee, and Chatuge Lakes). There are three incorporated places in the study area, one crushed stone mine, and two major NPDES-permitted facilities, all of which are in North Carolina upstream of the Apalachia Dam. There are 186 miles of primary and secondary roads in the study area. Previous consultations included consultations with the Cherokee National Forest as well as a water line extension for the city of Ducktown, TN (table 3-34).

3.17 Sequatchie River (SP8)

The Sequatchie River study area covers 368,137 acres across Bledsoe, Cumberland, Grundy, Marion, Sequatchie and Van Buren Counties in Tennessee (figure 3-7). The unit is occupied by the slabside pearl mussel, as well as other listed aquatic species (e.g., the snail darter, *Percina tanasi*).²³

The 2010 human population in the Sequatchie River study area was 55,491 and is expected to grow by 7 percent from 2013 to 2032 (table 3-3). The manufacturing, retail, and health care sectors are the largest employers in the study area (table 3-35).

There are three crushed stone mines, 156 miles of primary and secondary roads, and seven incorporated places in the study area, including Dunlap, Pikeville, and Whitwell, TN. No major NPDES-permitted facilities are located in the study area. Previous consultations in the Sequatchie River study area included abandoned mine reclamation and sewer and water line extensions (table 3-36).

²² U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

²³ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

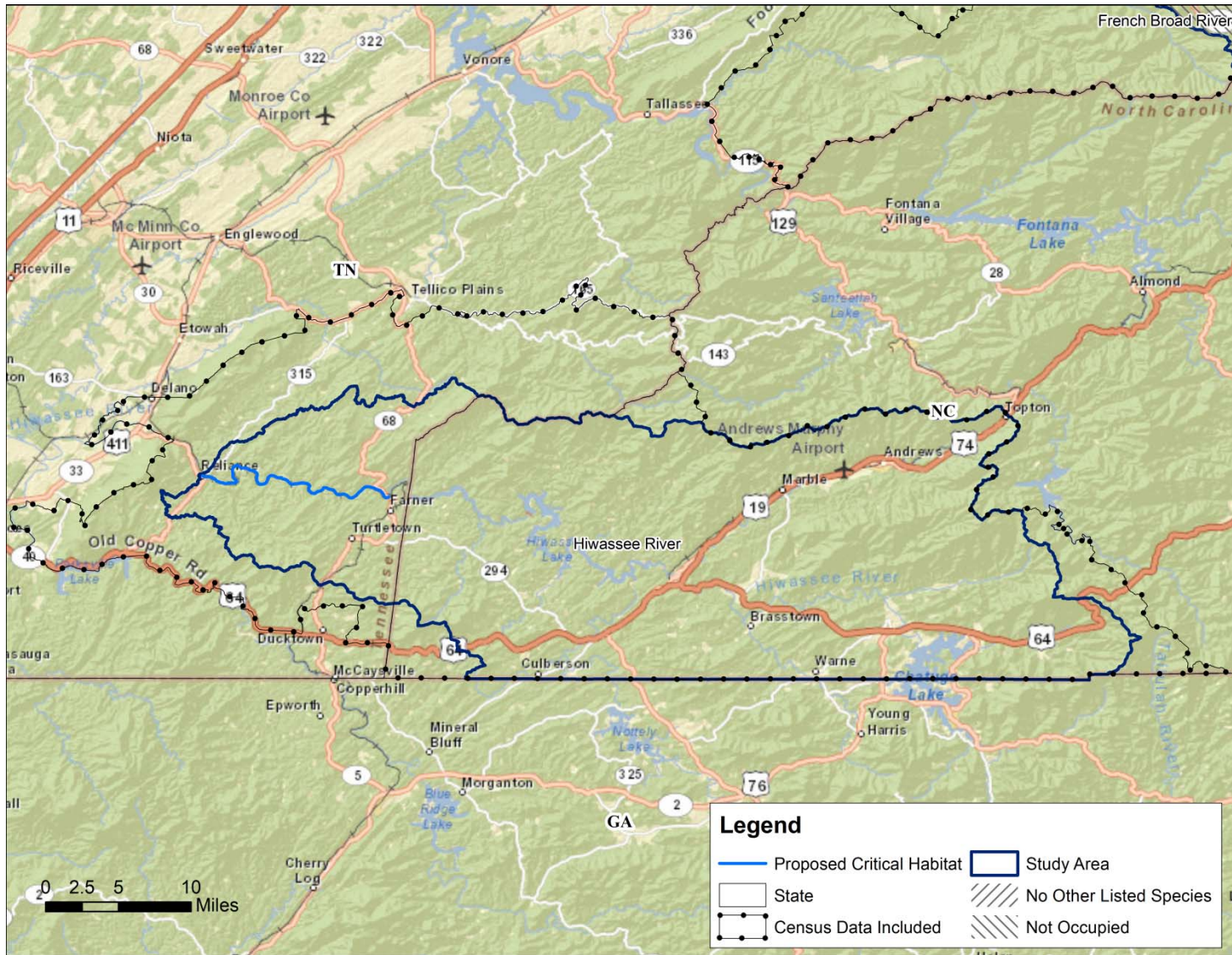


Figure 3-6. Hiwassee River Study Area

Table 3-33. Employment by Sector in Hiwassee River Study Area

NAICS	Sector	Hiwassee River	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	385	2%
21	Mining, Quarrying, and Oil and Gas Extraction	129	1%
22	Utilities	227	1%
23	Construction	2,675	15%
31–33	Manufacturing	2,370	13%
42	Wholesale Trade	349	2%
44–45	Retail Trade	2,106	11%
48–49	Transportation and Warehousing	371	2%
51	Information	197	1%
52	Finance and Insurance	425	2%
53	Real Estate and Rental and Leasing	445	2%
54	Professional, Scientific, and Technical Services	504	3%
55	Management of Companies and Enterprises	14	0%
56	Administrative and Support and Waste Management and Remediation Services	706	4%
61	Educational Services	1,332	7%
62	Health Care and Social Assistance	3,159	17%
71	Arts, Entertainment, and Recreation	344	2%
72	Accommodation and Food Services	912	5%
81	Other Services (except Public Administration)	932	5%
92	Public Administration	779	4%
Total		18,361	100%

Table 3-34. Relevant Consultation History for the Hiwassee River Study Area

Economic Activity	Formal	Informal
Commercial, Industrial, Residential, and Associated Utility Development	0.00	1.17
Dam Operation	0.14	0.00
Federal Land Management	0.00	5.35
Restoration and Conservation	0.00	0.35
State Water Quality Standards	0.00	0.19
Total	0.14	7.06

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.



Figure 3-7. Sequatchie River Study Area

Table 3-35. Employment by Sector in Sequatchie River Study Area

NAICS	Sector	Sequatchie River	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	590	3%
21	Mining, Quarrying, and Oil and Gas Extraction	129	1%
22	Utilities	503	2%
23	Construction	1,923	9%
31–33	Manufacturing	3,945	19%
42	Wholesale Trade	486	2%
44–45	Retail Trade	2,427	12%
48–49	Transportation and Warehousing	914	4%
51	Information	328	2%
52	Finance and Insurance	828	4%
53	Real Estate and Rental and Leasing	363	2%
54	Professional, Scientific, and Technical Services	521	3%
55	Management of Companies and Enterprises	10	0%
56	Administrative and Support and Waste Management and Remediation Services	543	3%
61	Educational Services	1,702	8%
62	Health Care and Social Assistance	2,362	12%
71	Arts, Entertainment, and Recreation	325	2%
72	Accommodation and Food Services	852	4%
81	Other Services (except Public Administration)	1,032	5%
92	Public Administration	728	4%
Total		20,511	100%

Table 3-36. Relevant Consultation History for the Sequatchie River Study Area

Economic Activity	Informal
Agricultural and Recreational Development	1.00
Commercial, Industrial, Residential, and Associated Utility Development	4.00
Federal Land Management	0.19
Mining	3.00
Restoration and Conservation	1.19
State Water Quality Standards	0.19
Total	9.56

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

3.18 Paint Rock River (SP9)

The Paint Rock River study area encompasses 280,045 acres in Jackson, Madison, and Marshall Counties in Alabama and Franklin County in Tennessee (figure 3-8). The unit is part of the Tennessee River system and is occupied by the slabside pearl mussel, as well as other listed mussels (e.g., the Alabama lamp mussel, *Lampsilis virescens*).²⁴

The 2010 human population was 37,144 and is expected to grow 15 percent between 2013 and 2032 (table 3-3). Manufacturing is the largest sector in the study area (table 3-37).

The study area includes eight small incorporated towns in northern Alabama: Grant, Gurley, Hytop, New Hope, Paint Rock, Pleasant Groves, Skyline, and Woodville. There are 91 miles of primary and secondary roads and no mines or major NPDES-permitted facilities in the study area. Previous consultations in the Paint Rock River related to restoration and conservation, including a stream bank stabilization project, but otherwise, were statewide consultations (table 3-38).

3.19 Elk River (FK22, SP10)

The Elk River study area covers 1.2 million acres in Bedford, Coffee, Franklin, Giles, Grundy, Lawrence, Lincoln, Marion, Marshall, Maury, and Moore Counties in Tennessee and Jackson, Limestone, and Madison Counties in Alabama (figure 3-8). The proposed habitat unit is occupied by the slabside pearl mussel, as well as other listed mussels (e.g., the cracking pearl mussel, *Hemistena lata*).²⁵

The population for the Elk River study area was 185,665 for 2010 and is forecasted to grow by 15 percent from 2013 to 2032 (table 3-3). Primary employment sectors include manufacturing, retail, and health care (table 3-39).

The critical habitat unit is downstream of the Tims Ford Dam, operated by TVA, and the Arnold Air Force Base is located in the headwaters of the study area. The study area contains 21 incorporated places including the cities of Fayetteville, Pulaski, Sewanee, and Tullahoma, TN, and the town of Elkmont in Limestone County, AL. Six crushed stone mines and one sand and gravel plant are located in the study area, as well as five major NPDES-permitted facilities. There are 647 miles of primary and secondary roads inside the unit, including the I-65 bridge

²⁴ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

²⁵ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

over the proposed critical habitat unit. Previous consultations for the Elk River study area included the Giles County water system rehabilitation and an emergency formal consultation regarding hydroelectric operations at Tims Ford Dam (table 3-40).

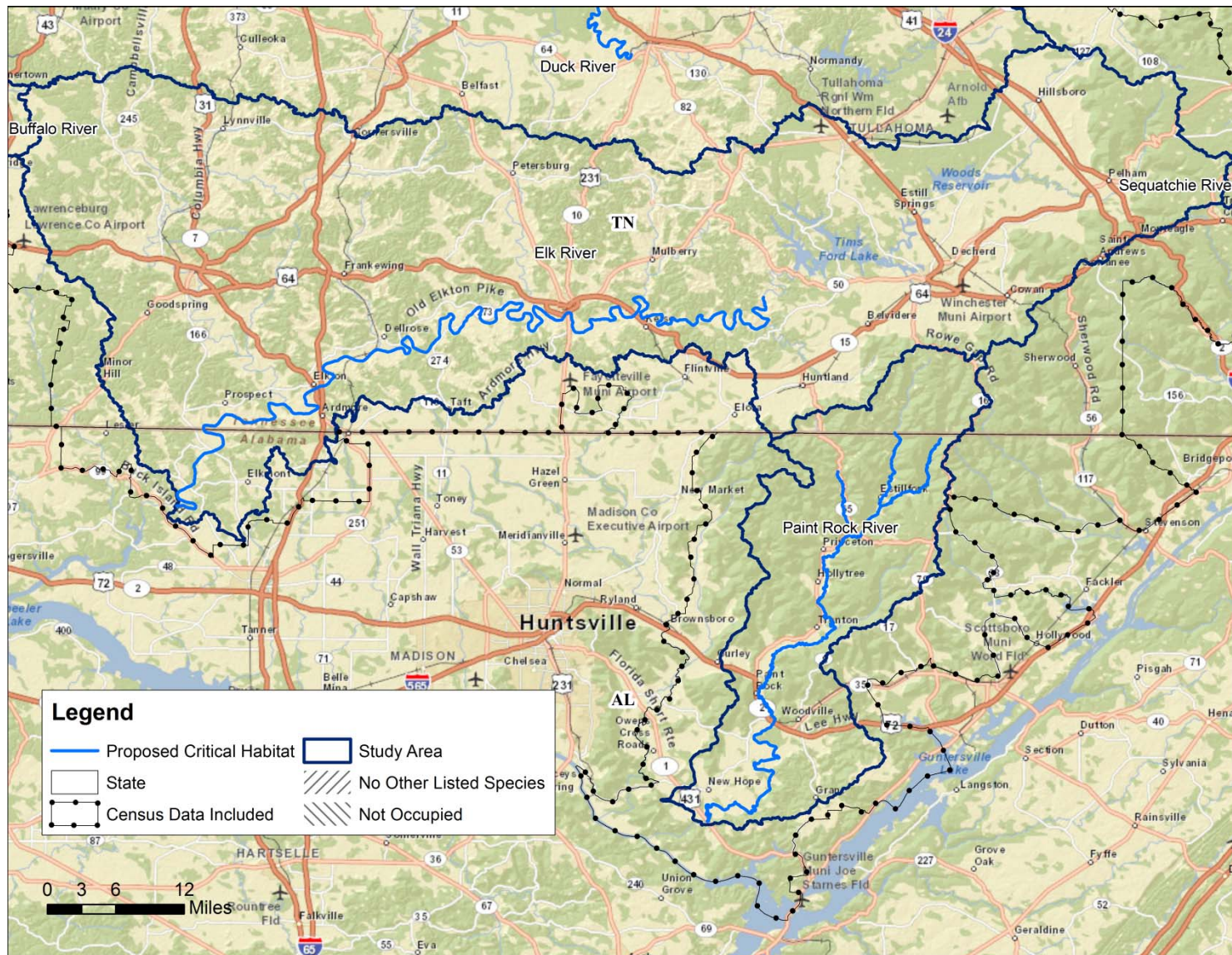


Figure 3-8. Paint Rock River and Elk River Study Areas

Table 3-37. Employment by Sector in Paint Rock River Study Area

NAICS	Sector	Paint Rock River	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	577	4%
21	Mining, Quarrying, and Oil and Gas Extraction	112	1%
22	Utilities	276	2%
23	Construction	1,814	11%
31–33	Manufacturing	3,428	21%
42	Wholesale Trade	368	2%
44–45	Retail Trade	1,819	11%
48–49	Transportation and Warehousing	501	3%
51	Information	208	1%
52	Finance and Insurance	367	2%
53	Real Estate and Rental and Leasing	153	1%
54	Professional, Scientific, and Technical Services	763	5%
55	Management of Companies and Enterprises	12	0%
56	Administrative and Support and Waste Management and Remediation Services	494	3%
61	Educational Services	1,250	8%
62	Health Care and Social Assistance	1,707	11%
71	Arts, Entertainment, and Recreation	126	1%
72	Accommodation and Food Services	667	4%
81	Other Services (except Public Administration)	746	5%
92	Public Administration	707	4%
Total		16,095	100%

Table 3-38. Relevant Consultation History for the Paint Rock River Study Area

Economic Activity	Informal
Federal Land Management	0.19
Restoration and Conservation	3.19
State Water Quality Standards	0.19
Total	3.56

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

Table 3-39. Employment by Sector in Elk River Study Area

NAICS	Sector	Elk River	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	2,387	3%
21	Mining, Quarrying, and Oil and Gas Extraction	106	0%
22	Utilities	1,020	1%
23	Construction	6,226	8%
31–33	Manufacturing	17,405	22%
42	Wholesale Trade	2,026	3%
44–45	Retail Trade	9,555	12%
48–49	Transportation and Warehousing	3,052	4%
51	Information	1,088	1%
52	Finance and Insurance	2,467	3%
53	Real Estate and Rental and Leasing	1,171	1%
54	Professional, Scientific, and Technical Services	3,819	5%
55	Management of Companies and Enterprises	24	0%
56	Administrative and Support and Waste Management and Remediation Services	2,611	3%
61	Educational Services	6,789	9%
62	Health Care and Social Assistance	8,351	10%
71	Arts, Entertainment, and Recreation	488	1%
72	Accommodation and Food Services	4,227	5%
81	Other Services (except Public Administration)	3,591	5%
92	Public Administration	3,205	4%
Total		79,608	100%

Table 3-40. Relevant Consultation History for the Elk River Study Area

Economic Activity	Formal	Informal
Agricultural and Recreational Development	0.00	4.00
Commercial, Industrial, Residential, and Associated Utility Development	0.00	10.17
Dam Operation	1.14	0.00
Federal Land Management	0.00	0.35
Restoration and Conservation	0.00	2.35
Road Maintenance and Construction	0.00	4.00
State Water Quality Standards	0.00	0.19
Total	1.14	21.06

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

3.20 Bear Creek (SP11)

The Bear Creek study area includes 470,875 acres in Colbert, Franklin, Lawrence, Marion, and Winston Counties in Alabama, and Itawamba and Tishomingo Counties in Mississippi (figure 3-9). The habitat unit is occupied by the slabside pearlymussel, as well as other listed mussels (e.g., the Cumberlandian combshell, *Epioblasma brevidens*),²⁶ and was designated as critical habitat for the Cumberlandian combshell (*Epioblasma brevidens*) and oyster mussel (*Epioblasma capsaeformis*) in 2004 (U.S. Fish and Wildlife Service, 2004).

The 2010 human population for the Bear Creek study area was 62,188 and is expected to grow by 8 percent between 2013 and 2032 (table 3-3). The manufacturing sector accounts for 30 percent of employment in the study area (table 3-41).

Federal land intersecting the study area includes the Natchez Trace Parkway, Bankhead National Forest, and the Bear Creek Projects, four dams operated by TVA. There are 10 incorporated places within the study area, including the towns of Belmont and Golden, MS, and Bear Creek, Phil Campbell, Red Bay, and Russellville, AL. There is one major NPDES-permitted facility in the study area, as well as 180 miles of primary and secondary roads, two sand and gravel mines, one dimension stone mine, and one crushed stone mine. Although there have been several road maintenance and construction projects, such as girder painting on the Natchez Trace Parkway bridge, many of the relevant consultations have been statewide consultations in Mississippi that are allocated solely to this unit (table 3-42).

3.21 Duck River (FK23, SP12)

The Duck River study area encompasses 1.7 million acres across Bedford, Cannon, Coffee, Dickson, Franklin, Giles, Hickman, Humphreys, Lawrence, Lewis, Lincoln, Marshall, Maury, Moore, Perry, Rutherford, and Williamson Counties in Tennessee (figures 3-10 and 3-11). The unit is occupied by the fluted kidneyshell and the slabside pearlymussel, as well as other listed mussels (e.g., the Cumberlandian combshell, *Epioblasma brevidens*).²⁷ A portion of this habitat unit was designated as critical habitat for the Cumberlandian combshell (*Epioblasma brevidens*) and oyster mussel (*Epioblasma capsaeformis*) in 2004 (U.S. Fish and Wildlife Service, 2004).

²⁶ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

²⁷ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

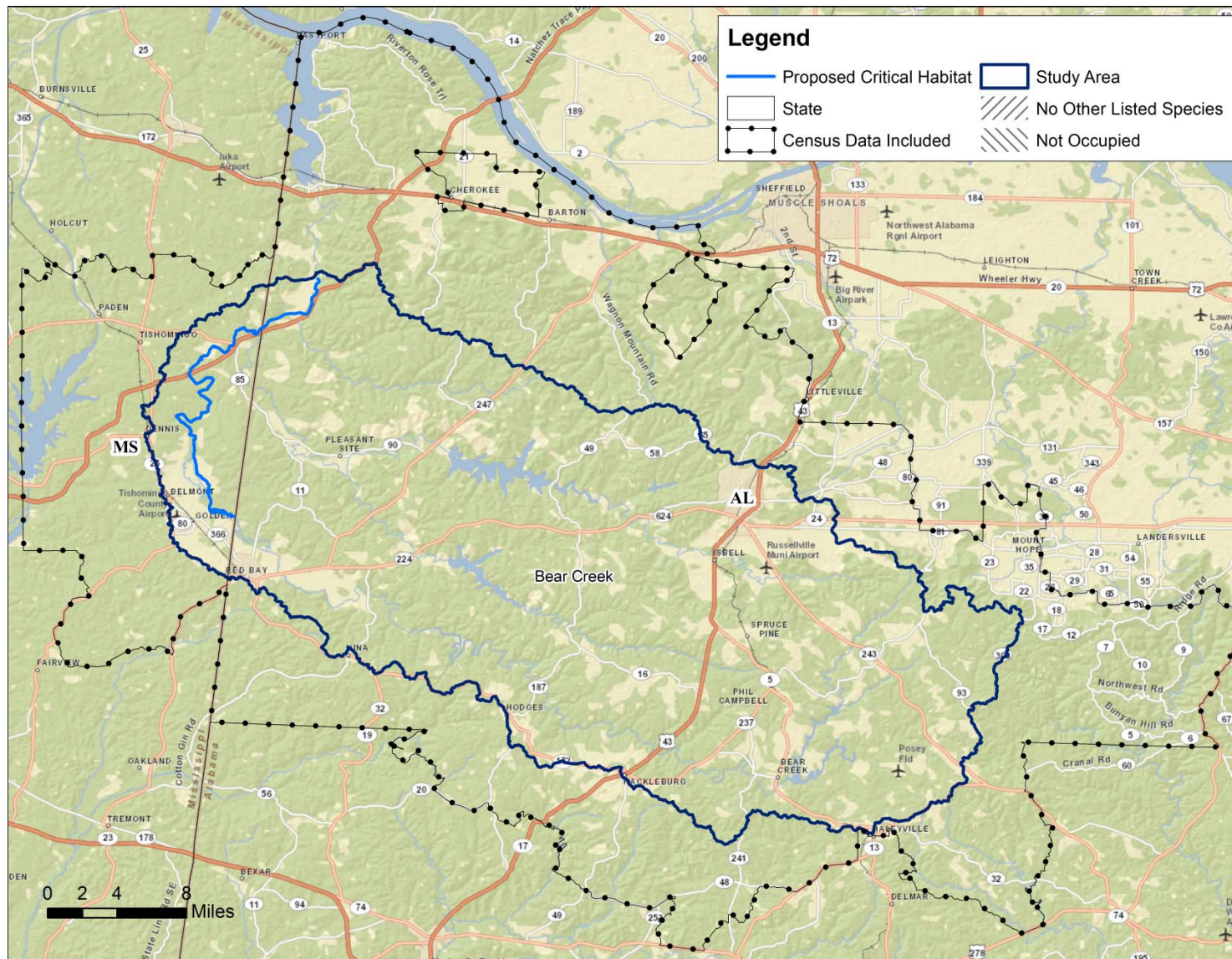


Figure 3-9. Bear Creek Study Area

Table 3-41. Employment by Sector in the Bear Creek Study Area

NAICS	Sector	Bear Creek	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	809	3%
21	Mining, Quarrying, and Oil and Gas Extraction	122	0%
22	Utilities	466	2%
23	Construction	1,549	6%
31–33	Manufacturing	7,593	30%
42	Wholesale Trade	760	3%
44–45	Retail Trade	2,946	12%
48–49	Transportation and Warehousing	1,174	5%
51	Information	203	1%
52	Finance and Insurance	686	3%
53	Real Estate and Rental and Leasing	231	1%
54	Professional, Scientific, and Technical Services	408	2%
55	Management of Companies and Enterprises	16	0%
56	Administrative and Support and Waste Management and Remediation Services	660	3%
61	Educational Services	1,576	6%
62	Health Care and Social Assistance	2,861	11%
71	Arts, Entertainment, and Recreation	102	0%
72	Accommodation and Food Services	1,295	5%
81	Other Services (except Public Administration)	1,087	4%
92	Public Administration	665	3%
Total		25,209	100%

Table 3-42. Relevant Consultation History for the Bear Creek Study Area

Economic Activity	Formal	Informal
Dam Operation	0.14	0.00
Federal Land Management	0.00	6.00
Restoration and Conservation	0.00	5.00
Road Maintenance and Construction	0.00	4.00
Total	0.14	15.00

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.



Figure 3-10. Buffalo River and Duck River Study Areas (Lower Duck)

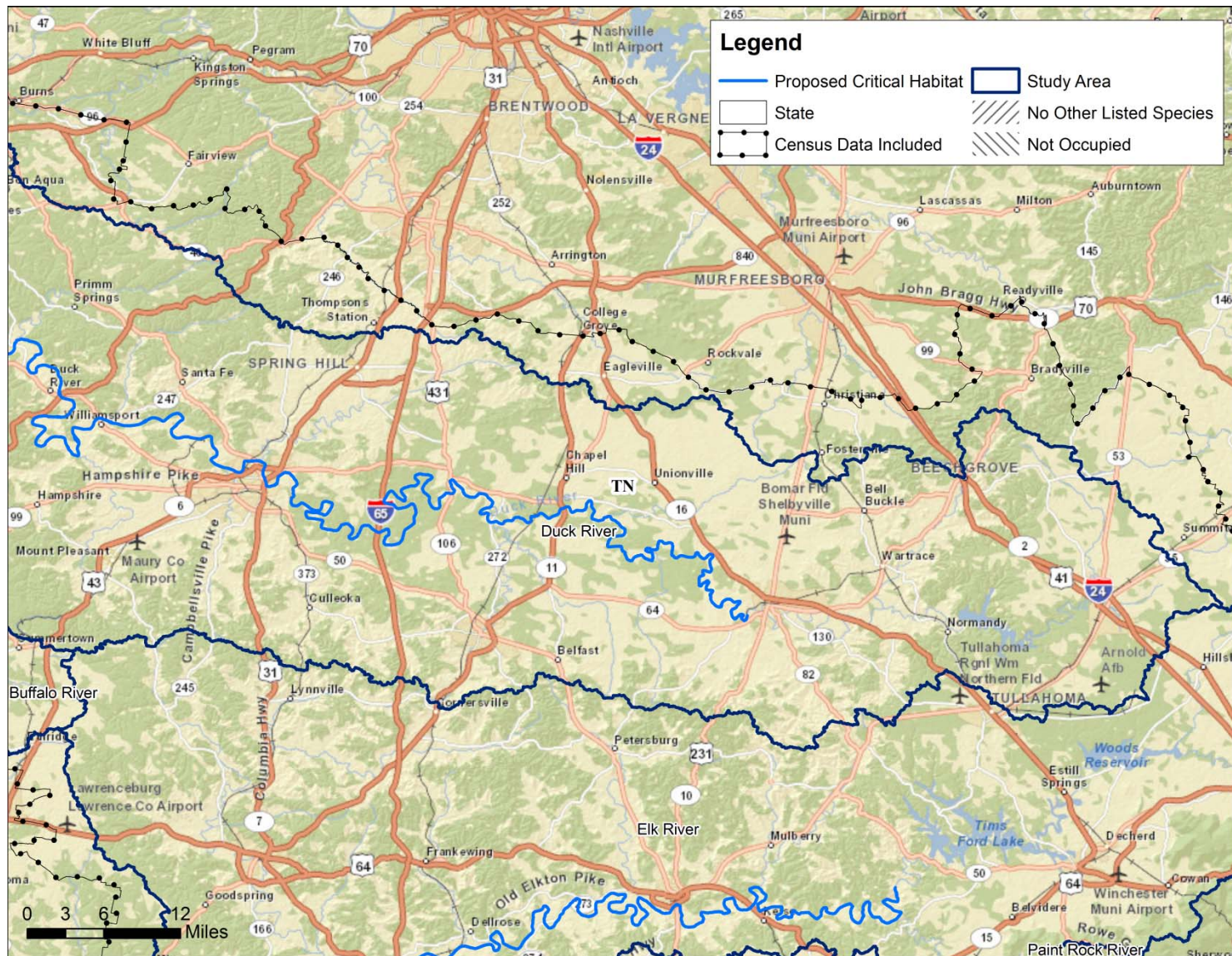


Figure 3-11. Duck River Study Area (Upper Duck)

Table 3-43. Employment by Sector in the Duck River Study Area

NAICS	Sector	Duck River	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	2,755	2%
21	Mining, Quarrying, and Oil and Gas Extraction	194	0%
22	Utilities	1,407	1%
23	Construction	13,628	9%
31–33	Manufacturing	27,555	19%
42	Wholesale Trade	3,474	2%
44–45	Retail Trade	17,927	12%
48–49	Transportation and Warehousing	5,909	4%
51	Information	2,606	2%
52	Finance and Insurance	6,245	4%
53	Real Estate and Rental and Leasing	2,210	2%
54	Professional, Scientific, and Technical Services	5,610	4%
55	Management of Companies and Enterprises	143	0%
56	Administrative and Support and Waste Management and Remediation Services	5,132	4%
61	Educational Services	10,138	7%
62	Health Care and Social Assistance	16,951	12%
71	Arts, Entertainment, and Recreation	1,519	1%
72	Accommodation and Food Services	8,081	6%
81	Other Services (except Public Administration)	7,630	5%
92	Public Administration	5,932	4%
Total		145,046	100%

The 2010 human population in the Duck River study area was 335,604 and is projected to grow by 25 percent from 2013 to 2032 (table 3-3). The manufacturing sector is the largest employer in the study area (table 3-43).

The proposed habitat unit is downstream of Normandy Dam, operated by TVA, and the Tennessee National Wildlife Refuge, Natchez Trace Parkway, and Arnold Air Force Base are all within the study area. There are seven crushed stone mines in the study area and a total of 871 miles of primary and secondary roads, including I-40 and I-65 bridges over the proposed critical habitat unit. There are 20 Tennessee incorporated places inside the unit, including the cities of Centerville, Columbia, and Shelbyville. Five major NPDES-permitted facilities are located within the study area.

There have been over 100 relevant consultations since 2006 in the Duck River study area, including 2 formal consultations related to bridges on or directly upstream of the proposed habitat unit. Many of the previous consultations for the study area related to pesticide use at the Tennessee National Wildlife Refuge (table 3-44).

Table 3-44. Relevant Consultation History for the Duck River Study Area

Economic Activity	Formal	Informal
Agricultural and Recreational Development	0.00	6.00
Commercial, Industrial, Residential, and Associated Utility Development	0.00	13.17
Dam Operation	0.14	2.00
Federal Land Management	0.00	42.35
Restoration and Conservation	0.00	7.35
Road Maintenance and Construction	2.00	30.00
State Water Quality Standards	0.00	0.19
Total	2.14	101.06

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

3.22 Buffalo River (FK24, SP13)

The Buffalo River study area includes 487,402 acres in Hickman, Humphreys, Lawrence, Lewis, Maury, Perry, and Wayne Counties in Tennessee (figure 3-10). The unit is occupied by the slabside pearlymussel, as well as other listed mussels (e.g., the rabbitsfoot, *Quadrula cylindrica cylindrica*).²⁸

The 2010 human population for the Buffalo River study area was 45,320 and is expected to decrease in population between 2013 and 2032 (table 3-3). The manufacturing, health care, construction, and retail sectors account for 55 percent of the total employment in this study area (table 3-45).

One major NPDES-permitted facility is present within the study area, located in Hohenwald, TN. There are 218 miles of primary and secondary roads within the study area, including the I-40 bridge over the proposed critical habitat unit. Previous consultations in the Buffalo River study area included Lobelville water treatment plant improvements, private dock construction, and streambank protection (table 3-46).

²⁸ U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office. October 4, 2012. Personal communication with Ross Loomis, RTI International.

Table 3-45. Employment by Sector in the Buffalo River Study Area

NAICS	Sector	Buffalo River	
		Employment	Percentage
11	Agriculture, Forestry, Fishing and Hunting	417	2%
21	Mining, Quarrying, and Oil and Gas Extraction	50	0%
22	Utilities	194	1%
23	Construction	1,681	10%
31–33	Manufacturing	3,159	18%
42	Wholesale Trade	520	3%
44–45	Retail Trade	1,803	10%
48–49	Transportation and Warehousing	835	5%
51	Information	233	1%
52	Finance and Insurance	624	4%
53	Real Estate and Rental and Leasing	153	1%
54	Professional, Scientific, and Technical Services	366	2%
55	Management of Companies and Enterprises	7	0%
56	Administrative and Support and Waste Management and Remediation Services	430	2%
61	Educational Services	1,250	7%
62	Health Care and Social Assistance	3,010	17%
71	Arts, Entertainment, and Recreation	57	0%
72	Accommodation and Food Services	772	4%
81	Other Services (except Public Administration)	679	4%
92	Public Administration	1,017	6%
Total		17,257	100%

Table 3-46. Relevant Consultation History for the Buffalo River Study Area

Economic Activity	Informal
Agricultural and Recreational Development	2.00
Commercial, Industrial, Residential, and Associated Utility Development	1.00
Federal Land Management	0.19
Restoration and Conservation	1.19
Road Maintenance and Construction	1.00
State Water Quality Standards	0.19
Total	5.56

Note: Consultation histories for study areas may not be whole numbers because consultations concerning multiple study areas are distributed evenly across all relevant study areas.

SECTION 4 COSTS

4.1 Road Maintenance and Construction

Road maintenance and construction activities conducted by the Federal government or States receiving Federal funding and that have potential adverse effects to the proposed critical habitat will require a Section 7 consultation. The Federal Highway Administration (FHWA) will be the lead action agency for interstate highway maintenance and construction, and the residing State's Department of Transportation (DOT) will act as the FHWA's delegate for other Federally funded projects. In addition, road maintenance and construction projects that have potential impacts to aquatic resources, such as bridge replacement projects, may require permits under Sections 401, 402, and 404 of the Clean Water Act from the Corps and EPA or EPA's delegate. Projects that take place along waterways within the Tennessee River system also require a permit from TVA under Section 26a of the Tennessee Valley Authority Act.

To estimate the administrative costs of future road maintenance and construction consultations, we assumed that in addition to the Service and FHWA or State DOT, the Corps participates as the primary permitting agency for the project. Based on stakeholder interviews, we assumed that the Service will spend, on average, 300 hours per formal and 8 hours per informal consultation (U.S. Fish and Wildlife Service, 2013), the Corps will spend, on average, 83.1 hours per formal and 40.6 hours per informal consultation,¹ and the project proponent will spend, on average, 400 hours per formal and 200 hours per informal consultation (Kentucky Transportation Cabinet, 2013). Applying the cost-of-employment estimates described in section 2, we estimated that the administrative cost of consultations for road maintenance and construction is \$45,222 for each formal consultation and \$14,474 for each informal consultation (table 4-1). As discussed in section 2.5, in occupied units, we assumed 15 percent of the administrative time is required to consider impacts to the critical habitat, resulting in incremental administrative cost of consultations of \$6,783 for each formal consultation and \$2,171 for each informal consultation. In the three unoccupied units, the entire administrative cost is included as incremental.

For road maintenance and construction projects, recommended project modifications can range from erosion and sediment control practices that are business as usual and add no additional cost to projects, to bridges that clear span a stream instead of placing piers in the

¹ Based on an October 2012 evaluation of time spent handling Endangered Species Act-related compliance for regulatory permits (U.S. Army Corps of Engineers, Nashville District, January 25, 2013).

Table 4-1. Estimated Administrative Cost of Future Consultations for Road Maintenance and Construction

Parameter	Service	Action Agency	Project Proponent	Total
Hours per Formal Consultation	300	83.1	400	783.1
Hours per Informal Consultation	8	40.6	200	248.6
Sector and Occupation	Federal—Wildlife Biologist	Federal—Wildlife Biologist	State—Civil Engineer	
Cost of Employment (\$/hour)	\$56.92	\$56.92	\$58.54	
Cost per Formal Consultation	\$17,076	\$4,730	\$23,416	\$45,222
Cost per Informal Consultation	\$455	\$2,311	\$11,708	\$14,474

channel, include stormwater controls to prevent runoff into the stream, and must be constructed without the construction of temporary bridges. When project modifications beyond business as usual are required, the cost range State DOTs provided ranged from \$20,000 to \$1.5 million in additional design and construction costs.² Based on discussions with State DOTs, we assumed that each informal consultation will result in project modification costs of \$20,000. For formal consultations, we selected an average of \$300,000 per consultation, which is likely to be on the high side of the actual costs based on the range of estimates provided by the different State DOTs. These costs are assumed to be direct baseline costs in occupied units and direct incremental costs in unoccupied units. Based on input from TVA, we also assumed that all projects associated with formal consultations will require a \$25,000 mussel survey, and informal consultations will require a \$2,500 mussel survey.³

In addition to these direct costs, Kentucky requires that transportation projects with potential impacts to listed species or critical habitat obtain individual water quality permits instead of compliance through general permits. This step adds an additional \$30,000 to \$80,000

² The Kentucky Transportation Cabinet (2013) reported a range of \$150,000 to \$1.5 million for project modification costs. The Virginia DOT (January 30, 2013) estimated that a recent formal consultation regarding the State Route 833 bridge replacement in Lee County, VA, resulted in approximately \$200,000 in project modification costs and that previous informal consultations in the study area, such as the Front Street bridge replacement in Richlands, VA, cost approximately \$20,000 in project modification costs. The Alabama Department of Transportation (January 30, 2013) indicated that business-as-usual erosion and sediment controls are typically sufficient and project modifications beyond \$1 million would not be expected to occur.

³ \$25,000 is the estimated cost of an outside consultant to conduct a mussel survey (TVA, personal communication, February 6, 2013), while \$2,500 is the cost of a 1-day diving mussel survey using a two-person crew conducted by a State agency (Tennessee Wildlife Resources Agency, personal communication, January 29, 2013).

to the cost of transportation projects in Kentucky.⁴ For this analysis, we assumed that each formal consultation will require additional costs at the midpoint within this range, \$55,000, and that each informal consultation will require additional costs at the lower bound of this range. These are considered indirect baseline costs in occupied units and indirect incremental costs in unoccupied units. Baseline indirect costs, such as those associated with other Clean Water Act permits and business-as-usual erosion and sediment controls, are not quantified in this analysis.

To project the number of future road maintenance and construction consultations for each habitat unit, we relied primarily on the relevant consultation history to develop average annual consultation estimates and made the following adjustments based on other available data. For the West Fork Obey River and Wolf River and Town Branch study areas, which have no other listed aquatic species, we multiplied miles of primary and secondary roads by our estimate of annual consultations per mile of primary and secondary roads. In Kentucky study areas, we adjusted our projected consultations in the Buck Creek, Middle Fork Rockcastle, and Rockcastle River study areas to reflect 15 proposed projects in the Kentucky Six Year Highway Plan. Based on input provided by Alabama's DOT, the Paint Rock River study area is projected to have one informal consultation every 6 years. Finally, all future road maintenance and construction consultations in Virginia study areas are assumed to have formal consultations based on Virginia DOT's interpretation of recent changes in guidance from the Virginia Ecological Services Field Office (Virginia Department of Transportation, January 23, 2013). These estimated average annual informal and formal consultations were then projected based on the projected change in study area populations between 2013 and 2032 (table 4-2).

We projected an estimated 205 informal and 27 formal consultations in the occupied habitat units over the study period, with 77 informal and no formal consultations in the unoccupied habitat units. Based on these consultations, we estimated the incremental costs of the proposed critical habitat designation on road maintenance and construction to be \$1.9 million over the next 20 years, discounting future costs at a 7 percent discount rate (table 4-2). Total incremental administrative costs in occupied units are approximately \$350,000. Incremental administrative costs in unoccupied units are estimated to be approximately \$623,000 with approximately \$108,000 for mussel surveys and an additional \$861,000 in estimated project modification costs. The indirect incremental costs of additional permitting in the unoccupied

⁴ The Kentucky Transportation Cabinet (2013) estimates that individual 401 permits required when impacts to listed species or critical habitat may occur add between \$15,000 and \$20,000 to transportation projects, and individual 404 permits add an additional \$15,000 to \$60,000.

Table 4-2. Road Maintenance and Construction Projected Consultations and Direct Incremental Costs by Habitat Unit

Unit ID	Unit Name	Primary and Secondary Road Miles	Previous Consultations		Projected Consultations				Direct Incremental Cost 7% Discount Rate \$1,000s
			Informal	Formal	2013		2032		
			Informal	Formal	Informal	Formal	Informal	Formal	
FK1	Horse Lick Creek	21	0.00	0.00	0.00	0.00	0.00	0.00	\$0.00
FK2	Middle Fork Rockcastle River	140	0.50	0.00	0.14	0.00	0.15	0.00	\$3.58
FK3	Rockcastle River	298	4.50	0.00	1.14	0.00	1.24	0.00	\$494.70
FK4	Buck Creek	182	0.00	0.00	0.86	0.00	0.98	0.00	\$22.29
FK5	Rock Creek	16	0.00	0.00	0.00	0.00	0.00	0.00	\$0.00
FK6	Little South Fork Cumberland River	72	1.00	0.00	0.14	0.00	0.15	0.00	\$3.58
FK7	Big South Fork Cumberland River	152	11.00	0.00	1.57	0.00	1.68	0.00	\$39.69
FK8	Wolf River and Town Branch	51	0.00	0.00	0.11	0.00	0.12	0.00	\$2.81
FK9	West Fork Obey River	17	0.00	0.00	0.04	0.00	0.04	0.00	\$0.98
FK10	Indian Creek	130	1.50	0.00	0.00	0.25	0.00	0.27	\$19.69
FK11	Little River	38	0.00	0.00	0.00	0.00	0.00	0.00	\$0.00
FK12, SP1	North Fork Holston River	49	0.00	0.00	0.00	0.00	0.00	0.00	\$0.00
FK13, SP2	Middle Fork Holston River	155	1.00	0.00	0.00	0.17	0.00	0.17	\$12.94
FK14, SP3	Big Moccasin Creek	18	0.00	0.00	0.00	0.00	0.00	0.00	\$0.00
FK15	Copper Creek	36	0.50	0.00	0.00	0.08	0.00	0.09	\$6.46
FK16, SP4	Clinch River	325	5.00	0.00	0.43	0.33	0.44	0.34	\$36.59
FK17, SP5	Powell River	338	0.00	1.00	0.00	0.17	0.00	0.18	\$13.11
FK18, SP6	Nolichucky River	429	3.00	0.00	0.43	0.00	0.49	0.00	\$11.09
FK19	Holston River	395	7.00	0.00	1.00	0.00	1.13	0.00	\$439.44
FK20	French Broad River	305	10.00	0.00	1.43	0.00	1.80	0.00	\$658.52
FK21, SP7	Hiwassee River	186	0.00	0.00	0.00	0.00	0.00	0.00	\$0.00
SP8	Sequatchie River	156	0.00	0.00	0.00	0.00	0.00	0.00	\$0.00
SP9	Paint Rock River	91	0.00	0.00	0.17	0.00	0.19	0.00	\$4.34
FK22, SP10	Elk River	647	4.00	0.00	0.57	0.00	0.66	0.00	\$14.88
SP11	Bear Creek	180	4.00	0.00	0.57	0.00	0.62	0.00	\$14.51
FK23, SP12	Duck River	871	30.00	2.00	4.29	0.29	5.35	0.36	\$139.60
FK24, SP13	Buffalo River	218	1.00	0.00	0.14	0.00	0.14	0.00	\$3.50
Total		5,514	84.00	3.00	13.03	1.29	15.17	1.40	\$1,942.30

Kentucky habitat unit, Rockcastle River, are estimated to be approximately \$401,000. If the administrative costs and project modifications in the unoccupied units are considered part of the baseline because of the presence of other listed aquatic species, the total incremental cost to road maintenance and construction would be approximately \$443,000 with no indirect incremental costs.

4.2 Dam Operation

TVA operates dams directly upstream of seven of the habitat units (table 4-3). In 2006, TVA and the Service conducted a formal consultation regarding the routine operation and maintenance at these and the other dams under TVA’s management. Based on conversations with the Service (U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office, October 17, 2013), this formal consultation will need to be reinitiated as a result of this proposed listing and designation and other species’ listings, but it may only require consultation for the Tims Ford Dam. TVA estimates that this reinitiated formal consultation will require 500 hours of staff time (TVA, 2013) and the Service estimates 150 hours (U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office, February 1, 2013). Based on input provided by TVA, we assumed other consultations will require a level of effort consistent with formal and informal consultations estimated for Federal land management described in section 4.6 (TVA, 2013) (table 4-4). None of these consultations are expected to result in any project modifications beyond those consistent with current operation of TVA’s Reservoir Release Improvement Program (TVA, 2013). In unoccupied units, the incremental cost is the total cost of the consultation. In occupied units, as described in section 2.5, the incremental cost is estimated to be 15 percent of the administrative cost.

Table 4-3. Proposed Critical Habitat Units and Associated Upstream Dams

Unit ID	Unit Name	Upstream Dam
FK18, SP6	Nolichucky River	Nolichucky
FK19	Holston River	Cherokee
FK20	French Broad River	Douglas
FK21, SP7	Hiwassee River	Apalachia
FK22, SP10	Elk River	Tims Ford
SP11	Bear Creek	Bear Creek Projects (Four Dams)
FK23, SP12	Duck River	Normandy

Table 4-4. Estimated Administrative Cost of Future Consultations for Dam Operation

Parameter	Service	Action Agency	Total
Hours to Reinitiate Formal Consultation for Tims Ford Dam	150	500	650
Hours per Formal Consultation	300	94.7	394.7
Hours per Informal Consultation	8	4	12
Sector and Occupation	Federal—Wildlife Biologist	Federal—Wildlife Biologist	
Cost of Employment (\$/hour)	\$56.92	\$56.92	
Cost to Reinitiate Formal Consultation for Tims Ford Dam	\$8,538	\$28,460	\$36,998
Cost per Formal Consultation	\$17,076	\$5,390	\$22,466
Cost per Informal Consultation	\$455	\$228	\$683

To project other future consultations related to dam operation, we relied on the relevant consultation history (table 4-5). Since 2006, there have been one formal consultation in addition to the 2006 programmatic consultation and three informal consultations related to dam operation. Given the small number of previous consultations, we allocated future consultations evenly across the dams within the study area, estimating one formal consultation and three informal consultations every 7 years. We did not project an increase in consultations for dam operation tied to population growth.

Total direct incremental costs associated with dam operation are estimated to be approximately \$21,000 in administrative costs over the next 20 years. If consultation costs related to other listed species in the Holston and French Broad Rivers were considered part of the baseline, the direct incremental cost would be reduced to approximately \$12,000.

4.3 Commercial, Industrial, Residential, and Associated Utility Development

Construction projects that receive Federal funding, such as those funded by Community Development Block Grants provided to States by the U.S. Department of Housing and Urban Development, must consult with the Service to consider impacts to listed species and designated critical habitat. In addition, construction projects that have potential impacts to aquatic resources may require permits under Sections 401, 402, and 404 of the Clean Water Act from the Corps and EPA or EPA's delegate. Projects that take place along waterways within the Tennessee River system also require a permit from TVA under Section 26a of the Tennessee Valley Authority Act.

Table 4-5. Dam Operation Projected Consultations and Direct Incremental Costs by Habitat Unit

Unit ID	Unit Name	Upstream Dam	Previous Consultations		Projected Annual Consultations		Direct Incremental Cost 7% Discount Rate \$1,000s
			Informal	Formal	Informal	Formal	
FK18, SP6	Nolichucky River	Nolichucky	1.00	0.14	0.06	0.02	\$0.85
FK19	Holston River	Cherokee	0.00	0.14	0.06	0.02	\$5.67
FK20	French Broad River	Douglas	0.00	0.14	0.06	0.02	\$5.67
FK21, SP7	Hiwassee River	Apalachia	0.00	0.14	0.06	0.02	\$0.85
FK22, SP10	Elk River	Tims Ford	0.00	1.14	0.06	0.02	\$6.40
SP11	Bear Creek	Bear Creek Projects	0.00	0.14	0.06	0.02	\$0.85
FK23, SP12	Duck River	Normandy	2.00	0.14	0.06	0.02	\$0.85
Total			3.00	2.00	0.43	0.14	\$21.15

To estimate the administrative costs of future commercial, industrial, residential, and associated utility development consultations, we assumed that the Service and the project proponent participate, with the Corps included as the primary permitting agency for the project. Based on stakeholder interviews, we assumed that the Service will spend, on average, 300 hours per formal and 8 hours per informal consultation (U.S. Fish and Wildlife Service, Virginia Ecological Services Southwest Virginia Field Office, January 16, 2013.); the Corps will spend, on average, 83.1 hours per formal and 40.6 hours per informal consultation⁵; and the project proponent will spend, on average, 160 hours per formal and 60 hours per informal consultation.⁶

⁵ Based on an October 2012 evaluation of time spent handling Endangered Species Act-related compliance for regulatory permits (U.S. Army Corps of Engineers, Nashville District, January 25, 2013).

⁶ TVA does not delegate completion of the Biological Assessment to the project proponent when they are the lead agency for consultations regarding commercial, industrial, residential, and associated utility development projects. For formal consultations, TVA estimates a range of between 120 and 160 hours for the Biological Assessment. We used the upper bound of this range to estimate administrative time by project proponents during formal consultations. For informal consultations, TVA estimates that the majority of informal consultations require between 16 and 24 hours to develop the Biological Assessment; however, more complicated informal consultations may require more time than formal consultation to avoid entering a formal consultation (Tennessee Valley Authority, January 31, 2013). The Kentucky Transportation Cabinet indicated that Biological Assessments during informal consultation required between 50 and 60 hours of staff time (Kentucky Transportation Cabinet, 2013). We assumed that informal consultations require 60 hours of time by project proponents to avoid underestimating the administrative time spent by project proponents during informal consultations.

Applying the cost-of-employment estimates described in section 2, we estimated that the administrative cost of consultations for commercial, industrial, residential, and associated utility development is \$31,964 for each formal consultation and \$6,576 for each informal consultation (table 4-6). As discussed in section 2.5, in occupied units, we assumed 15 percent of the administrative time is required to consider impacts to the critical habitat, resulting in incremental administrative cost of consultations of \$4,795 for each formal consultation and \$986 for each informal consultation. In the three unoccupied units, the entire administrative cost is included as incremental.

Table 4-6. Estimated Administrative Cost of Future Consultations for Commercial, Industrial, Residential, and Associated Utility Development

Parameter	Service	Action Agency	Project Proponent	Total
Hours per Formal Consultation	300	83.1	160	543.1
Hours per Informal Consultation	8	40.6	60	108.6
Sector and Occupation	Federal—Wildlife Biologist	Federal—Wildlife Biologist	Private—Civil Engineer	
Cost of Employment (\$/hour)	\$56.92	\$56.92	\$63.49	
Cost per Formal Consultation	\$17,076	\$4,730	\$10,158	\$31,964
Cost per Informal Consultation	\$455	\$2,311	\$3,809	\$6,576

Recommended project modifications for commercial, industrial, residential, and associated utility development can range from erosion and sediment control and restoration practices that are business as usual that add no additional cost to projects, to requiring directional drilling instead of open trench for pipeline construction with on-site biologists and spill containment during project work. Although we have not been able to collect data regarding the estimated costs associated with project modifications for commercial, industrial, residential, and associated utility development, discussions with TVA indicate that estimating project modification costs to be half of what we estimate for road maintenance and construction would likely be an overestimate based on their experience (TVA, February 5, 2013). To avoid underestimating the potential project modification costs related to commercial, industrial, residential, and associated utility development, we assumed that each informal consultation will result in project modification costs of \$10,000 and that each formal consultation will result in project modification costs of \$150,000. These costs were assumed to be direct baseline costs in occupied units and direct incremental costs in unoccupied units. Based on input from TVA, we

also assumed that all projects associated with formal consultations will require a \$25,000 mussel survey and informal consultations will require a \$2,500 mussel survey.⁷

To project the number of commercial, industrial, residential, and associated utility development consultations for each habitat unit, we relied primarily on the relevant consultation history to develop average annual consultation estimates and made the following adjustments based on other available data. For the West Fork Obey River and Wolf River and Town Branch study areas, which have no other listed aquatic species, we used the expected population change to 2032 as a proxy of previous population growth and multiplied the study areas' expected population change by our estimate of annual consultations in other study areas per population change. These estimated average annual informal and formal consultations were then projected based on the projected change in study area populations between 2013 and 2032 (table 4-7).

We projected an estimated 291 informal and 10 formal consultations in the occupied habitat units over the study period, with 86 informal and no formal consultations in the unoccupied habitat units. Based on these consultations, we estimated the incremental costs of the proposed critical habitat designation on commercial, industrial, residential, and associated utility development to be \$1.1 million over the next 20 years, discounting future costs at a 7 percent discount rate (table 4-7). Total incremental administrative costs in occupied units are approximately \$188,000. Incremental administrative costs in unoccupied units are estimated to be approximately \$316,000 with approximately \$120,000 for mussel surveys and an additional \$481,000 in estimated project modification costs. If consultation costs related to other listed species in the unoccupied units were considered part of the baseline, the direct incremental cost would be reduced to approximately \$236,000.

4.4 Agricultural and Recreational Development

Agricultural and recreational development projects that receive Federal funding, such as those funded by the U.S. Department of Agriculture, must consult with the Service to consider impacts to listed species and designated critical habitat. In addition, projects that have potential impacts to aquatic resources may require permits under Sections 401, 402, and 404 of the Clean Water Act from the Corps and EPA or EPA's delegate. Projects that take place along waterways within the Tennessee River system also require a permit from TVA under Section 26a of the Tennessee Valley Authority Act.

⁷ \$25,000 is the estimated cost of an outside consultant to conduct a mussel survey (TVA, February 6, 2013), while \$2,500 is the cost of a 1-day diving mussel survey using a two-person crew conducted by a State agency (TWRA, January 29, 2013).

Table 4-7. Commercial, Industrial, Residential, and Associated Utility Development Projected Consultations and Direct Incremental Costs by Habitat Unit

Unit ID	Unit Name	Projected Change in Population (2013–2032)	Previous Consultations		Projected Consultations				Direct Incremental Cost
			Informal	Formal	2013		2032		7% Discount Rate \$1,000s
					Informal	Formal	Informal	Formal	
FK1	Horse Lick Creek	82	0.71	0.00	0.10	0.00	0.10	0.00	\$1.14
FK2	Middle Fork Rockcastle River	1,224	1.71	0.00	0.24	0.00	0.26	0.00	\$2.78
FK3	Rockcastle River	5,562	6.71	0.00	0.96	0.00	1.04	0.00	\$214.02
FK4	Buck Creek	4,109	2.38	0.00	0.34	0.00	0.39	0.00	\$4.01
FK5	Rock Creek	241	1.88	0.00	0.27	0.00	0.28	0.00	\$3.04
FK6	Little South Fork Cumberland River	376	0.38	0.00	0.05	0.00	0.06	0.00	\$0.61
FK7	Big South Fork Cumberland River	3,825	12.88	0.00	1.84	0.00	1.96	0.00	\$21.10
FK8	Wolf River and Town Branch	469	0.38	0.00	0.03	0.00	0.04	0.00	\$0.38
FK9	West Fork Obey River	1,253	0.00	0.00	0.09	0.00	0.10	0.00	\$1.05
FK10	Indian Creek	2,471	3.00	0.25	0.50	0.04	0.53	0.04	\$8.05
FK11	Little River	892	0.50	0.25	0.08	0.04	0.09	0.04	\$3.27
FK12, SP1	North Fork Holston River	443	1.00	0.25	0.17	0.04	0.17	0.04	\$4.18
FK13, SP2	Middle Fork Holston River	1,452	2.00	0.00	0.33	0.00	0.34	0.00	\$3.76
FK14, SP3	Big Moccasin Creek	526	0.00	0.00	0.00	0.00	0.00	0.00	\$0.00
FK15	Copper Creek	292	0.00	0.00	0.00	0.00	0.00	0.00	\$0.00
FK16, SP4	Clinch River	4,173	26.50	2.25	4.25	0.38	4.37	0.39	\$68.67
FK17, SP5	Powell River	4,518	4.00	0.00	0.64	0.00	0.68	0.00	\$7.35
FK18, SP6	Nolichucky River	22,598	5.17	0.00	0.74	0.00	0.84	0.00	\$8.68
FK19	Holston River	31,957	13.17	0.00	1.88	0.00	2.12	0.00	\$426.44
FK20	French Broad River	45,756	8.17	0.00	1.17	0.00	1.47	0.00	\$277.46
FK21, SP7	Hiwassee River	6,880	1.17	0.00	0.17	0.00	0.19	0.00	\$1.97
SP8	Sequatchie River	4,092	4.00	0.00	0.57	0.00	0.61	0.00	\$6.57
SP9	Paint Rock River	5,709	0.00	0.00	0.00	0.00	0.00	0.00	\$0.00
FK22, SP10	Elk River	28,794	10.17	0.00	1.45	0.00	1.67	0.00	\$17.19
SP11	Bear Creek	5,158	0.00	0.00	0.00	0.00	0.00	0.00	\$0.00
FK23, SP12	Duck River	86,490	13.17	0.00	1.88	0.00	2.35	0.00	\$23.04
FK24, SP13	Buffalo River	-373	1.00	0.00	0.14	0.00	0.14	0.00	\$1.59
Total		240,084	120.00	3.00	17.90	0.50	19.80	0.52	\$1,106.33

To estimate the administrative costs of future agricultural and recreational consultations, we assumed that the Service and the project proponent participate with the Corps included as the primary permitting agency for the project. We assumed that administrative time for informal consultations related to agricultural and recreational consultations is consistent with the time required for informal consultations regarding commercial, industrial, residential, and associated utility development described in section 4.3. There have been no relevant formal consultations related to agricultural and recreational development. Applying the cost of employment estimates described in section 2, we estimated that the administrative cost of consultations for agricultural and recreational development is \$6,576 for each informal consultation (table 4-8). Assuming 15% of the administrative time is required to consider impacts to the critical habitat, the incremental administrative cost of consultations in occupied units is estimated to be \$986 for each informal consultation. In the three unoccupied units, the entire administrative cost is included as incremental.

Table 4-8. Estimated Administrative Cost of Future Consultations for Agricultural and Recreational Development

Parameter	Service	Action Agency	Project Proponent	Total
Hours per Informal Consultation	8	40.6	60	108.6
Sector and Occupation	Federal—Wildlife Biologist	Federal—Wildlife Biologist	Private—Civil Engineer	
Cost of Employment (\$/hour)	\$56.92	\$56.92	\$63.49	\$31,964
Cost per Informal Consultation	\$455	\$2,311	\$3,809	\$6,576

Recommended project modifications for recreational and agricultural development are typically recommendations to conduct the work outside of breeding seasons and otherwise business-as-usual erosion and sediment control and restoration practices that add no additional cost to projects (TVA, February 5, 2013). Although we assumed no additional project modification costs are associated with the listing or critical habitat designation, we did assume that projects will require a \$2,500 mussel survey.⁸

To project the number of agricultural and recreational development consultations for each habitat unit, we relied on the relevant consultation history to develop average annual consultation estimates. We projected an estimated 68 informal consultations in the occupied habitat units over

⁸ \$2,500 is the cost of a 1-day diving mussel survey using a two-person crew (TWRA, January 29, 2013).

the study period, with 7 informal consultations in the unoccupied habitat units. No formal consultations were estimated for agricultural and recreational development. Based on these projections, we estimated the incremental costs of the proposed critical habitat designation on agricultural and recreational development to be approximately \$76,000 over the next 20 years, discounting future costs at a 7 percent discount rate (table 4-9). Total incremental administrative costs in occupied units are approximately \$38,000. Incremental administrative costs in unoccupied units are estimated to be approximately \$28,000 and an additional \$10,000 for mussel surveys. If consultation costs related to other listed species in the unoccupied units were considered part of the baseline, the direct incremental cost would be reduced to approximately \$42,000.

4.5 Mining

Mining operations require permits under the Surface Mining Control and Reclamation Act (SMCRA) of 1977. SMCRA allows States to gain primacy over the Federal government and administer their own mining regulatory programs. This is the case in all States in the study area except for Tennessee. Although there is no Federal nexus in the other study area States, the Service may still provide comments and other technical assistance to State mining permits, which we included as informal consultations for the purposes of the analysis. In addition, construction activities at mining operations, such as constructing detention ponds or new roads on site, may require permits under Sections 401, 402, and 404 of the Clean Water Act from the Corps and EPA or EPA's delegate.

To estimate the administrative costs of future mining consultations, we assumed that the Service and the project proponent participate with the relevant mining agency included as the primary permitting agency for the project. Based on information provided by the Service and the Office of Surface Mining Reclamation and Enforcement (OSM), we estimates that informal consultations related to mining operations require a comparable amount of time to that required for development projects (OSM, Knoxville Field Office, 2013) (table 4-8). In the three unoccupied units, the entire administrative cost is included as incremental.

Based on a review of relevant consultations by OSM, the Service's recommendations for mining in Tennessee have been strict adherence to the State's water quality standards and a request that projects occur in less biologically important streams (e.g., ephemeral streams instead of intermittent or perennial streams). These recommendations do not go above and beyond the requirements under mining operations' other water quality permits, so all project modifications

Table 4-9. Agricultural and Recreational Development Projected Consultations and Direct Incremental Costs by Habitat Unit

Unit ID	Unit Name	Previous Consultations	Projected Annual Consultations	Direct Incremental Cost 7% Discount Rate
		Informal	Informal	\$1,000s
FK1	Horse Lick Creek	0.58	0.08	\$0.93
FK2	Middle Fork Rockcastle River	0.58	0.08	\$0.93
FK3	Rockcastle River	1.58	0.23	\$23.27
FK4	Buck Creek	0.25	0.04	\$0.40
FK5	Rock Creek	1.75	0.25	\$2.80
FK6	Little South Fork Cumberland River	0.25	0.04	\$0.40
FK7	Big South Fork Cumberland River	2.75	0.39	\$4.39
FK8	Wolf River and Town Branch	0.25	0.04	\$0.40
FK9	West Fork Obey River	0.00	0.00	\$0.00
FK10	Indian Creek	0.00	0.00	\$0.00
FK11	Little River	0.00	0.00	\$0.00
FK12, SP1	North Fork Holston River	0.00	0.00	\$0.00
FK13, SP2	Middle Fork Holston River	0.00	0.00	\$0.00
FK14, SP3	Big Moccasin Creek	0.00	0.00	\$0.00
FK15	Copper Creek	0.50	0.08	\$0.93
FK16, SP4	Clinch River	0.50	0.08	\$0.93
FK17, SP5	Powell River	2.00	0.31	\$3.46
FK18, SP6	Nolichucky River	1.00	0.14	\$1.60
FK19	Holston River	1.00	0.14	\$14.70
FK20	French Broad River	0.00	0.00	\$0.00
FK21, SP7	Hiwassee River	0.00	0.00	\$0.00
SP8	Sequatchie River	1.00	0.14	\$1.60
SP9	Paint Rock River	0.00	0.00	\$0.00
FK22, SP10	Elk River	4.00	0.57	\$6.39
SP11	Bear Creek	0.00	0.00	\$0.00
FK23, SP12	Duck River	6.00	0.86	\$9.58
FK24, SP13	Buffalo River	2.00	0.29	\$3.19
Total		26.00	3.76	\$75.90

would be considered part of the indirect baseline and not incremental to the critical habitat designation (OSM, Knoxville Field Office, 2013).

Sand, gravel, and stone mining operations are located within 17 of the habitat unit study areas. Coal mining operations are located in the Powell River, Indian Creek, Clinch River, Big South Fork Cumberland River, and Bear Creek study areas. In addition to active mines, there have been consultations related to reclaiming an inactive coal mine in the Sequatchie River study area. To project the number of mining consultations for each habitat unit, we relied on the relevant consultation history to develop average annual consultation estimates.

We projected an estimated 218 informal consultations in the occupied habitat units over the study period, with 3 informal consultations in the unoccupied habitat units. No formal consultations were estimated for mining. We estimated the incremental costs of the proposed critical habitat designation on mining to be approximately \$132,000 in administrative costs over the next 20 years, discounting future costs at a 7 percent discount rate (table 4-10). If consultation costs related to other listed species in the unoccupied units were considered part of the baseline, the direct incremental cost would be reduced marginally to approximately \$123,000.

4.6 Federal Land Management

Federal agencies must consult with the Service regarding their land management, such as resource, pesticide, and fire management plans. The proposed critical habitat unit study areas include several National Forests, National Parks, TVA reservoirs, the Tennessee National Wildlife Refuge, and Arnold Air Force Base (table 4-11). In addition, we included statewide consultations with Federal agencies in this category, such as a consultation between the Service and USDA's Animal and Plant Health Inspection Service related to their Boll Weevil Eradication Program.

Based on stakeholder interviews, we assumed that the Service will spend, on average, 300 hours per formal and 8 hours per informal consultation (U.S. Fish and Wildlife Service, Virginia Ecological Services Southwest Virginia Field Office, 2013) and the Federal action agency will spend, on average, 94.7 hours per formal⁹ and 4 hours per informal consultation (U.S. Fish and Wildlife Service, Tennessee National Wildlife Refuge, 2013). Applying the cost-of-employment estimates described in section 2, we estimated that the administrative cost of consultations for Federal land management is \$683 for each informal consultation and \$22,466 for each formal consultation (table 4-12). As discussed in section 2.5, in occupied units, we assumed 15 percent of the administrative time is required to consider impacts to the critical

⁹ Based on an October 2012 evaluation of time spent handling Endangered Species Act-related compliance for regulatory permits (U.S. Army Corps of Engineers, Nashville District, January 25, 2013).

habitat, resulting in incremental administrative cost of consultations of \$102 for each informal consultation and \$3,370 for each formal consultation. In the three unoccupied units, the entire administrative cost is included as incremental.

Table 4-10. Mining Projected Consultations and Direct Incremental Costs by Habitat Unit

Unit ID	Unit Name	Previous Consultations Informal	Projected Consultations Informal	Direct Incremental Cost 7% Discount Rate \$1,000s
FK1	Horse Lick Creek	0.00	0.00	\$0.00
FK2	Middle Fork Rockcastle River	0.00	0.00	\$0.00
FK3	Rockcastle River	1.00	0.14	\$10.65
FK4	Buck Creek	0.00	0.00	\$0.00
FK5	Rock Creek	0.00	0.00	\$0.00
FK6	Little South Fork Cumberland River	0.00	0.00	\$0.00
FK7	Big South Fork Cumberland River	29.00	4.14	\$46.32
FK8	Wolf River and Town Branch	0.00	0.00	\$0.00
FK9	West Fork Obey River	0.00	0.00	\$0.00
FK10	Indian Creek	0.33	0.06	\$0.62
FK11	Little River	0.00	0.00	\$0.00
FK12, SP1	North Fork Holston River	0.00	0.00	\$0.00
FK13, SP2	Middle Fork Holston River	0.00	0.00	\$0.00
FK14, SP3	Big Moccasin Creek	0.00	0.00	\$0.00
FK15	Copper Creek	0.00	0.00	\$0.00
FK16, SP4	Clinch River	26.83	4.47	\$50.00
FK17, SP5	Powell River	10.83	1.78	\$19.92
FK18, SP6	Nolichucky River	0.00	0.00	\$0.00
FK19	Holston River	0.00	0.00	\$0.00
FK20	French Broad River	0.00	0.00	\$0.00
FK21, SP7	Hiwassee River	0.00	0.00	\$0.00
SP8	Sequatchie River	3.00	0.43	\$4.79
SP9	Paint Rock River	0.00	0.00	\$0.00
FK22, SP10	Elk River	0.00	0.00	\$0.00
SP11	Bear Creek	0.00	0.00	\$0.00
FK23, SP12	Duck River	0.00	0.00	\$0.00
FK24, SP13	Buffalo River	0.00	0.00	\$0.00
Total		71.00	11.02	\$132.31

Table 4-11. Federal Lands Intersecting Habitat Unit Study Areas

Unit ID	Unit Name	Intersecting Federal Lands
FK1	Horse Lick Creek	Daniel Boone National Forest
FK2	Middle Fork Rockcastle River	Daniel Boone National Forest
FK3	Rockcastle River	Daniel Boone National Forest
FK4	Buck Creek	Daniel Boone National Forest
FK5	Rock Creek	Daniel Boone National Forest, Big South Fork National River and Recreation Area
FK6	Little South Fork Cumberland River	Daniel Boone National Forest
FK7	Big South Fork Cumberland River	Daniel Boone National Forest, Big South Fork National River and Recreation Area
FK10	Indian Creek	George Washington and Jefferson National Forests
FK11	Little River	George Washington and Jefferson National Forests
FK12, SP1	North Fork Holston River	George Washington and Jefferson National Forests
FK13, SP2	Middle Fork Holston River	George Washington and Jefferson National Forests
FK16, SP4	Clinch River	George Washington and Jefferson National Forests
FK17, SP5	Powell River	George Washington and Jefferson National Forests, Cumberland Gap National Historical Park
FK18, SP6	Nolichucky River	Cherokee National Forest, Davy Crockett Lake (TVA)
FK19	Holston River	Cherokee Lake (TVA)
FK20	French Broad River	Douglas Lake (TVA), Great Smoky Mountains National Park
FK21, SP7	Hiwassee River	Cherokee National Forest, Nantahala National Forest, Apalachia, Hiwassee, and Chatuge Lakes (TVA)
FK22, SP10	Elk River	Arnold Air Force Base, Tims Ford Lake and Woods Reservoir (TVA)
SP11	Bear Creek	Natchez Trace Parkway (NPS), William B. Bankhead National Forest, Little Bear Creek Reservoir, Cedar Creek Lake, Upper Bear Creek Reservoir (TVA)
FK23, SP12	Duck River	Natchez Trace Parkway (NPS), Tennessee National Wildlife Refuge, Arnold Air Force Base, Normandy Lake (TVA)
FK24, SP13	Buffalo River	Natchez Trace Parkway (NPS), Tennessee National Wildlife Refuge

Table 4-12. Estimated Administrative Cost of Future Consultations for Federal Land Management

Parameter	Service	Action Agency	Total
Hours per Formal Consultation	300	94.7	394.7
Hours per Informal Consultation	8	4	12
Sector and Occupation	Federal—Wildlife Biologist	Federal—Wildlife Biologist	
Cost of Employment (\$/hour)	\$56.92	\$56.92	
Cost per Formal Consultation	\$17,076	\$5,390	\$22,466
Cost per Informal Consultation	\$455	\$228	\$683

Recommended project modifications for Federal land management include conducting prescribed burns outside of mussel breeding season and increasing buffers around streams where pesticide application will occur. Based on information provided by the Service and NPS, these project modifications can be incorporated into business practices without additional cost (U.S. Fish and Wildlife Service, Tennessee National Wildlife Refuge, 2013; National Park Service, Big South Fork National River and Recreation Area, 2013). To project the number of Federal management plan consultations for each habitat unit, we relied on the relevant consultation history to develop average annual consultation estimates.

We projected an estimated 220 informal and 3 formal consultations in the occupied habitat units over the study period, with 13 informal and no formal consultations in the unoccupied habitat units. We estimated the incremental costs of the proposed critical habitat designation on Federal land management to be approximately \$24,000 of administrative costs over the next 20 years, discounting future costs at a 7 percent discount rate (table 4-13). If consultation costs related to other listed species in the unoccupied units were considered part of the baseline, the direct incremental cost would be reduced to approximately \$20,000.

Table 4-13. Federal Land Management Projected Consultations and Direct Incremental Costs by Habitat Unit

Unit ID	Unit Name	Previous Consultations		Projected Annual Consultations		Direct Incremental Cost 7% Discount Rate
		Informal	Formal	Informal	Formal	\$1,000s
FK1	Horse Lick Creek	0.93	0.00	0.13	0.00	\$0.15
FK2	Middle Fork Rockcastle River	0.93	0.00	0.13	0.00	\$0.15
FK3	Rockcastle River	1.93	0.00	0.28	0.00	\$2.13
FK4	Buck Creek	0.93	0.00	0.13	0.00	\$0.15
FK5	Rock Creek	1.78	0.00	0.25	0.00	\$0.30
FK6	Little South Fork Cumberland River	1.28	0.00	0.18	0.00	\$0.21
FK7	Big South Fork Cumberland River	5.78	0.00	0.83	0.00	\$0.96
FK8	Wolf River and Town Branch	0.19	0.00	0.03	0.00	\$0.03
FK9	West Fork Obey River	0.19	0.00	0.03	0.00	\$0.03
FK10	Indian Creek	0.17	0.17	0.03	0.03	\$1.09
FK11	Little River	0.17	0.17	0.03	0.03	\$1.09
FK12, SP1	North Fork Holston River	0.17	0.17	0.03	0.03	\$1.09
FK13, SP2	Middle Fork Holston River	0.17	0.17	0.03	0.03	\$1.09
FK14, SP3	Big Moccasin Creek	0.00	0.00	0.00	0.00	\$0.00
FK15	Copper Creek	0.00	0.00	0.00	0.00	\$0.00
FK16, SP4	Clinch River	2.35	0.17	0.39	0.03	\$1.51
FK17, SP5	Powell River	0.35	0.17	0.64	0.03	\$1.81
FK18, SP6	Nolichucky River	2.35	0.00	0.34	0.00	\$0.39
FK19	Holston River	0.35	0.00	0.05	0.00	\$0.39
FK20	French Broad River	2.35	0.00	0.34	0.00	\$2.60
FK21, SP7	Hiwassee River	5.35	0.00	0.76	0.00	\$0.89
SP8	Sequatchie River	0.19	0.00	0.03	0.00	\$0.03
SP9	Paint Rock River	0.19	0.00	0.03	0.00	\$0.03
FK22, SP10	Elk River	0.35	0.00	0.05	0.00	\$0.06
SP11	Bear Creek	6.00	0.00	0.86	0.00	\$1.00
FK23, SP12	Duck River	42.35	0.00	6.05	0.00	\$7.03
FK24, SP13	Buffalo River	0.19	0.00	0.03	0.00	\$0.03
Total		77.00	1.00	11.66	0.17	\$24.27

4.7 State Water Quality Standards

EPA has authorized all five States to implement the NPDES permit program as part of the Clean Water Act. As such, relevant State agencies consult with the Service regarding their established water quality standards and permits for point sources of water pollution when there may be impacts to listed species or critical habitat.

Based on information provided by the Service and Tennessee’s Department of Environment and Conservation, most water quality standard consultations require little administrative time (U.S. Fish and Wildlife Service, Virginia Ecological Services Field Office, personal communication, January 23, 2013; Tennessee Department of Environment and Conservation, Division of Water Pollution Control, 2013). On occasion, additional time is required for public meetings, such as during the development of Total Maximum Daily Loads (TMDLs) of pollutants. For the purposes of this analysis, we assumed that the administrative time for consultations regarding water quality standards is comparable to that for the review of Federal land management (table 4-14). There have been no formal consultations related to State water quality standards. In addition, no previous consultations related solely to unoccupied study areas, so any recommended project modifications are considered part of the baseline. Therefore, as discussed in section 2.5, the incremental cost associated with critical habitat designation is 15 percent of the administrative cost of informal consultations or \$100 per consultation.

Table 4-14. Estimated Administrative Cost of Future Consultations for State Water Quality Standards

Parameter	Service	Action Agency	Total
Hours per Informal Consultation	8	4	12
Sector and Occupation	Federal—Wildlife Biologist	State—Environmental Engineer	
Cost of Employment (\$/hour)	\$56.92	\$53.10	
Cost per Informal Consultation	\$455	\$212	\$668

Based on the relevant consultation history, we projected an estimated 116 informal consultations in the occupied habitat units over the study period, with 4 informal consultations in the unoccupied habitat units. No formal consultations were estimated for State water quality standards. We estimated the incremental costs of the proposed critical habitat designation on State water quality standards to be approximately \$7,000 of administrative costs over the next 20 years, discounting future costs at a 7 percent discount rate (table 4-15).

Table 4-15. State Water Quality Standards Projected Consultations and Direct Incremental Cost by Habitat Unit

Unit ID	Unit Name	Previous Consultations	Projected Consultations	Direct Incremental Cost
		Informal	Informal	7% Discount Rate \$1,000s
FK1	Horse Lick Creek	0.50	0.07	\$0.08
FK2	Middle Fork Rockcastle River	0.50	0.07	\$0.08
FK3	Rockcastle River	0.50	0.07	\$0.08
FK4	Buck Creek	0.50	0.07	\$0.08
FK5	Rock Creek	0.69	0.10	\$0.11
FK6	Little South Fork Cumberland River	0.69	0.10	\$0.11
FK7	Big South Fork Cumberland River	0.69	0.10	\$0.11
FK8	Wolf River and Town Branch	0.69	0.10	\$0.11
FK9	West Fork Obey River	0.19	0.03	\$0.03
FK10	Indian Creek	2.00	0.33	\$0.38
FK11	Little River	2.00	0.33	\$0.38
FK12, SP1	North Fork Holston River	2.00	0.33	\$0.38
FK13, SP2	Middle Fork Holston River	5.00	0.83	\$0.95
FK14, SP3	Big Moccasin Creek	2.00	0.33	\$0.38
FK15	Copper Creek	2.00	0.33	\$0.38
FK16, SP4	Clinch River	8.19	1.36	\$1.54
FK17, SP5	Powell River	6.19	1.03	\$1.17
FK18, SP6	Nolichucky River	0.69	0.10	\$0.11
FK19	Holston River	0.19	0.03	\$0.03
FK20	French Broad River	0.69	0.10	\$0.11
FK21, SP7	Hiwassee River	0.19	0.03	\$0.03
SP8	Sequatchie River	0.19	0.03	\$0.03
SP9	Paint Rock River	0.19	0.03	\$0.03
FK22, SP10	Elk River	0.19	0.03	\$0.03
SP11	Bear Creek	0.00	0.00	\$0.00
FK23, SP12	Duck River	0.19	0.03	\$0.03
FK24, SP13	Buffalo River	0.19	0.03	\$0.03
Total		37.00	5.98	\$6.79

4.8 Restoration and Conservation

Conservation projects that receive Federal funding, such as State Wildlife Grants provided through Congressional appropriations, must consult with the Service. In addition, stream restoration projects may require permits under Sections 401, 402, and 404 of the Clean Water Act from the Corps and EPA or EPA's delegate. Projects that take place along waterways within the Tennessee River system also require a permit from TVA under Section 26a of the Tennessee Valley Authority Act.

Project proponents for restoration and conservation actions may be the Service or other Federal agencies, State agencies, nongovernment conservation organizations such as The Nature Conservancy, or private citizens. To estimate the administrative costs of future consultations for restoration and conservation, we assumed consultations require the same level of effort and distribution across Federal and private entities as those for commercial, industrial, residential, and associated utility development consultations (table 4-6). Recommended project modifications for restoration and conservation projects are typically recommendations to conduct the work outside of breeding seasons or to conduct the work in sections of stream that can be incorporated at negligible cost to the project. Other project modifications, such as bypassing flow around work areas, are business as usual to comply with existing water quality permit requirements and are considered part of the indirect baseline (Tennessee Valley Authority, February 5, 2013). Although we assumed no additional project modification costs associated with the listing or critical habitat designation, projects associated with formal consultations will require a \$25,000 mussel survey, and informal consultations will require a \$2,500 mussel survey,¹⁰ which is considered an incremental cost in unoccupied units.

To project the number of restoration and conservation consultations for each habitat unit, we relied on the relevant consultation history to develop average annual consultation estimates. We projected an estimated 134 informal and 6 formal consultations in the occupied habitat units over the study period, with 25 informal and no formal consultations in the unoccupied habitat units. Based on this projection, we estimated the incremental costs of the proposed critical habitat designation on conservation and restoration to be approximately \$221,000 over the next 20 years, discounting future costs at a 7 percent discount rate (table 4-16). Total incremental administrative costs in occupied units are approximately \$92,000. Incremental administrative costs in unoccupied units were estimated to be approximately \$94,000 with approximately

¹⁰ Based on an October 2012 evaluation of time spent handling Endangered Species Act-related compliance for regulatory permits (U.S. Army Corps of Engineers, Nashville District, January 25, 2013).

Table 4-16. Restoration and Conservation Projected Consultations and Direct Incremental Costs by Habitat Unit

Unit ID	Unit Name	Conservation Easements (Acres)	Previous Consultations		Projected Annual Consultations		Direct Incremental Cost
			Informal	Formal	Informal	Formal	7% Discount Rate \$1,000s
FK1	Horse Lick Creek	512	1.75	0.00	0.25	0.00	\$2.80
FK2	Middle Fork Rockcastle River	85	1.25	0.00	0.18	0.00	\$2.00
FK3	Rockcastle River	0	5.08	0.00	0.73	0.00	\$74.71
FK4	Buck Creek	348	3.25	0.00	0.46	0.00	\$5.19
FK5	Rock Creek	0	1.44	0.00	0.21	0.00	\$2.30
FK6	Little South Fork Cumberland River	0	3.27	0.00	0.47	0.00	\$5.22
FK7	Big South Fork Cumberland River	107	4.27	0.00	0.61	0.00	\$6.82
FK8	Wolf River and Town Branch	157	1.44	0.00	0.21	0.00	\$2.30
FK9	West Fork Obey River	0	0.19	0.00	0.03	0.00	\$0.30
FK10	Indian Creek	1,749	1.00	0.50	0.17	0.08	\$6.39
FK11	Little River	13,839	0.00	0.00	0.00	0.00	\$0.00
FK12, SP1	North Fork Holston River	1,677	0.00	0.00	0.00	0.00	\$0.00
FK13, SP2	Middle Fork Holston River	1,078	0.00	0.00	0.00	0.00	\$0.00
FK14, SP3	Big Moccasin Creek	196	0.00	0.00	0.00	0.00	\$0.00
FK15	Copper Creek	90	0.50	0.00	0.08	0.00	\$0.93
FK16, SP4	Clinch River	7,115	2.69	1.50	0.42	0.23	\$16.99
FK17, SP5	Powell River	3,509	1.19	0.00	0.64	0.00	\$7.19
FK18, SP6	Nolichucky River	1,219	0.35	0.00	0.05	0.00	\$0.57
FK19	Holston River	1,134	1.35	0.00	0.19	0.00	\$19.90
FK20	French Broad River	437	2.35	0.00	0.34	0.00	\$34.60
FK21, SP7	Hiwassee River	987	0.35	0.00	0.05	0.00	\$0.57
SP8	Sequatchie River	119	1.19	0.00	0.17	0.00	\$1.90
SP9	Paint Rock River	3,559	3.19	0.00	0.46	0.00	\$5.09
FK22, SP10	Elk River	4,353	2.35	0.00	0.34	0.00	\$3.76
SP11	Bear Creek	490	5.00	0.00	0.71	0.00	\$7.99
FK23, SP12	Duck River	11,364	7.35	0.00	1.05	0.00	\$11.75
FK24, SP13	Buffalo River	865	1.19	0.00	0.17	0.00	\$1.90
Total		54,989	52.00	2.00	7.97	0.31	\$221.14

\$120,000 for mussel surveys and an additional \$36,000 for mussel surveys. If consultation costs related to other listed species in the unoccupied units were considered part of the baseline, the direct incremental cost would be reduced to approximately \$106,000.

Although the costs of consultations described above represent the direct baseline cost of listing the species and designating critical habitat, all actions to conserve and restore these habitat units and upland areas should be considered indirect costs of the listing and habitat designation. Notable conservation efforts in the study areas include the Wolf River Greenway (Wolf River Conservancy, 2012), the Copper Creek Cooperative Conservation Partnership Initiative (U.S. Fish and Wildlife Service, 2012a), the Powell River Preserve (Tennessee Department of Environment and Conservation, 2012), and a variety of other efforts by Federal, State, nonprofit conservation organizations, and private citizens. Based on data in the National Conservation Easement Database (2012), there are approximately 55,000 acres in conservation easements within these habitat study areas.

SECTION 5

BENEFITS

The incremental benefit of the critical habitat designation is primarily the value of the information provided by defining the PCEs of fluted kidneyshell and slabside pearlymussel habitat necessary for the species survival and recovery. To the extent that this information decreases the probability of species extinction, this contributes to the nonuse preservation value enjoyed by society. An additional benefit of the proposed designation is the potential for benefits to other threatened and endangered species and other biota co-occurring or found in similar habitats as the fluted kidneyshell and slabside pearlymussel.

Baseline benefits stem from both the presence of the mussels and the additional protection provided to the riparian zone and stream bed. Freshwater mussels filter the water column removing suspended particulates that contribute to water turbidity. Mussel beds provide habitat for other members of the benthic community especially macroinvertebrates including other molluscs, worms and aquatic insects, thereby enhancing the biological diversity of the stream. Mussel density is associated with increased density of other macroinvertebrates (Vaughn and Spooner, 2006). It has been demonstrated that mussels effectively transfer nutrients from the water column to the sediment, supporting interconnected food webs (Vaughn et al., 2008) that may provide for stream community stability (Folke et al., 2004). There is recent research that suggests mussel diversity is associated with energy flows between aquatic and terrestrial systems (Allen et al., 2012), which could further enhance riparian community stability.

The protections for aquatic species under the Act promote enhanced vegetation in riparian communities. Riparian vegetation is now recognized as providing a number of ecological services. The vegetation itself acts as a filter reducing the flow of nutrients and contaminants from agricultural fields and roads. Stream flows tend to be more stable, which reduces the risk of channel and bank erosion. Stabilized banks allow greater use of the riparian zone by birds, insects, small and large mammals. Reduced bank erosion results in less sediment on the stream bottoms, where gravel beds important for both fish and aquatic insects are less likely to become smothered. Stable benthic communities appear to efficiently recycle and use nutrients (Sweeney et al., 2004; Covich et al., 1999), providing downstream benefits by reducing eutrophication. There is a growing body of evidence that stable, natural communities, such as might be developed in areas protected by the Act, are more resilient and better able to survive pressures from some level of stream modification as well as climate change (Folke et al., 2004; Gunderson, 2000).

Riparian vegetation provides litter for stream metabolism and, especially trees, help to keep stream temperatures low, which in turn benefits fishes. The recreational opportunities for anglers are enhanced, by supporting certain game fish, enhancing fish diversity, and providing an aesthetically appealing site for fishing. This same aesthetically appealing stream also may enhance the value to canoers and kayakers and swimmers. Vegetated stream banks provide habitat for avian fauna that in turn provide recreational opportunities for bird watchers as well as providing enhanced pest control in any neighboring agricultural fields.

Finally, it is important to recognize that critical habitat designation results in more stream reaches that remain or re-attain a more natural state thereby providing *in situ* locations for scientific investigation and understanding. We assume that these benefits are part of the baseline in occupied habitat units and incremental in the unoccupied habitat units, however the presence of other listed aquatic species in the unoccupied habitat units is likely to generate these benefits in the absence of critical habitat designation.

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APPENDIX A:
REGULATORY FLEXIBILITY AND ENERGY IMPACT SCREENING ANALYSES

Appendix A investigates the possibility of significant incremental adverse effects resulting from the designation of critical habitat to small entities (small businesses, small organizations, and small governments) and the supply, distribution, and use of energy. The goal of these analyses is to consider whether a Regulatory Flexibility Analysis or Statement of Energy Effects will be required for this rulemaking.

A.1 Potential Impacts to Small Entities

The Small Business Regulatory Enforcement Fairness Act (SBREFA) requires that the Service determine whether small entities will be significantly adversely affected by the designation of critical habitat. If there is the potential for a significant impact on a substantial number of small entities (SISNOSE), the Service must prepare a Regulatory Flexibility Analysis, as described in section 4 of this analysis, which estimates total incremental impacts. This appendix focuses exclusively on economic activities for which it is possible for the project proponent, or third party, to be a small entity.

Federal and State agencies are automatically disqualified from this characterization. The following activities will not be analyzed based on this criterion:

- Road maintenance and construction: Project proponents are expected to be State DOT organizations.
- Dam operation: All dams within the study area are operated by TVA, a Federal corporation.
- Federal land management: All incremental costs will be incurred by Federal agencies.
- Water quality standards: Project proponents are expected to be State organizations.

The remaining potentially affected sectors include (1) commercial, industrial, residential, and associated utility development; (2) agricultural and recreational development; (3) mining; and (4) restoration and conservation. The following small entity analysis reflects incremental Section 7 consultation costs to project proponents as described in section 4. Section 4 provides cost estimates for project proponents per consultations and the projected frequency of consultations in the future. Impacts are assessed from 2013 to 2032, assuming a 7 percent discount rate as described in section 2.

A significant economic impact threshold is generally a 3 percent impact as measured by appropriate quantitative metrics, such as annualized cost of compliance as a percentage of sales, government revenue, or annual operating expenditures. In general, if greater than 20 percent of the affected small entities experience a significant economic impact, then there is considered to be a SISNOSE, and a Regulatory Flexibility Analysis must be prepared (U.S. EPA, 2006). For the purposes of the screening analysis, we conservatively assumed that small entities would be incur all project proponent costs.

A.1.1 Occupied Habitat Units

In occupied habitat units within the study area, the costs incurred were assumed to be limited to 15 percent of the project proponent's administrative cost of each projected formal or informal Section 7 consultation: \$1,524 per formal consultation and \$571 per informal consultation. These costs do not cross the threshold into significant impacts on small entities.

A.1.2 Unoccupied Habitat Units

In habitat units that are currently unoccupied by the mussels¹ but occupied by other listed aquatic species, the economic analysis assumed that project proponent costs included the entire cost of each consultation and the cost of all required project modifications. All projected Section 7 consultations for these activities are informal. The total incremental cost incurred by project proponents over the study time period based on information in section 4 is listed below by economic activity. This analysis finds a worst case scenario of approximately \$908,000 in impacts to all small businesses within the study region over 20 years, discounted at 7 percent (table A-1). This represents an annualized cost of approximately \$85,736 across all entities with the vast majority of the incremental costs associated with project modifications for development projects.

However, we recognize that the unoccupied units are already occupied by other listed mussel species that are unlikely to be delisted in the near future. Therefore, consultation costs and project modifications are expected to occur as a result of these other listed species and not the critical habitat designation. As with the occupied habitat unit analysis above, it is unlikely that increased annual costs at these levels will have a significant impact on small entities. Thus, we do not anticipate significant adverse impacts to small entities in either occupied or unoccupied habitat units.

¹ Rockcastle River, Holston River, and French Broad River

Table A-1. Incremental Costs Over 20 Years Discounted at 7% for Project Proponents in Unoccupied Habitat Units

Economic Activity	Incremental Cost
Commercial, Industrial, Residential and Associated Utility Development	\$785,802
Agricultural and Recreational Development	\$26,395
Mining	\$6,169
Restoration and Conservation	\$89,927
Total	\$908,293

A.2 Potential Impacts to Energy Industry

In accordance with Executive Order No. 13211 (Office of Management and Budget, 2001), the Service must determine whether the proposed critical habitat designation is expected to have a significant adverse effect on energy supply, distribution, or use. The following section describes our screening analysis of potential impacts to energy supply and distribution relative to significant adverse effect thresholds set forth by the Office of Management and Budget (table A-2).

Table A-2. Significant Adverse Effects to U.S. Energy Sector

Energy Source	Outcome
Crude Oil	Reductions in crude oil supply in excess of 10,000 barrels per day
Natural Gas	Reductions in natural gas production in excess of 25 million cubic feet (mcf) per year
Fuel	Reductions in fuel production in excess of 4,000 barrels per day
Coal	Reductions in coal production in excess of 5 million tons per year
Electricity Production	Reductions in electricity production in excess of 1 billion kilowatt-hours per year or in excess of 500 megawatts of installed capacity
Cost of Energy Production	Increases in the cost of energy production in excess of one percent Increases in the cost of energy distribution in excess of one percent

A.2.1 Coal

Coal production within study area counties has declined by an average annual rate of 4.9 percent. In 2011, total coal production, including both underground and surface mining, was 15 million tons (table A-3) (U.S. Energy Information Administration, 2012a), down from more than 19 million tons in 2007 (U.S. Energy Information Administration, 2009).

Table A-3. Historical Coal Production in Study Area Counties, 2007 to 2011 (thousand short tons)

State	County	Habitat Unit(s)	2007	2008	2009	2010	2011
Alabama	Franklin	Bear Creek	153	297	158	110	198
	Winston	Bear Creek	738	616	429	685	697
Tennessee	Anderson	Big South Fork Cumberland River	121	185	224	295	250
	Campbell	Big South Fork Cumberland River	728	796	870	931	836
Virginia	Dickenson	Clinch River	2,140	2,070	1,385	1,059	1,332
	Lee	Clinch River, Powell River	807	1,156	634	514	510
	Russell	Clinch River, Powell River ^a	1,073	1,134	1,031	726	881
	Tazewell	Indian Creek ^b	1,168	745	836	943	1,119
	Wise	Clinch River, Powell River	12,385	11,169	10,334	10,258	9,214
Study Area			19,313	18,168	15,901	15,521	15,037

^a Russell County contains other habitat units, but no coal production takes place within these units.

^b Tazewell County contains other habitat units, but no coal production takes place within these units.

Source: U.S. Energy Information Administration. 2012e. "Profile Overview by State, Coal Mines Map." Available at <http://www.eia.gov/beta/state/>. Accessed January 18, 2013.

All coal production within the study area occurs within five habitat units: Bear Creek, Big South Fork Cumberland River, Clinch River, Powell River, and Indian Creek. Although other counties are intersected by additional habitat units, no active coal mines fall within the study area outside of these five units (U.S. Energy Information Administration, 2012e). Each of these habitat units is occupied by the fluted kidneyshell or slabside pearlymussel. The units are also occupied by and have been previously designated critical habitat for other listed mussels (U.S. Fish and Wildlife Service, 2004). In particular, Bear Creek has no history of consultations, and we forecasted no consultations in the future. For the remaining coal-producing units, the incremental cost of the proposed critical habitat designation will be the 15 percent additional administrative time per consultation to consider impacts to critical habitat, as outlined in section 4.5. The analysis estimates that this will lead to a total cost of approximately \$132,000 for the entire study area over the next 20 years, assuming a 7 percent discount rate. Eleven consultations are anticipated annually. Communications with State and Federal mining regulatory agencies indicate that the bulk of water quality measures required for critical habitat designation for the mussels are already implemented under existing legislation and guidelines, including the Clean Water Act, State laws such as Tennessee's Responsible Miner's Act, and permitting requirements (Office of Surface Mining Reclamation and Enforcement, Knoxville Field Office,

2013).² Based on these estimated costs and the existing regulatory systems, we do not expect that the proposed designation of critical habitat would reduce coal production by 5 million tons (nearly 33 percent of current levels).

A.2.2 Crude Oil and Natural Gas

Crude oil production in the States containing proposed critical habitat is relatively low. Production in 2011 was well below 10,000 barrels per day for North Carolina, Tennessee, and Virginia (table A-4).

Table A-4. Historical Crude Oil Production, 2007 to 2011 (barrels per day)

State	2007	2008	2009	2010	2011
Alabama	21,000	20,000	21,000	20,000	19,000
Kentucky	6,000	7,000	7,000	7,000	7,000
Mississippi	50,000	57,000	63,000	65,000	66,000
North Carolina	0	0	0	0	0
Tennessee	1,000	1,000	1,000	1,000	1,000
Virginia	0	0	0	0	0

Source: U.S. Energy Information Administration. 2012. “Crude Oil Production.” Available at http://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbbldpd_a.htm. Accessed January 21, 2013.

In Alabama, only a small portion of the Bear Creek unit overlaps the Black Warrior Basic Region oil and gas production area in Franklin County. The northern portion of the State contains no active oil and gas production areas (Alabama State Oil and Gas Board, 2013). It is unlikely that a substantial portion of Alabama production takes place within this limited region. Similarly, the Bear Creek unit overlaps small portions of Tishomingo and Itawamba Counties in Mississippi, but these counties produced no crude oil in 2001 (Mississippi Department of Environmental Quality, 2002), and the unit overlaps only mines that have been abandoned (Mississippi State Oil and Gas Board, 2013). Kentucky crude oil production within the counties containing some portion of a habitat unit is minimal, ranging from 187 to 220 barrels per day since 2006 (Kentucky Geological Survey, 2013).

Natural gas production is higher than crude oil production, but significant amounts occur only within study area counties in Virginia (table A-5).

² Office of Surface Mining Reclamation and Enforcement, Knoxville Field Office, personal communication, February 5, 2013.

Table A-5. Historical Natural Gas Production, 2007 to 2011 (mcf)

State	2007	2008	2009	2010	2011
Alabama	265,155,000	250,576,000	240,662,000	218,797,000	203,873,000
Kentucky	93,068,000	93,480,000	111,715,000	110,030,000	130,754,000
Mississippi	45,869,000	60,363,000	85,795,000	69,803,000	55,316,000
North Carolina	0	0	0	0	0
Tennessee	2,663,000	3,942,000	4,700,000	5,478,000	4,638,000
Virginia	103,027,000	112,057,000	128,454,000	140,738,000	147,255,000

Source: U.S. Energy Information Administration. 2012d. "Natural Gas Withdrawals and Production." Available at http://www.eia.gov/dnav/ng/ng_prod_sum_dc_u_NUS_a.htm. Accessed January 21, 2013.

The habitat units cover only small portions of both Alabama and Mississippi, and habitat designation here is unlikely to disrupt the bulk of natural gas operations. Tishomingo and Itawamba Counties in Mississippi produced only 52,413 mcf of natural gas in 2001 (Mississippi Department of Environmental Quality, 2002) compared with the State-level production of 92,087,000 mcf (U.S. Energy Information Administration, 2012d). Kentucky natural gas production within the counties containing some portion of a habitat unit was 2,587,022 mcf consistent with the historical trend (Kentucky Geological Survey, 2013).

Study area counties within Virginia accounted for more than 68 mcf of natural gas production in 2010 (Virginia Department of Mines Minerals and Energy, 2011); however, all of this production occurred in the occupied Clinch River, Powell River, and Indian Creek habitat units. Each of these habitat units is occupied by the fluted kidneyshell or slabside perlymussel. The units are also occupied by and have been previously designated critical habitat for other listed species. Consultations for natural gas production have been required in the past but only in the Big South Fork Cumberland River habitat unit. We do not anticipate future consultations related to these wells because 39 oil and gas wells near habitat in this unit have been capped and retired (National Park Service, Big South Fork National River and Recreation Area. January 23, 2013). Future consultations are a possibility given recent interest in natural gas fracking and the area's mineral richness, although projecting these costs is not possible given the inherent uncertainty in this new area. Based on production levels occurring with the habitat units and consultation history for this activity, we do not expect that the proposed designation of critical habitat would reduce coal production by 25 million mcf (37 percent of current levels).

Electricity Production

Four operating hydroelectric dams are contained within the habitat units in North Carolina and Tennessee. The combined capacity for the dams is 454 MWs (table A-6).

Hydroelectric production is rising at each dam at a regional average of 16 percent per year, reaching 1,168,915 MWh of net generation in 2011 (table A-7) (U.S. Energy Information Administration, 2012f; Federal Energy Regulatory Commission, 2013; U.S. Army Corps of Engineers, 2013).

Table A-6. Capacity of Hydroelectric Dams in Study Area Counties (megawatts)

Dam Name	State	Utility	Habitat Unit	Capacity (MW)
Apalachia	North Carolina	TVA	Hiwassee River	82
Tims Ford	Tennessee	TVA	Elk River	40.2
Cherokee	Tennessee	TVA	Holsten River	153.4
Douglas	Tennessee	TVA	French Broad River	177.9
Total Capacity				453.5

Source: U.S. Energy Information Administration. 2012f. "Profile Overview by State, Hydro Power Plants Map." Available at <http://www.eia.gov/beta/state/>. Accessed January 20, 2013.

Table A-7. Historical Hydroelectric Net Generation in Study Area Counties, 2007 to 2011 (megawatt-hours)

Dam Name	2007	2008	2009	2010	2011
Apalachia	217,877	204,629	429,700	398,680	302,380
Tims Ford	7,214	31,341	65,394	46,712	50,419
Cherokee	158,230	153,428	375,408	283,637	409,115
Douglas	174,213	191,097	441,437	348,019	407,001
Total Generation	557,534	580,495	1,311,939	1,077,048	1,168,915

Source: U.S. Energy Information Administration. 2012c. "Electricity Data Browser." Available at <http://www.eia.gov/beta/enerdat>. Accessed January 20, 2013.

Two of the dams lie within occupied habitat units. Together these dams accounted for 123 MW (27 percent) of capacity and 352,799 MWh (30 percent) of net generation in 2011. Impacts to capacity are unlikely because habitat designation will not lead to closing any of the facilities. Given that these units are all occupied by the mussels, the incremental increase in administrative costs for each Section 7 consultation due to critical habitat designation is not likely to reduce generation.

The two remaining dams, Cherokee Dam and Douglas Dam in Tennessee, are contained within unoccupied habitat units. Capacity for these is 331 MW and net generation in 2011 was 816,116 MWh. Historically, these facilities have increased production annually by an average of 19.7 percent, indicating that current generation levels are likely nearly 1 billion kWh per year.

Again, critical habitat designation is not expected to result in the closure of any hydroelectric facilities, so impacts to generation capacity are not anticipated. TVA already operates these dams at reduced flow to meet habitat requirements for other aquatic species associated with the indirect baseline (Tennessee Valley Authority, January 31, 2013). Further, compliance with its own internal reservoir releases improvement program necessitates mitigation practices to increase dissolved-oxygen levels and wetted habitat in dam tailwaters (Tennessee Valley Authority, 2013). Total incremental costs to hydroelectric dams associated with critical habitat designation were estimated at approximately \$21,000 over 20 years at a 7 percent discount rate, assuming 0.14 formal and 0.43 informal consultations per year. Based on these estimated costs and the existing regulatory systems, we do not expect that the proposed designation of critical habitat will result in significant decreases in total generation.

Cost of Energy Production

The energy analysis above highlights no significant adverse impacts to energy production in any of the major sectors. Based on this, it is unlikely that the national cost of energy production or distribution will increase by 1 percent as a result of critical habitat designation.

**APPENDIX B:
ADDITIONAL RESULTS**

Table B-1. Estimated Undiscounted Incremental Costs of the Proposed Critical Habitat Designation by Study Area and Economic Activity over 20 Years (\$1,000s)

Unit ID	Unit Name	Road Maintenance and Construction	Commercial, Industrial, Residential, and Associated Utility Development	Mining	Agricultural and Recreational Development	Federal Management Plan Administration	Dam Operation	State Water Quality Standards	Restoration and Conservation	Total
FK1	Horse Lick Creek	\$0.00	\$2.01	\$0.00	\$1.64	\$0.27	\$0.00	\$0.14	\$4.93	\$9.00
FK2	Middle Fork Rockcastle River	\$6.34	\$4.92	\$0.00	\$1.64	\$0.27	\$0.00	\$0.14	\$3.52	\$16.85
FK3	Rockcastle River	\$881.10	\$381.18	\$18.79	\$41.06	\$3.76	\$0.00	\$0.14	\$131.81	\$1,457.85
FK4	Buck Creek	\$39.95	\$7.18	\$0.00	\$0.70	\$0.27	\$0.00	\$0.14	\$9.16	\$57.41
FK5	Rock Creek	\$0.00	\$5.38	\$0.00	\$4.93	\$0.52	\$0.00	\$0.20	\$4.05	\$15.09
FK6	Little South Fork Cumberland River	\$6.35	\$1.08	\$0.00	\$0.70	\$0.38	\$0.00	\$0.20	\$9.22	\$17.93
FK7	Big South Fork Cumberland River	\$70.55	\$37.51	\$81.73	\$7.75	\$1.69	\$0.00	\$0.20	\$12.04	\$211.47
FK8	Wolf River and Town Branch	\$4.98	\$0.68	\$0.00	\$0.70	\$0.05	\$0.00	\$0.20	\$4.05	\$10.67
FK9	West Fork Obey River	\$1.75	\$1.88	\$0.00	\$0.00	\$0.05	\$0.00	\$0.05	\$0.53	\$4.27
FK10	Indian Creek	\$34.99	\$14.30	\$1.10	\$0.00	\$1.93	\$0.00	\$0.67	\$11.28	\$64.26
FK11	Little River	\$0.00	\$5.81	\$0.00	\$0.00	\$1.93	\$0.00	\$0.67	\$0.00	\$8.41
FK12, SP1	North Fork Holston River	\$0.00	\$7.40	\$0.00	\$0.00	\$1.93	\$0.00	\$0.67	\$0.00	\$10.00
FK13, SP2	Middle Fork Holston River	\$22.90	\$6.66	\$0.00	\$0.00	\$1.93	\$0.00	\$1.67	\$0.00	\$33.16
FK14, SP3	Big Moccasin Creek	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.67	\$0.00	\$0.67
FK15	Copper Creek	\$11.43	\$0.00	\$0.00	\$1.64	\$0.00	\$0.00	\$0.67	\$1.64	\$15.38
FK16, SP4	Clinch River	\$64.77	\$121.56	\$88.22	\$1.64	\$2.67	\$0.00	\$2.72	\$29.97	\$311.56

(continued)

B-1

Table B-1. Estimated Undiscounted Incremental Costs of the Proposed Critical Habitat Designation by Study Area and Economic Activity over 20 Years (\$1,000s) (continued)

Unit ID	Unit Name	Road Maintenance and Construction	Commercial, Industrial, Residential, and Associated Utility Development	Mining	Agricultural and Recreational Development	Federal Management Plan Administration	Dam Operation	State Water Quality Standards	Restoration and Conservation	Total
FK17, SP5	Powell River	\$23.28	\$13.06	\$35.15	\$6.11	\$3.19	\$0.00	\$2.06	\$12.68	\$95.52
FK18, SP6	Nolichucky River	\$19.86	\$15.54	\$0.00	\$2.82	\$0.69	\$1.50	\$0.20	\$1.00	\$41.60
FK19	Holston River	\$786.03	\$762.77	\$0.00	\$25.93	\$0.69	\$10.01	\$0.05	\$35.11	\$1,620.60
FK20	French Broad River	\$1,193.34	\$502.79	\$0.00	\$0.00	\$4.59	\$10.01	\$0.20	\$61.04	\$1,771.98
FK21, SP7	Hiwassee River	\$0.00	\$3.53	\$0.00	\$0.00	\$1.57	\$1.50	\$0.05	\$1.00	\$7.65
SP8	Sequatchie River	\$0.00	\$11.68	\$8.45	\$2.82	\$0.05	\$0.00	\$0.05	\$3.35	\$26.41
SP9	Paint Rock River	\$7.78	\$0.00	\$0.00	\$0.00	\$0.05	\$0.00	\$0.05	\$8.98	\$16.87
FK22, SP10	Elk River	\$26.69	\$30.82	\$0.00	\$11.27	\$0.10	\$7.05	\$0.05	\$6.63	\$82.63
SP11	Bear Creek	\$25.83	\$0.00	\$0.00	\$0.00	\$1.76	\$1.50	\$0.00	\$14.09	\$43.18
FK23, SP12	Duck River	\$252.70	\$41.70	\$0.00	\$16.91	\$12.40	\$1.50	\$0.05	\$20.73	\$345.99
FK24, SP13	Buffalo River	\$6.18	\$2.81	\$0.00	\$5.64	\$0.05	\$0.00	\$0.05	\$3.35	\$18.08
Total		\$3,486.81	\$1,982.27	\$233.44	\$133.92	\$42.82	\$33.07	\$11.97	\$390.17	\$6,314.45

B-2

Table B-2. Estimated Undiscounted Incremental Costs of the Proposed Critical Habitat Designation by Study Area and Economic Activity over 20 Years Using a 3% Discount Rate (\$1,000s)

Unit ID	Unit Name	Road Maintenance and Construction	Commercial, Industrial, Residential, and Associated Utility Development	Mining	Agricultural and Recreational Development	Federal Management Plan Administration	Dam Operation	State Water Quality Standards	Restoration and Conservation	Total
FK1	Horse Lick Creek	\$0.00	\$1.54	\$0.00	\$1.26	\$0.21	\$0.00	\$0.11	\$3.78	\$6.89
FK2	Middle Fork Rockcastle River	\$4.85	\$3.76	\$0.00	\$1.26	\$0.21	\$0.00	\$0.11	\$2.70	\$12.89
FK3	Rockcastle River	\$672.26	\$290.83	\$14.39	\$31.46	\$2.88	\$0.00	\$0.11	\$100.99	\$1,112.93
FK4	Buck Creek	\$30.39	\$5.47	\$0.00	\$0.54	\$0.21	\$0.00	\$0.11	\$7.02	\$43.73
FK5	Rock Creek	\$0.00	\$4.12	\$0.00	\$3.78	\$0.40	\$0.00	\$0.15	\$3.10	\$11.55
FK6	Little South Fork Cumberland River	\$4.85	\$0.83	\$0.00	\$0.54	\$0.29	\$0.00	\$0.15	\$7.06	\$13.72
FK7	Big South Fork Cumberland River	\$53.87	\$28.65	\$62.62	\$5.94	\$1.30	\$0.00	\$0.15	\$9.22	\$161.74
FK8	Wolf River and Town Branch	\$3.81	\$0.52	\$0.00	\$0.54	\$0.04	\$0.00	\$0.15	\$3.10	\$8.16
FK9	West Fork Obey River	\$1.33	\$1.43	\$0.00	\$0.00	\$0.04	\$0.00	\$0.04	\$0.40	\$3.25
FK10	Indian Creek	\$26.73	\$10.92	\$0.84	\$0.00	\$1.48	\$0.00	\$0.51	\$8.64	\$49.12
FK11	Little River	\$0.00	\$4.44	\$0.00	\$0.00	\$1.48	\$0.00	\$0.51	\$0.00	\$6.43
FK12, SP1	North Fork Holston River	\$0.00	\$5.66	\$0.00	\$0.00	\$1.48	\$0.00	\$0.51	\$0.00	\$7.65
FK13, SP2	Middle Fork Holston River	\$17.53	\$5.10	\$0.00	\$0.00	\$1.48	\$0.00	\$1.28	\$0.00	\$25.38
FK14, SP3	Big Moccasin Creek	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.51	\$0.00	\$0.51
FK15	Copper Creek	\$8.74	\$0.00	\$0.00	\$1.26	\$0.00	\$0.00	\$0.51	\$1.26	\$11.78

(continued)

Table B-2. Estimated Undiscounted Incremental Costs of the Proposed Critical Habitat Designation by Study Area and Economic Activity over 20 Years Using a 3% Discount Rate (\$1,000s) (continued)

Unit ID	Unit Name	Road Maintenance and Construction	Commercial, Industrial, Residential, and Associated Utility Development	Mining	Agricultural and Recreational Development	Federal Management Plan Administration	Dam Operation	State Water Quality Standards	Restoration and Conservation	Total
FK16, SP4	Clinch River	\$49.55	\$93.00	\$67.60	\$1.26	\$2.04	\$0.00	\$2.09	\$22.96	\$238.50
FK17, SP5	Powell River	\$17.78	\$9.97	\$26.93	\$4.68	\$2.44	\$0.00	\$1.58	\$9.72	\$73.10
FK18, SP6	Nolichucky River	\$15.12	\$11.83	\$0.00	\$2.16	\$0.53	\$1.15	\$0.15	\$0.76	\$31.70
FK19	Holston River	\$598.58	\$580.87	\$0.00	\$19.87	\$0.53	\$7.67	\$0.04	\$26.90	\$1,234.46
FK20	French Broad River	\$903.54	\$380.69	\$0.00	\$0.00	\$3.52	\$7.67	\$0.15	\$46.77	\$1,342.33
FK21, SP7	Hiwassee River	\$0.00	\$2.68	\$0.00	\$0.00	\$1.20	\$1.15	\$0.04	\$0.76	\$5.84
SP8	Sequatchie River	\$0.00	\$8.92	\$6.48	\$2.16	\$0.04	\$0.00	\$0.04	\$2.56	\$20.20
SP9	Paint Rock River	\$5.92	\$0.00	\$0.00	\$0.00	\$0.04	\$0.00	\$0.04	\$6.88	\$12.88
FK22, SP10	Elk River	\$20.30	\$23.44	\$0.00	\$8.64	\$0.08	\$6.70	\$0.04	\$5.08	\$64.29
SP11	Bear Creek	\$19.71	\$0.00	\$0.00	\$0.00	\$1.35	\$1.15	\$0.00	\$10.80	\$33.00
FK23, SP12	Duck River	\$191.42	\$31.59	\$0.00	\$12.96	\$9.50	\$1.15	\$0.04	\$15.88	\$262.54
FK24, SP13	Buffalo River	\$4.74	\$2.15	\$0.00	\$4.32	\$0.04	\$0.00	\$0.04	\$2.56	\$13.85
Total		\$2,651.02	\$1,508.40	\$178.86	\$102.61	\$32.81	\$26.63	\$9.17	\$298.94	\$4,808.44

B-4