June 17, 2014

Mr. John T. Baxter
Manager, Endangered Species Act Compliance
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, Tennessee 37902 – 1499

Lt. Colonel John L. Hudson
District Engineer
U.S. Army Corps of Engineers, Regulatory Branch
3701 Bell Road
Nashville, Tennessee 37214

Re: FWS #2014-F-0219. Section 7 Consultation and Conference Opinion for Proposed Construction and Operation of a Water Intake and Treatment Facility at Elk River Mile 75.3 in Lincoln County, Tennessee.

Dear Mr. Baxter:

This document is the biological opinion of the U.S. Fish and Wildlife Service (Service) based on our review of the Lincoln County Board of Public Utilities (LCBPU) Proposed Lincoln County Water Intake and Treatment Facility in Lincoln County, Tennessee, and its effects to the endangered boulder darter (*Etheostoma wapiti*), and designated critical habitat for the slabside pearlymussel (*Pleuronaia dolabelloides*) and fluted kidneyshell (*Ptychobranchus subtentum*), per section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). Your January 28, 2014, request for formal consultation was received on February 3, 2014.

Although prohibitions against take in section 9 of the Act do not apply until a species is federally listed as threatened or endangered, in response to the Tennessee Valley Authority's (TVA) request for a conference review of the potential effects on the northern long-eared bat (*Myotis septentrionalis*) (included with your January 28, 2014, request for formal consultation), a conference report on the proposed for federal listing as endangered northern long-eared bat is incorporated into this biological opinion. Hereinafter, in this document, the biological opinion, including the conference report, as described here, will solely be referred to as the biological opinion.

This biological opinion is based on information provided in a biological assessment, received by the Service on February 3, 2014, and other sources of information. A complete administrative record of this consultation is on file and available for review at the Tennessee Ecological Services Field Office, 446 Neal Street, Cookeville, Tennessee 38501.

Consultation History

01-10-11 The TVA, the federal lead agency, coordinated an interagency telecom to discuss the joint public notice for the proposed action. Participants included the TVA, U.S. Army Corps of Engineers (Corps), the Service's Tennessee Field Office (TFO), Tennessee Department of Environment and Conservation (TDEC) and Tennessee Wildlife Resources Agency (TWRA).

02-18-11 TVA and the Corps held a follow-up interagency telecom with TFO (David Pelren) and TWRA (Robert Todd) to further discuss numerous and substantive concerns expressed by both agencies, in regards to the proposed action.

03-13-11 Mary Jennings (TFO) sent a letter, addressed to Colonel Mitchell and to the attention of Lisa Morris (Corps), expressing concerns about the potential for the proposed water withdrawal to affect federally protected fish and mussels in the Elk River, especially larval boulder darters, which could be entrained by the water intake. The TFO further recommended that the permit be held in abeyance until concerns regarding endangered fish and mussels were adequately addressed (letter copied to Samantha Strickland, Chuck Howard and John [Bo] Baxter [TVA], Dan Eager [TDEC], and Robert Todd).

03-28-11 Samantha Strickland sent a letter to Billy Joe Wiley (LCBPU), with the TFO's March 3, 2011, letter attached, indicating that, "there are concerns that the proposal has the potential to adversely impact federally listed, aquatic endangered species or a candidate for federal listing". Ms. Strickland requested a May 11, 2011, meeting with LCBPU and its consultant at the Corps' Nashville District Regulatory Office in Nashville, Tennessee, to afford an opportunity to discuss and address concerns, and provide clarification with interested parties (letter copied to Robert Ramsey [James C. Hailey and Company], Lisa Morris, Robert Baker [TDEC], Robert Todd and David Pelren).

05-11-11 TVA led a meeting at the Corps' Nashville District Regulatory Office to discuss and address concerns regarding the proposed action and its potential effects to listed aquatic species. Approximately 20 people were in attendance, including representatives for LCBPU (the project proponent) and Griggs and Maloney (LCBPU's engineering firm), and state and federal agency representatives with TDEC, TWRA, the Corps, and Service. Various avoidance and minimization measures were discussed to assist in addressing potential effects to listed species. It was determined that a pre-project mussel survey would be conducted to

determine presence of rare mussels in the proposed project vicinity; pre and post-project monitoring would be conducted in the vicinity of the proposed water intake to determine if the proposed action would result in effects to boulder darters; LCBPU indicated that they might be able to provide funding to assist with boulder darter recovery work in the Elk River; TVA agreed to prepare the biological assessment.

07-08-11 In response to LCBPU potentially providing funds to assist with boulder darter recovery in the Elk River, the Service exchanged e-mails with TVA discussing how those dollars could best be utilized. It was suggested at the May 11, 2011, meeting that those dollars could go towards increasing instream habitat for boulder darters (i.e., placement of slab boulders in the river channel). However, because of past failures in attempting to introduce additional slab boulder habitat into the Elk River, the Service recommended that TVA instead use any additional monies to increase boulder darter surveying in the Elk River and possibly, include Elk River tributaries, or do a study with light traps to determine their effectiveness in sampling juveniles. TVA indicated that they would consider the Service's input (e-mail exchange between Todd Shaw and Chuck Howard; Peggy Shute [Service], and Bo Baxter, Samantha Strickland and Clint Jones [TVA] were copied on this e-mail correspondence).

03-19-13 TVA exchanged e-mails with the Service regarding which mussel species should be evaluated for effects in the draft biological assessment as a result of the proposed action. It was mutually agreed that the effects analysis should consider potential effects to the Alabama lampmussel (*Lampsilis virescens*), birdwing pearlymussel (*Lemiox rimosus*), cracking pearlymussel (*Hemistena lata*), Cumberland monkeyface (*Quadrula intermedia*), fine-rayed pigtoe (*Fusconaia cuneolus*), shiny pigtoe (*Fusconaia cor*) and tan riffleshell (*Epioblasma florentina walkeri*). TVA further indicated that it would also include evaluations for conferencing on the proposed threatened rabbitsfoot (*Quadrula cylindrica cylindrica*), proposed endangered slabside pearlymussel (*Pleuronaia dolabelloides*), and proposed critical habitat for the slabside pearlymussel and fluted kidneyshell (*Ptychobranchus subtentum*) (e-mail exchange between John Griffith [Service] and Chuck Howard; Todd Shaw, Bo Baxter, Samantha Strickland and Lisa Morris were copied on this e-mail correspondence).

07-16-13 Griggs and Maloney contacted the Service regarding preparation of an environmental assessment for LCBPU's proposed action. The Service sent an e-mail to TVA asking if the biological assessment was ready for review because it was unclear whether the biological assessment had been completed and would be part of the environmental assessment. TVA responded that the biological assessment had been placed on hold because LCBPU had failed to provide information regarding how the water would be handled after delivery from the intake facility. Also, TVA had

discovered a new processing facility was being planned nearby, prompting TVA to request surveys for bat habitat and cultural resources at the additional sites; TVA indicated that the biological assessment would be completed upon its receipt of data from the requested bat habitat and cultural resources surveys (e-mail exchange between Robbie Sykes [Service] and Chuck Howard; Todd Shaw, Peggy Shute, John Griffith, David Pelren and Sandra Silvey [Service] and Bo Baxter were copied on this e-mail correspondence).

02-03-14 TVA's January 28, 2014, letter requesting initiation of formal consultation and a conference review of the project's potential effects on the northern long-eared bat, currently proposed for federal listing as endangered, with an attached biological assessment arrived at the TFO in Cookeville, Tennessee (letter from Bo Baxter to Mary Jennings; Bradley Bishop [Corps] and Robert Todd were copied on this correspondence).

02-28-14 The TFO provided a letter to TVA to notify it that its initiation of formal consultation under section 7 of the Act was complete (Mary Jennings signed the letter; it was addressed and mailed John Baxter).

FWS Log No: 2014-F-0219 ***Application No:*** N/A
Date Started: March 11, 2014 ***Ecosystem:*** Lower Tennessee-Cumberland
Applicant: Lincoln County Board of Public Utilities
Action Agency: Tennessee Valley Authority
Project Title: Proposed Lincoln County Water Intake and Treatment Facility
Counties: Lincoln County, Tennessee

Table 1. Species and critical habitat evaluated for effects and those where the Service has concurred with a "not likely to adversely affect" determination.

SPECIES or CRITICAL HABITAT	SPECIES PRESENT IN ACTION AREA	CRITICAL HABITAT PRESENT IN ACTION AREA	PRESENT IN ACTION AREA BUT "NOT LIKELY TO BE ADVERSELY AFFECTED"
Boulder Darter (*Etheostoma wapiti*)	X	-----	-----
Alabama Lampmussel (*Lampsilis virescens*)	-----	-----	X
Birdwing Pearlymussel (*Lemiox rimosus*)	-----	-----	X
Cracking Pearlymussel (*Hemistena lata*)	-----	-----	X

Cumberland Monkeyface (*Quadrula intermedia*)	-----	-----	X
Fine-rayed Pigtoe (*Fusconaia cuneolus*)	-----	-----	X
Shiny Pigtoe (*Fusconaia cor*)	-----	-----	X
Slabside Pearlymussel (*Pleuronaia dolabelloides*)	-----	-----	X
Snuffbox (*Epioblasma triquetra*)	-----	-----	X
Tan Riffleshell (*Epioblasma florentina walkeri*)	-----	-----	X
Rabbitsfoot (*Quadrula cylindrica cylindrica*)	-----	-----	X
Gray Bat (*Myotis grisescens*)	-----	-----	X
Indiana bat (*Myotis sodalis*)	-----	-----	X
Fluted Kidneyshell (*Ptychobranchus subtentum*) Critical Habitat	-----	X	-----
Slabside Pearlymussel (*Pleuronaia dolabelloides*) Critical Habitat	-----	X	-----

***** A conference report on the northern long-eared bat (*Myotis septentrionalis*), a species proposed for federal listing as endangered, has been included after the "Incidental Take Statement" in this biological opinion.

TVA has indicated in its biological assessment (Tennessee Valley Authority 2014a) that the proposed action would adversely affect boulder darters, but would not adversely affect the other federally listed species or adversely modify designated critical habitat, indicated in Table 1. The Service, however, believes that designated critical habitat for the fluted kidneyshell and slabside pearlymussel may potentially be adversely affected as a result of the proposed action and have provided rationale for these determinations in the **"EFFECTS OF THE ACTION"** of this consultation.

BIOLOGICAL OPINION

DESCRIPTION OF THE ACTION

Project Purpose and Location

The purpose of the proposed action is to supplement water supplies for unincorporated areas of Lincoln County, Tennessee. The proposed action would entail construction of a surface water withdrawal facility, comprised of a water intake and water treatment facility, along the left, descending bank of the Elk River at Elk River Mile (ERM) 75.3 in Lincoln County, Tennessee (Tennessee Valley Authority 2014a). The proposed water intake would be located at an approximate latitude of 35.131944 decimal degrees (DD) and an approximate longitude of -86.660278 DD; the proposed water treatment facility would be located at an approximate latitude of 35.12911 DD and an approximate longitude of -86.65593 DD on a site owned by Lincoln County off of Old Moline Road (Parcel 29.00 on Map 93 of Lincoln County, Tennessee; U.S. Geological Survey [USGS], 7.5 Minute Series, Boonhill Quadrangle Topographic Map; Tennessee Valley Authority 2014a). Please refer to Figures 1 and 2 in Appendix A to view the proposed project location.

LCBPU supplies water to over 90 percent (%) of the unincorporated areas of Lincoln County. Currently, Lincoln County has a cumulative average water consumption rate (including system losses) of 2.2 million gallons per day (mgd), most of which is extracted from wells in the Flintville, Taft, and Elora areas, with a combined firm capacity of 1.7 mgd. The current water supply has significant losses of water in the system that have not been identified, and the groundwater supply to the wells is unreliable during sustained periods of dry weather. LCBPU has previously requested additional water supply from the cities of Fayetteville and Lewisburg, Tennessee, but these requests were denied. Other alternatives to develop additional wells were deemed unfeasible due to cost, water quality and lack of sustainable water resources. To improve the reliability of a safe water supply to the area, and to meet the demand of expected growth to the area over the next several decades, LCBPU's proposed facility would be capable of withdrawing 4.0 mgd. However, they anticipate a typical daily withdrawal rate of 1.6 mgd by 2030. With an intake on the Elk River, LCBPU would be able to supplement or replace its unreliable groundwater supply, which is severely strained during dry periods (Tennessee Valley Authority 2014a).

Project Construction

The new surface water intake structure, would be constructed near the left, descending bank of the Elk River, and include a 26 feet (ft) by 21.3 ft reinforced, concrete building above a 26 ft by13.5 ft reinforced, concrete pump shaft. The concrete shaft would extend approximately 5 ft below the riverbed to provide an increased water depth for the pumps and allow sediment storage for reduced maintenance. The pump system would consist of three vertical turbine pumps with pump columns extending down into the shaft. Flow into the structure would pass through two, 21-inch (in) diameter, T-shaped, stainless steel, wedge, wire screens with 16-in inlet pipes bolted onto the intake structure (see Figure 3a in Appendix A) (Tennessee Valley Authority 2014a).

Construction of the intake structure would require excavation of the riverbed and a portion of the left, descending riverbank, and removing herbaceous vegetation, shrubs and trees on the bank within the project footprint. A 6 ft by 6ft by 4 ft cofferdam, constructed with sacks of sand,

would be installed within the Elk River channel to enclose the aquatic project footprint and dewater the footprint during instream construction activities. The cofferdam would extend approximately 38 ft into the river off of the left, descending bank, positioned approximately 71 ft upstream and 78 ft downstream, to enclose an approximately 3,200 square foot (ft^2) instream area (Figure 3a). The cofferdam would be constructed with a crane, located upland and outside of the river channel, adjacent to the intake structure. Water levels within the cofferdam would be regulated via a hydraulic pump. No construction would take place on days when the cofferdam is over-topped by water (if there would be such an occurrence[s]), and all tree removal would take place between October 15 and March 31 (Tennessee Valley Authority 2014a).

To provide sufficient depth at the intake, LCBPU would excavate approximately 94,500 cubic feet (ft^3) of upland material and 6,345 ft^3 of material from the riverbed to achieve an elevation of 611 ft above mean sea level (msl). Materials would be removed with rock hammers and a crane. Machinery would be restricted to bank/upland areas and within the cofferdam. Upon completing excavation, the reinforced, concrete intake structure would be constructed and intake screens installed. The area surrounding the intake structure would be backfilled with shot rock, native material, and approximately 70,200 ft^3 of excess excavated materials. A Storm Water Pollution Prevention Plan (SWPPP) will also be developed and implemented (Tennessee Valley Authority 2014a).

The proposed plant site would contain 10.2 acres (ac). Raw water withdrawn from the Elk River would be routed through approximately 1,900 ft of 16-in pipe from the intake to the new treatment plant. The pipeline would require a 15-ft wide construction path and disturb approximately 0.66-ac (see Figure 3b in Appendix A) (Tennessee Valley Authority 2014a).

Project Operations and Maintenance

The LCBPU has proposed a daily withdrawal rate of approximately 1 mgd from the Elk River, with typical maximum water withdrawals occurring at a rate of approximately 2,880 gallons per minute (gpm) (3 mgd) over an 8-hour (hr) day, until 2030. By 2030, daily withdrawals are projected to increase to approximately 1.6 mgd. This withdrawal amount would be achieved by increasing the duration of daily water withdrawals from 8 hrs to 12 hrs. However, the maximum withdrawal rate of approximately 2,880 gpm (3 mgd) would remain the same, unless low groundwater levels inhibited existing well withdrawals. Under those circumstances, LCBPU might increase withdrawals at the proposed intake facility to a peak of 4 mgd over a 24-hr day, with a 2,880 gpm peak pumping rate. Water withdrawn from the river would be returned to the water table via septic treatment facilities and groundwater recharge. Evaporative and consumptive losses would be minimal. The intake would be designed to maintain slot velocities of less than 0.5 feet per second (fps) at the screens, as well as minimize impacts to aquatic fauna, such as larval fish. Most fish possess the physical capabilities to swim away from a water intake with intake velocity rates of 0.5 fps or less (U.S. Environmental Protection Agency 2011). TVA's 26a Permit Application for LCBPU's 4 mgd intake and its attachments report specific estimates of river depth of flow calculations and withdrawal schedules (included in Appendix B) (Tennessee Valley Authority 2014a).

No future maintenance dredging is planned around the proposed intake structure. Normal high flow events should scour the immediate area surrounding the structure and flush larger sediments and bedload downstream. The LCBPU would remove fine sediment accumulations from the intake screens via "air scour" cleaning, as needed.

Construction Impacts

Terrestrial direct impact areas from construction (Figure 3b) would include: (1) a 12,500 ft² (0.3-ac) facility footprint and buffer area (approximately 125 ft long by 100 ft wide), including the site of the proposed facility and a work/laydown area (where the crane would operate, equipment would be staged and fueling would occur); (2) an 854 ft^2 area (0.02-ac) on the Elk River bank where LCBPU would construct the intake structure and approximately 94,500 ft³ of fill would be excavated for placement of the intake structure; (3) a 2,625 ft^2 area (0.06-ac) on top of the riverbank, upstream and downstream of the proposed intake structure (approximately 75 ft of combined distances by a 35 ft width), where the riverbank would be disturbed and vegetation removed; (4) upland areas totaling approximately 17,424 ft^2 (0.4-ac) where excavated excess fill would be placed; and (5) an impact area of 28,500 ft² (0.7-ac) where approximately 1,900 linear ft of 16-in waterline would be buried (from the proposed intake to the new treatment plant) and equipment would be transported, resulting in vegetation being affected in a 15-ft wide path (Tennessee Valley Authority 2014a; Strickland, personal communication, 2014; Howard, personal communication, 2014a).

Known aquatic direct impact areas from construction would include the following areas below the ordinary high waterline (OHW) of the Elk River: (1) an approximately 3,200 ft^2 (0.07-ac) instream construction area in the Elk River that would be enclosed by the cofferdam and dewatered during construction activities, and (2) vertical removal at the intake site of approximately 6,345 ft^3 of fill (sediment) from a 198 ft² (0.005-ac) area of riverbank above a 611 ft msl elevation (Tennessee Valley Authority 2014a; Howard, personal communication, 2014a).

Because excavation would occur in the dewatered area within the cofferdam, it is anticipated that turbidity would likely be contained within this area and any increased turbidity in the water column outside of the cofferdam would be minimal. Installation of the cofferdam and intake structure would alter flows during construction. Water pumped from within the cofferdam would be subject to permit limits established during construction permitting. These limits would be protective of aquatic resources in the Elk River outside of the project area (Tennessee Valley Authority 2014a).

An indirect impact area, surrounding the site, could be subject to temporary increases in debris and suspended sediments during rock hammering and excavation activities (Tennessee Valley Authority 2014a).

Operational Impacts

Potential operational impacts to aquatic resources are most likely to occur within the river channel in the immediate vicinity of the intake pipes and immediately adjacent to the water intake, where the wetted channel perimeter would be reduced as a result of water withdrawals.

Results of hydrologic modeling, provided by Griggs & Maloney, Inc. (included in Appendix B), on behalf of LCBPU, indicate that the critical low flow rate (derived using USGS minimum low flow criterion for watersheds with sensitive species) at the location of the proposed water intake is approximately 205 cubic feet per second (cfs). Griggs & Maloney (2012) performed a similar calculation, using the USGS minimum flow criterion for watersheds without sensitive species, and derived a flow of 102 cfs. They then simulated the change in width at the location of the intake structure based on flows less than the recommended 205 cfs for sensitive species. The model indicated that flows of 123-160 cfs would reduce the surface width by 0.338 ft (4 in), which would equate to a reduction of wetted channel width of 2 in (vertically) on each bank (included in Appendix B) (Tennessee Valley Authority 2014a).

In the biological assessment, TVA has estimated that an instream area surrounding and including the project site could be subject to changes in flow levels and riverbed composition, and result in a small loss of wetted-channel perimeter during project operations. It has described this area as measuring approximately 75 ft wide (active Elk River channel from the left, descending riverbank, riverward) and 325 ft long (including 25 ft of distance upstream of the proposed facility and 50 ft of distance downstream of the proposed facility), totaling approximately 24,375 ft^2 (0.6-ac) of aquatic habitat that could be impacted by the project (Figure 3b) (Tennessee Valley Authority 2014a). In a follow-up conversation with TVA (Howard, personal communication, 2014b), it was indicated the active channel width of the Elk River is approximately 150 ft at the proposed project site, but TVA believed that the proposed action would only impact approximately 75 ft (half) of the active channel width from the left, descending bank, riverward. Therefore, as described above, this 75 ft width was used by TVA to arrive at the aquatic habitat area impacted by the proposed action. The Service believes that the entire width of the active Elk River channel would be impacted by the proposed action because the biological assessment indicates there would be a reduction in wetted channel perimeter (approximately a 2-in vertical drop on each bank), as a result of proposed intake withdrawals (Tennessee Valley Authority 2014a). Therefore, there would be minor changes in channel form and function at this site, including the bankfull width, bankfull mean and maximum depths, entrenchment ratio, width/depth ratio, bankfull cross-sectional area, discharges, velocities, flow patterns, and potentially other morphological characteristics. Taking these changes into account (based upon the full 150 ft active channel width of the Elk River), the Service has doubled the amount of aquatic habitat, described as impacted by TVA, from 24,375 ft^2 (0.6-ac) to 48,750 ft^2 (1.1 ac). We believe this more accurately depicts the aquatic area that would be impacted as a result of the proposed action.

Conservation Measures

Construction

- During the project construction phase, silt fencing and other erosion and sediment control measures would be required around upland construction activities to prevent runoff and deposition of sediment into the Elk River. In compliance with TDEC requirements, a Storm Water Permit and associated SWPPP would be prepared and provided to TDEC for this activity.

- The cofferdam would act as a stilling basin for proposed instream construction activities. Dewatering of the construction site would not occur until turbidity levels subsided and the water column cleared to ambient conditions.

- Removal of trees in the project area would occur between October 15 and March 31 to avoid direct impacts to bats potentially present in trees during the summer roosting season (Tennessee Valley Authority 2014a).

Operations and Maintenance

- LCBPU would continue to address water losses resulting from leaks in its existing water supply system. LCBPU has taken steps over the past 10 years towards reducing water losses. Although significant losses of water occur in the existing system, LCBPU's efforts to date have succeeded in identifying only a few locations where water loss was occurring. Apparently, the water losses are a result of shortages that cannot be accounted for, small leaks, service theft and metering inaccuracies. Water loss over the last 10 years has generally ranged from 43% to 48%. Currently, water loss ranges from 39% to 43%. However, if water loss was reduced more significantly, it would not eliminate the need for the proposed Elk River water withdrawal facility due to the current demand and certain growth of the service area.

  Steps taken by LCBPU to date to reduce water losses have included:

  - reporting water system losses of 35% or higher to the Utility Management Review Board or the Water and Wastewater Financing Board for further action;
  - contracting with leak detection services to locate leaks;
  - purchasing, maintaining and utilizing leak detection equipment on an almost daily basis;
  - replacing 11,500 linear ft of waterlines subject to continuous leak problems;
  - implementing a "War on Leaks" policy, which included soliciting the public to report any suspected leaks;
  - ongoing replacement of approximately 22 mi of asbestos-cement (AC) waterline with ductile iron, which is estimated to decrease losses by as much as 20,000 gallons per day (gpd) or about 2.2%.

- Water intake screens would be utilized to minimize the potential uptake of small fish (including boulder darters and potential fish hosts for mussels) and other organisms into the proposed intake structure. The specific design of the intake would be developed with recommendations from the Service and TWRA to minimize impacts to target aquatic species.

- TVA would monitor boulder darters in the vicinity of the proposed intake to assist with assessing potential impacts to the species from construction and operation of the facility. TVA would continue to annually monitor this site and evaluate potential project impacts to the boulder darter after the start of operations at the LCBPU water intake.

- LCBPU would provide relevant data related to water intake volumes and schedules, as well as information regarding maintenance or possible accidents that occur at the proposed facility, to facilitate evaluation of potential project impacts. A monitoring plan would be developed for this site, similar to the effort and methodology used for monitoring boulder darters at other locations on the Elk River. The monitoring methods would be developed via consultation with and approval by the Service (Tennessee Valley Authority 2014a; James C. Hailey & Company 2012).

Project Footprint

Based upon information provided in the biological assessment (Tennessee Valley Authority 2014a) and communication with TVA (Strickland, personal communication, 2014; Howard, personal communication, 2014a, 2014b), the Service estimates that the project footprint would be comprised of an area totaling approximately 2.6 ac. This estimate includes approximately 1.1 ac of aquatic habitat below OHW and within the active channel of the Elk River, which could be subject to changes in flow levels and riverbed composition and result in a small loss of wetted-channel perimeter during project operations, and would encompass the sites where instream construction activities would transpire (i.e., installation of the cofferdam and removal of sediment from an area of the riverbank at the proposed intake site, totaling approximately 0.08-ac). The remainder of the footprint would be comprised of approximately 1.5 ac of terrestrial areas, located above the OHW, and include sites where the following activities would occur: (1) construction of the proposed facility (facility footprint), crane operation, equipment staging (cleaning, refueling and storage), work/laydown and an associated buffer area, (2) excavation of fill for placement of the proposed intake structure and construction of the structure into the left, descending bank of the Elk River, (3) disturbance and removal of vegetation on top of the left, descending bank of the Elk River, associated with installation of the proposed intake structure, (4) placement of excavated excess fill in upland areas, and (5) removal of vegetation and excavation of a 15-ft wide waterline path to bury approximately 1,900 linear ft of the proposed 16-in waterline from the proposed intake to the new treatment plant and to provide an area for equipment to be transported.

Action Area

By definition, the action area encompasses an area where proposed activities can cause measurable or detectable changes in land, air and water or to other measurable factors that may elicit a response in the species or critical habitat addressed under the consultation. The action area is not limited to the footprint of the action, and considers and includes chemical and physical impacts to the environment resulting from the action.

For the proposed action, the Service has estimated that the project action area would include a total of approximately 17.7 ac of aquatic and terrestrial areas, which would consist of the project footprint, land owned by Lincoln County surrounding the proposed water treatment plant and areas of the Elk River channel outside of the project footprint. This 17.7-ac area has been identified as the action area for reasons that will be explained and discussed in the **"EFFECTS OF THE ACTION"** of this consultation.

STATUS OF THE SPECIES/CRITICAL HABITAT

Species/critical habitat description

Boulder darter

The boulder darter (*Etheostoma wapiti*) was listed as an endangered species on September 1, 1988 (53 FR 33996). A recovery plan addressing the boulder darter was approved on July 27, 1989 (U.S. Fish and Wildlife Service 1989). Critical habitat has not been designated for this species.

The boulder darter grows to a maximum length of approximately 3 in. The body of the male is olive to gray in color with eight to nine dorsal saddles and 10-11 mid-lateral blotches often present, especially in juveniles. There are 10-14 dark horizontal lines between scale rows on the sides of the fish. Red pigmentation may be present near the margins of the first one or two membranes of the spinous dorsal fin on adult females. Red coloration is lacking on fins and the body of adult males with chromatic colors restricted to pale yellow submarginal bands on spinous dorsal, soft dorsal, and caudal fins; and pale blue on the gular area, bases of the pelvic fins, and between the anal spines. Males are otherwise dark grey on the body and fins except for the horizontal lines on sides and dark margins on the median fins. Females are lighter in color. Both sexes have a dark gray or black bar beneath the eyes and a dark spot behind the eyes (Etnier, personal communication, 1988; Etnier and Starnes 1993).

Fluted kidneyshell critical habitat

Critical habitat for the fluted kidneyshell was designated on September 26, 2013 (78 FR 59555) and includes the following primary constituent elements (PCE), which are those physical and biological features essential for the conservation of the species:

(1) Riffle habitats within large, geomorphically stable stream channels (channels that maintain lateral dimensions, longitudinal profiles and sinuosity patterns over time without an aggrading or degrading bed elevation);

(2) Stable substrates of sand, gravel and cobble with low to moderate amounts of fine sediment and containing flow refugia with low shear stress;

(3) A natural hydrologic flow regime (the magnitude, frequency, duration and seasonality of discharge over time) necessary to maintain benthic habitats where the species are found, and connectivity of rivers with the floodplain, allowing the exchange of nutrients and sediment for habitat maintenance, food availability for all life stages and spawning habitat for native fishes;

(4) Water quality with low levels of pollutants and including a natural temperature regime, pH (between 6.0 and 8.5), oxygen content (not less than 5.0 milligrams per liter [mg/L]), hardness and turbidity necessary for normal behavior, growth and viability of all life stages;

(5) The presence of abundant fish hosts, which may include the barcheek darter (*Etheostoma obeyense*), fantail darter (*Etheostoma flabellare*), rainbow darter (*Etheostoma caeruleum*), redline darter (*Etheostoma rufilineatum*), bluebreast

darter (*Etheostoma camurum*), dusky darter (*Percina sciera*) and banded sculpin (*Cottus carolinae*), necessary for recruitment of the fluted kidneyshell.

In total, 24 critical habitat units encompassing approximately 1,181 river miles (RMs) of stream channel in Alabama, Kentucky, Tennessee and Virginia were designated for the fluted kidneyshell (see Table 2 and Figure 1).

Habitat loss and degradation negatively impact the fluted kidneyshell. Severe degradation from impoundments, gravel and coal mining, oil and natural gas development, sedimentation, chemical contaminants and stream channel alterations threaten the stream habitat and water quality on which these species depend (Neves 1993; Williams et al. 1993; Neves et al. 1997). Contaminants associated with coal mining (metals, other dissolved solids), municipal effluents (bacteria, nutrients, pharmaceuticals), and agriculture (fertilizers, pesticides, herbicides and animal waste) cause degradation of water quality and habitats through increased acidity and conductivity, instream oxygen deficiencies, excess nutrification and excessive algal growths.

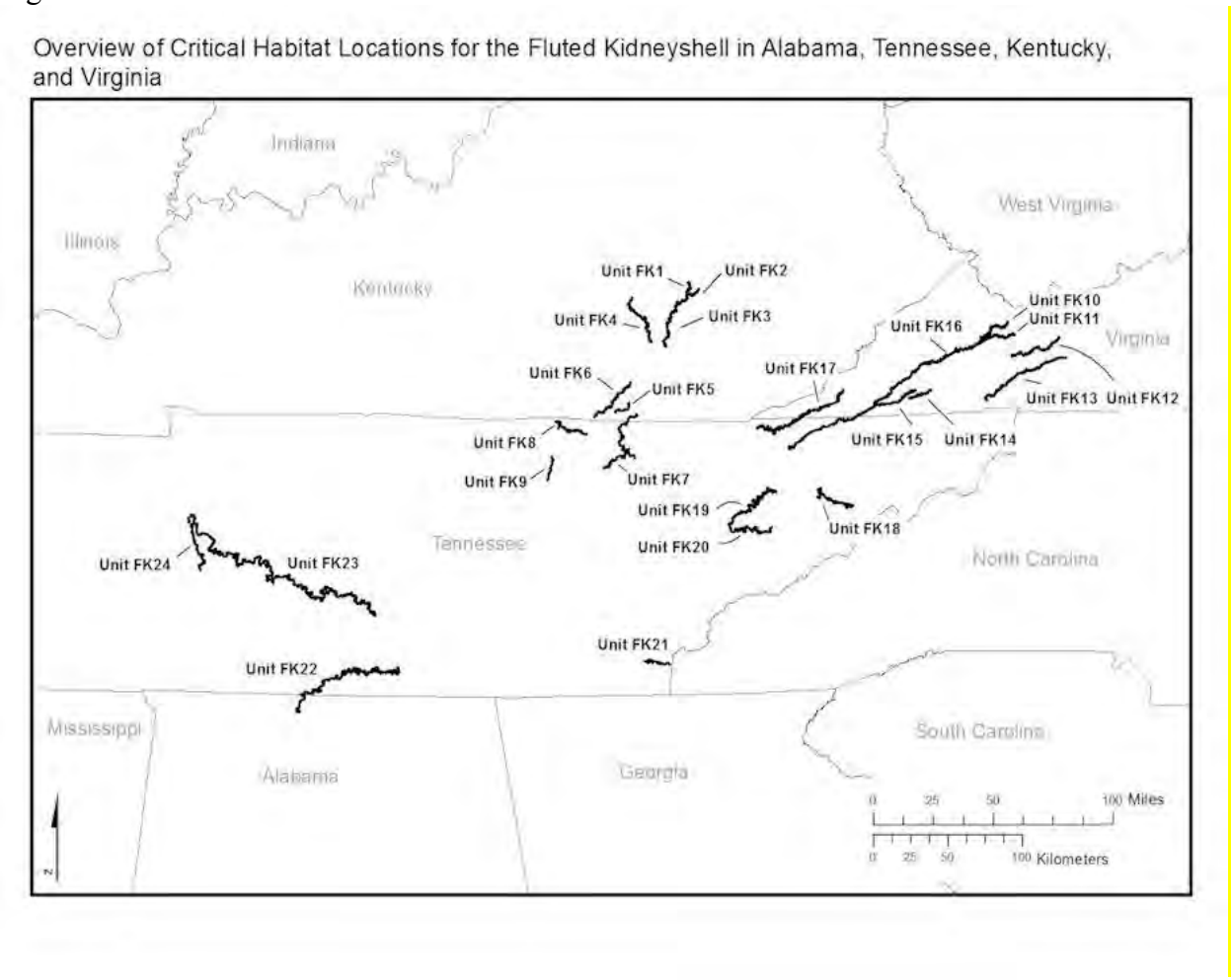
Other natural and manmade factors, such as alteration of natural temperature regimes below dams; chemical contaminants; sedimentation; small, isolated populations; and low genetic diversity, combined with localized extinctions from point source pollution (PSP) or accidental toxic chemical spills, habitat modification and progressive degradation by nonpoint source pollution (NPS), natural catastrophic changes to habitat through flood scour or drought as exacerbated by climate change, and nonindigenous species, are threats to remaining populations of the fluted kidneyshell and its critical habitat.

Table 2. Designated critical habitat units for the fluted kidneyshell.

Unit	Location	Occupied	Total Length (RM)
FK1	Horse Lick Creek, KY	Yes	12.4
FK2	Middle Fork Rockcastle River, KY	Yes	7.7
FK3	Rockcastle River, KY	No	43.5
FK4	Buck Creek, KY	Yes	37.9
FK5	Rock Creek, KY	Yes	11.9
FK6	Little South Fork Cumberland River, KY	Yes	40.7
FK7	Big South Fork Cumberland River, KY, TN	Yes	56.9
FK8	Wolf River and Town Branch, TN	Yes	27.5
FK9	West Fork Obey River, TN	Yes	12.0
FK10	Indian Creek, VA	Yes	4.2
FK11	Little River, VA	Yes	31.3
FK12	North Fork Holston River, VA	Yes	41.8
FK13	Middle Fork Holston River, VA	Yes	55.3
FK14	Big Moccasin Creek, VA	No	20.6
FK15	Copper Creek, VA	Yes	34.5
FK16	Clinch River, TN, VA	Yes	163.2

FK17	Powell River, TN, VA	Yes	94.9
FK18	Nolichucky River, TN	Yes	32.2
FK19	Holston River, TN	No	52.9
FK20	French Broad River, TN	No	34.9
FK21	Hiwassee River, TN	No	15.2
FK22	Elk River, AL, TN	No	102.1
FK23	Duck River, TN	Yes	215.9
FK24	Buffalo River, TN	No	31.0
Total RMs			1,180.5

Figure 1.



Slabside pearlymussel critical habitat

A proposed rule to list the slabside pearlymussel as endangered with critical habitat designation was published on October 4, 2012 (77 FR 60804). The final rule listing the slabside

pearlymussel as an endangered species and designation of critical habitat was published on September 26, 2013 (78 FR 59269). A separate rule designating approximately 216 RMs of the Duck River in Tennessee as slabside pearlymussel critical habitat was also published on September 26, 2013 (78 FR 59556).

The critical habitat for the slabside pearlymussel designation includes the following primary PCEs:

(1) Riffle habitats within large, geomorphically stable stream channels (channels that maintain lateral dimensions, longitudinal profiles and sinuosity patterns over time without an aggrading or degrading bed elevation);

(2) Stable substrates of sand, gravel and cobble with low to moderate amounts of fine sediment and containing flow refugia with low shear stress;

(3) A natural hydrologic flow regime (magnitude, frequency, duration and seasonality of discharge over time) necessary to maintain benthic habitats where the species is found, and connectivity of rivers with the floodplain, allowing the exchange of nutrients and sediment for habitat maintenance, food availability for all life stages and spawning habitat for native fishes;

(4) Water quality with low levels of pollutants and including a natural temperature regime, pH (between 6.0 to 8.5), oxygen content (not less than 5.0 mg/L, hardness and turbidity necessary for normal behavior, growth and viability of all life stages;

(5) The presence of abundant fish hosts, which may include the popeye shiner (*Notropis ariommus*), rosyface shiner (*Notropis rubellus*), saffron shiner (*Notropis rubricroceus*), silver shiner (*Notropis photogenis*), telescope shiner (*Notropis telescopus*), Tennessee shiner (*Notropis leuciodus*), whitetail shiner (*Cyprinella galactura*), white shiner (*Luxilus albeolus*), and eastern blacknose dace (*Rhinichthys atratulus*), necessary for recruitment of the slabside pearlymussel.

In total, 13 critical habitat units were designated, encompassing approximately 970 RMs of stream channel in Alabama, Mississippi, Tennessee and Virginia for the slabside pearlymussel (see Table 3 and Figure 2).

Habitat loss and degradation negatively impact the slabside pearlymussel. Severe degradation from impoundments, gravel and coal mining, oil and natural gas development, sedimentation, chemical contaminants and stream channel alterations threaten the stream habitat and water quality on which this species depends (Neves 1993; Williams et al. 1993; Neves et al. 1997). Contaminants associated with coal mining (metals, other dissolved solids), municipal effluents (bacteria, nutrients, pharmaceuticals) and agriculture (fertilizers, pesticides, herbicides and animal waste) cause degradation of water quality and habitats through increased acidity and conductivity, instream oxygen deficiencies, excess nutrification and excessive algal growths.

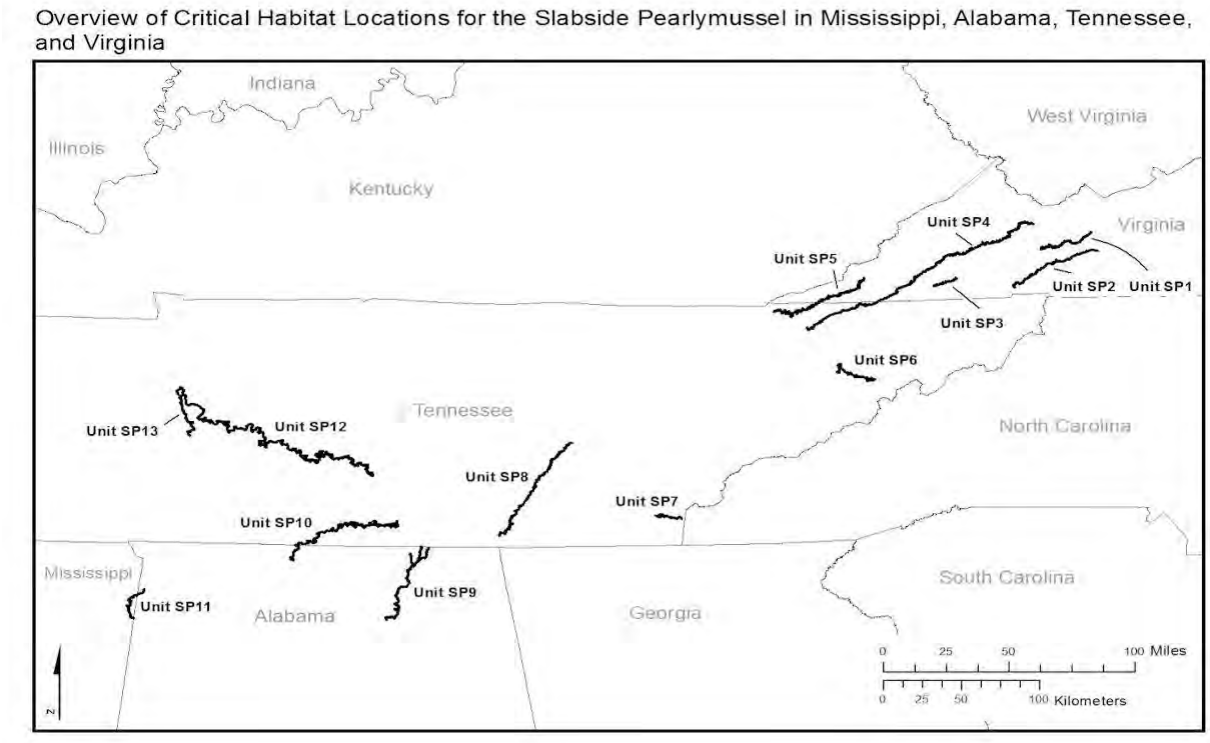
Other natural and manmade factors, such as alteration of natural temperature regimes below dams; chemical contaminants; sedimentation; small, isolated populations; and low genetic diversity, combined with localized extinctions from PSP or accidental toxic chemical spills, habitat modification and progressive degradation by NPS, natural catastrophic changes to habitat

through flood scour or drought as exacerbated by climate change and nonindigenous species, are threats to remaining populations of the slabside pearlymussel and its critical habitat.

Table 3. Designated critical habitat units for the slabside pearlymussel.

Unit	Location	Occupied	Total Length (RM)
SP1	North Fork Holston River, VA	Yes	41.8
SP2	Middle Fork Holston River, VA	Yes	55.3
SP3	Big Moccasin Creek, VA	Yes	20.6
SP4	Clinch River, TN, VA	Yes	163.2
SP5	Powell River, TN, VA	Yes	94.9
SP6	Nolichucky River, TN	Yes	32.2
SP7	Hiwassee River, TN	Yes	15.2
SP8	Sequatchie River, TN	Yes	94.1
SP9	Paint Rock River, AL	Yes	77.7
SP10	Elk River, AL, TN	Yes	102.1
SP11	Bear Creek, AL, MS	Yes	26.3
SP12	Duck River, TN	Yes	215.9
SP13	Buffalo River, TN	Yes	31.0
Total RMs			970.3

Figure 2.



Life history

Boulder darter

Observations made by ichthyologists indicate that the boulder darter inhabits areas in warmwater streams with moderate to swift current velocity over boulder or slab rock substrate. The species has not been found in pool habitat or in areas with gravel substrate unless other cover (i.e., slabrocks) is also available. Juvenile boulder darters, however, may occur in areas with smaller-sized substrate (U.S. Fish and Wildlife Service 1989). While extensive life history studies of boulder darters have not been conducted, Conservation Fisheries, Incorporated (CFI) has obtained incidental life history information through observation of the species associated with captive propagation activities.

O'Bara and Etnier (1987) indicated that reproductive habitat of the boulder darter was thought to be large boulders and/or slabrocks as was known or inferred for other members of the closely related *E. maculatum* species group. This theory was strengthened considerably by their failure to collect adults in the absence of these habitats and the rather predictable presence of the boulder darter in the Elk River, where such habitats occurred. Burkhead and Williams (1992), in laboratory studies, found that spawning habitat was boulder substrate in flowing water with a velocity of about 1-2 cfs. However, Rakes (personal communication, 2010) has observed boulder darters spawning at lower stream velocities.

Laboratory studies found that boulder darter nesting sites had specific attributes: (1) the egg deposition site was between boulders, not between a boulder and gravel or a boulder and pieces of rubble, although a space created between a boulder and bedrock could potentially be acceptable; (2) it had a wedge-shaped configuration, with two boulders touching at a relatively narrow angle, creating a space into which the female wedged her eggs; (3) the egg-deposition site had current flowing across it; (4) the cavity was roughly horizontal (no vertical or nearly vertical spaces were selected); and (5) the boulders had to be not only in the correct depth and current ranges, but also occurred in certain configurations relative to the current and to each other (Burkhead and Williams 1992).

Rakes et al. (2009) noted that the spawning season for boulder darters in a propagation facility (CFI) remained fairly consistent from year to year, beginning over a six-week period from about April 25 and ending in mid-June. Rakes and Shute (2008) observed that yolk-sac larvae at CFI alternated between swimming and resting on the bottom for a day or two. The larvae became fully pelagic after their yolk-sac was absorbed and they began feeding.

Rakes et al. (1999) and Rakes and Shute (2002) determined that boulder darters typically exhibit breeding colors when water temperatures are at approximately 64.4-73.4°F. Eight adult boulder darters in a laboratory environment began spawning when water temperatures reached 69.8° F and continued to spawn at a stable temperature of 75.2° F (Burkhead and Williams 1992).

Etnier and Williams (1989) speculated that although the species' actual food habits were still unknown, most fish of the *Nothonotus* subgenus fed on immature aquatic insects. The maximum total length of the species is 3.3 in (Etnier and Starnes 1993).

Population dynamics

Boulder darter

The only naturally occurring population of boulder darters occurs in low numbers in the Elk River drainage. Prior to its listing on September 1, 1988 (53 FR 33996), fewer than 60 boulder darters had been collected since 1986 in a 60-RM reach of the Elk River. Sedimentation, pollution, water temperature reductions, and construction of the mainstem impoundments (i.e., Wilson and Wheeler reservoirs) destroyed or adversely altered habitat for the boulder darter in the Tennessee River and its tributaries where the species was thought to exist (Etnier and Williams 1989).

The lack of pre-impoundment records precludes determination of the precise historical distribution of the boulder darter. However, ichthyologists believe, based on the historic availability of suitable habitat that this species once inhabited the mainstem of the Tennessee River and the lower reaches of its major tributaries from the Paint Rock River (Marshall and Madison counties, Alabama) to at least the mouth of Shoal Creek (Lauderdale County, Alabama) (U.S. Fish and Wildlife Service 1989). Historical records are known from Shoal Creek, the Tennessee River tributary mentioned above with its lower reaches now impounded by Wilson Reservoir (U.S. Fish and Wildlife Service 1989), as opposed to the smaller Elk River tributary of the same name in Limestone County, Alabama, for which there are recent collection records (Shepard et al. 2009). Historically, individuals were collected in the Elk River as far upstream as approximately ERM 90 (Lincoln County, Tennessee) (U.S. Fish and Wildlife Service 1989).

The following approximate total numbers of boulder darters have been collected or observed in the following reaches since 1986: (1) approximately 300 individuals in the Elk River from approximately ERM 28 in the vicinity of Gallus Island (Limestone County, Alabama) upstream throughout 64 mi in Giles and Lincoln, counties, Tennessee, to approximately ERM 91.8 in the vicinity of the Wells Creek confluence near Fayetteville, in Lincoln County, Tennessee, (2) four individuals in the lower 0.5 creek miles (CM) of Shoal Creek, an Elk River tributary, in Limestone County, Alabama, (3) 32 individuals in the lower 2.1 mi of Richland Creek, an Elk River tributary, in Giles County, Tennessee, and (4) one individual in the lower 0.5-CM of Indian Creek, an Elk River tributary, in Giles County, Tennessee (O'Bara and Etnier 1987; Williams and Burkhead, personal communication, 1988; U.S. Fish and Wildlife Service 1989, 2013; Rakes et al. 1998, 2000; Rakes and Shute 2001, 2002, 2003, 2004b, and personal communication, 2004a; Shepard et al. 2009; Saylor, personal communication, 2011a; Rakes, personal communication, 2011, 2013a, 2014a; Shepard, personal communication, 2011; Tennessee Technological University 2012; Tennessee Valley Authority 2012, 2014b; Petty et al. 2012, 2014).

CFI propagated and released a total of 2,264 boulder darters at four sites in the Elk River (ERM 97; ERM 89.5; ERM 60.9; ERM 49.2) between 1997 and 2003 (Rakes et al. 1998, 2000; Rakes and Shute 2001, 2002, 2003, 2004b). Between 1997 and 2007, CFI observed a total of 93 boulder darters in the Elk River, many of which were propagated individuals (Rakes and Shute, personal communication, 2004a). Because many of these fish were propagated individuals, they

have not been included in the approximate total number of Elk River boulder darters (300) sampled since 1986, as indicated in the above paragraph.

TVA initiated a program to monitor the boulder darter population in the Elk River in July 2010. This program is ongoing and provides a baseline for measuring future trends.

The Service published the final rule for "Establishment of a Nonessential Experimental Population (NEP) for Two Fishes (Boulder Darter and Spotfin Chub) in Shoal Creek, Tennessee and Alabama" (70 FR 17916-17927) on April 2, 2005, which allowed for the reintroduction of boulder darters within their historic range in Shoal Creek, tributary to the Tennessee River. Since 2005, CFI has propagated and released a total of 5,844 boulder darters into Shoal Creek near Iron City, Lawrence County, Tennessee (Rakes, personal communication, 2013b, 2014b; Petty et al. 2014). Individuals believed to be wild progeny of the stocked fish have been observed in Shoal Creek since 2008 (Rakes et al. 2009; Rakes, personal communication, 2009a, 2009b, 2013b; Petty et al. 2011). Additional surveys of Shoal Creek will determine the over-wintering survivorship, downstream dispersal, natural reproduction and recruitment success of these fish.

Status and distribution

Boulder darter

Currently, boulder darters are scattered throughout small areas of suitable habitat over 64 mi of the Elk River from the vicinity of Gallus Island (Limestone County, Alabama) at approximately ERM 28 upstream through Giles and Lincoln counties, Tennessee, to ERM 91.8 in the vicinity of the Wells Creek confluence near Fayetteville (Lincoln County, Tennessee). The species has also been collected from the following three tributaries to the Elk River: (1) approximately the lower 2.1 mi of Richland Creek in Giles County, Tennessee, (2) approximately the lower 0.5-CM of Indian Creek in Giles County, Tennessee, and (3) approximately the lower 0.5-CM of Shoal Creek in Limestone County, Alabama (O'Bara and Etnier 1987; Williams and Burkhead, personal communication, 1988; Shepard et al. 2009; Saylor, personal communication, 2011a; U.S. Fish and Wildlife Service 1989, 2013; Rakes and Shute, personal communication, 2004a; Rakes, personal communication, 2011; Shepard, personal communication, 2011; Tennessee Valley Authority 2012, 2014b; Rakes et al. 1998, 2000; Rakes and Shute 2001, 2002, 2003, 2004b).

CFI also released propagated boulder darters at four sites (ERM 97; ERM 89.5; ERM 60.9; ERM 49.2) in the Elk River from 1997 through 2003 (Rakes et al. 1998, 2000; Rakes and Shute 2001, 2002, 2003, 2004b).

Since 1993, CFI has sampled and documented boulder darter presence in the Elk River, confirming the species presence at various locations between approximately ERM 49 (downstream of the I-65 Highway Bridge) and ERM 90 (upstream of Fayetteville) in Giles and Lincoln counties, Tennessee. They have also observed boulder darters at three new localities (downstream of Harms Mill, at Hobbs Bridge, and at a shoal upstream of the I-65 Bridge) in these counties, expanding the known distribution of the species in the Elk River since the

recovery plan was written (Rakes and Shute 2001). Boulder darters have also been collected in the Elk River in Limestone County, Alabama, from ERM 28 at Gallus Island (their most downstream documented extent) upstream to ERM 32.5 (Fishtrap Ford) on several occasions between 1993 and 2006 (Shepard et al. 2009).

TVA's 2010 survey efforts included collection of one individual at ERM 91.8 in the vicinity of the Wells Creek confluence near Fayetteville, in Lincoln County, Tennessee, the furthest recorded upstream extent for the species (Saylor, personal communication, 2011a). TVA has also encountered boulder darters in recent years when conducting Index of Biological Integrity (IBI) surveys and coordinating sampling efforts with CFI at various sites in the vicinity of Harms Mill and Fayetteville (approximately ERM 75 to ERM 90).

Geological Survey of Alabama collected two boulder darters in Shoal Creek, tributary to the Elk River in Limestone County, Alabama, upstream of the embayment of Wheeler Reservoir in 2004; this represented a new tributary record for this species. An additional specimen was collected in the same stream in 2005 and again in 2006 (Shepard et al. 2009).

Records indicate that boulder darters historically occurred in Shoal Creek, Tennessee River tributary in Lawrence County, Tennessee, and Lauderdale County, Alabama. Two juveniles were collected and documented in 1884 in Shoal Creek near Florence, Lauderdale County, Alabama (Etnier and Starnes 1993). Indigenous populations of boulder darters in Shoal Creek are presumed to be extirpated. However, the Service's Establishment of a NEP for Two Fishes (Boulder Darter and Spotfin Chub) in Shoal Creek, Tennessee and Alabama, Final Rule (70 FR 17916-17927) has provided for reintroduction of boulder darters into this system since 2005.

Since the recovery plan was written (U.S. Fish and Wildlife Service 1989), no additional populations of the boulder darter have been discovered in adjoining drainages. However, the known distribution of the Elk River population has been expanded to include the several additional collection sites within the mainstem Elk River mentioned in the above paragraphs.

The entire known range of the existing Elk River population continues to be affected by operation of Tims Ford Dam and the presence of Wheeler Reservoir. It is believed that cold-water releases from Tims Ford Reservoir suppressed population size and affected distribution in the Elk River. While this population may persist, full recovery will be dependent upon TVA's modified operations and maintenance (O&M) at Tims Ford Dam and establishment of additional populations in other watersheds, similar to the ongoing reintroduction efforts in Shoal Creek, Tennessee River tributary. Listed species will continue to occur in low numbers and be at risk of extinction unless changes in Tims Ford Dam O&M to address unnatural flow regimes and temperature fluctuations downstream from the dam are successful. Sedimentation from poor land use practices, NPS from agriculture, potential wastewater treatment plant discharges, municipal and agricultural water withdrawals, and various other water quality impacts also remain threats to the boulder darter.

Presently, much uncertainty exists regarding recovery of the species. Due to its limited distribution, unknown population trends and continued threats, the boulder darter continues to be

in danger of extinction throughout its range. Therefore, the status of the boulder darter listed as endangered remains appropriate.

A recovery plan was approved for the boulder darter on July 27, 1989 (U.S. Fish and Wildlife Service 1989). This species will be considered recovered when:

Through protection of the existing population and successful establishment of reintroduced populations or discovery of additional populations, three distinct viable populations exist. The existing Elk River population, including the three tributary segments, must be secure from ERM 90 downstream to approximately ERM 30.

Studies of the fish's biological and ecological requirements have been completed, and the implementation of management strategies developed from these studies has been successful.

No foreseeable threats exist that would likely threaten survival of any of the populations.

Analysis of the species/critical habitat likely to be affected

Boulder darter

The boulder darter is the only federally listed species that is likely to be adversely affected by the proposed action and, therefore, the only species that will be addressed in this biological opinion. Other federally listed species, which may be present in the action area, but are not likely to be adversely affected by the proposed action, have been identified in Table1.

According to occurrence records (Rakes and Shute 2006; Saylor, personal communication, 2011a, 2011b), 13 boulder darters were collected or observed in the action area from 2000 through 2011. **Boulder darters are likely to be affected by LCBPU's Proposed Lincoln County Water Intake and Treatment Facility because of their known presence in the action area in the recent past (Rakes and Shute 2006; Saylor, personal communication, 2011a, 2011b) and the anticipated effects associated with the proposed action.**

No designated critical habitat for the boulder darter occurs within the action area. **Therefore, the action would not affect, adversely modify or destroy any designated critical habitat for the federally listed boulder darter.**

Fluted kidneyshell and slabside pearlymussel critical habitat

The action area supports federally designated critical habitat for the fluted kidneyshell and slabside pearlymussel. Portions of designated Elk River critical habitat units FK 22 (fluted kidneyshell) and SP 10 (slabside pearlymussel) occur throughout the entire extent of the action area. The fluted kidneyshell was known historically from the Elk River (78 FR 59564), but has not been observed since the 1960s (Isom et al. 1973) and is presumed extirpated from the Elk River (78 FR 59566). Therefore, Critical Habitat Unit FK 22 is considered "unoccupied" by the fluted kidneyshell (78 FR 59571). The slabside pearlymussel has been collected recently in the Elk River (Tennessee Valley Authority 2009; 77 FR 60811-60812), and therefore, Critical

Habitat Unit SP 10 is designated as "occupied" (78 FR 59571). **Critical habitat for the fluted kidneyshell and slabside pearlymussel are likely to be affected, by LCBPU's proposed action because it exists within the action area and due to the nature of the anticipated effects associated with the proposed action.**

An effects analysis, describing potential effects to the boulder darter and fluted kidneyshell and slabside pearlymussel critical habitat as a result of the proposed action, is presented in the next section.

ENVIRONMENTAL BASELINE

The Elk River is approximately 195 mi in length and drains approximately 2,250 square miles (mi^2) in south-central Tennessee and north-central Alabama (Tennessee Valley Authority 1962; Shepard et al. 2009). It originates in Burroughs Cove in Grundy County, Tennessee, near the community of Elkhead. It then flows southwestward and forms the Coffee-Franklin County, Tennessee Line. It is first impounded by Elk River Dam, forming the 6.1 mi^2 Woods Reservoir (Findlakes 2011), which extends upstream to about where the river ceases to serve as the Coffee-Franklin County Line and is entirely located within Franklin County. Approximately 4 mi downstream of Elk River Dam, the Elk River enters the slackwaters of Tims Ford Reservoir and continues 34 mi in a southwesterly direction before exiting Tims Ford Dam. Immediately downstream of the dam, the Elk River forms the boundary between Franklin and Moore counties, Tennessee, at approximately ERM 129.7, and then subsequently between Moore and Lincoln counties, Tennessee, in the vicinity of the Beans Creek confluence at ERM 120. The river continues downstream through Lincoln County and the community of Fayetteville, Tennessee, and southwesterly through Giles County, Tennessee, crossing into Limestone County, Alabama, at ERM 33.5. The Elk River enters the slackwaters of Wheeler Reservoir at approximately ERM 28 (Shepard et al. 2009). The impounded Elk River continues its southwesterly course into Lauderdale County, Alabama, and empties into a reach of the Tennessee River impounded by Wheeler Reservoir at Tennessee River Mile (TRM) 285, approximately 10 mi upstream of TVA's Wheeler Lock and Dam at TRM 275 (U.S. Army Corps of Engineers 2011).

The Elk River is navigable, and the U.S. Coast Guard maintains buoys and day beacons in aid of commercial navigation on the Elk River from the impounded mouth to the U.S. Route 72 bridge at ERM 4.9. Beyond that, TVA maintains navigation aids for recreational boating upstream to the Mills Bridge at ERM 14.5. There is no regular commercial navigation activity on the Elk River at this time with the exception of marine construction companies building private dock facilities and periodic bridge inspection and maintenance for the Alabama Department of Transportation (Tennessee Valley Authority 2006).

Tims Ford Dam is located at ERM 133.3 in Franklin County, Tennessee. The dam is an earthen structure, 1,580 ft in length and 175 ft in height (Tennessee Valley Authority 2011a). The hydroelectric power plant at Tims Ford Dam consists of one operational generating unit which has a generating capacity of 45,000 kilowatts (kW). A smaller secondary unit, rated at 39 kW, 74 cfs, was installed to provide minimum flows as part of TVA's Reservoir Release Improvements Program (RRIP). The smaller turbine was damaged due to high flows in May 2004 and is no longer in use. A minimum flow of 80 cfs has been provided via the sluiceway

since that incident occurred (Tennessee Valley Authority 2008). The spillway consists of three bays with radial gates that have a combined discharge of 3,890 cfs (Tennessee Valley Authority 2011a). The sluiceway and/or spillway consist of vertical slots in the dam that can be opened to release water from Tims Ford Reservoir without passing it through the penstock and turbine area (Tennessee Valley Authority 2011b).

Tims Ford Reservoir extends 34 mi and has 275 mi of shoreline and 10,680 ac of surface water at normal summer pool (Tennessee Valley Authority 2000). Tims Ford has a flood-storage capacity of 219,600 acre-feet (Tennessee Valley Authority 2011a). From June 1 through Labor Day, TVA maintains elevations in the reservoir as close as possible to the Tims Ford Reservoir flood guide-line to support reservoir recreation and provide downstream flood control. According to this flood-guide, the minimum recreation elevation (reservoir pool from 888 to 883 ft above msl is maintained on Tims Ford Reservoir to benefit recreation from May 15 to October 15. The Tims Ford Reservoir flood guide pool elevations have a planned seasonal fluctuation of 15 ft, 873 ft above msl in winter months to 888 ft above msl during summer months, to provide flood storage upstream of Fayetteville, Tennessee (Koroa, personal communication, 2011).

Tims Ford Dam was completed in 1970 by the TVA for the primary purpose of recreation; the dam also provides flood protection for downstream locations on the Elk River (particularly Fayetteville, Tennessee), hydropower generation, and economic development for water quality and supply (Tennessee Valley Authority 2008). The greatest potential capital benefit for construction of Tims Ford Dam was recreation; 47.3% of capital funds were identified to provide recreation benefits. The Elk River is a popular recreation area for canoeing, fishing, camping and picnicking. The Elk River has a designated use as a trout reach from ERM 133.3 (Tims Ford Dam) downstream to ERM 90.5 (Fayetteville, Tennessee) (Tennessee Valley Authority 2008). The TWRA stocks rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) in the upper reach of the Tims Ford tailwaters from March through November each year (Tennessee Wildlife Resources Agency 2011).

Other capital benefits that formed the basis for construction of Tims Ford Dam and the percentage of funds identified to cover those benefits included, flood control (13.7%), reservoir shoreline development (13.7%), power (11.6%), fish and waterfowl (8.8%), water supply and water quality control (3.6%) and commercial fishing (1.4%) (Tennessee Valley Authority 2008). Counties and several municipalities in Tennessee and Alabama use the Elk River as a water supply. Water intakes are located at various points along the waterway.

Historically, several federally listed aquatic species, including the boulder darter, cracking pearlymussel (*Hemistena lata*), shiny pigtoe (*Fusconaia cor*), fine-rayed pigtoe (*Fusconaia cuneolus*), birdwing pearlymussel (*Lemiox rimosus*), Cumberland monkeyface (*Quadrula intermedia*), slabside pearlymussel (*Pleuronaia dolabelloides*), snuffbox (*Epioblasma triquetra*), tan riffleshell (*Epioblasma florentina walkeri*) and rabbitsfoot (*Quadrula cylindrica cylindrica*), have been negatively impacted by TVA's O&M activities at Tims Ford Dam. Several of these species (i.e., shiny pigtoe, fine-rayed pigtoe, birdwing pearlymussel, Cumberland monkeyface and tan riffleshell) have not been observed in the Elk River for several decades and may be extirpated. Federally designated critical habitat for the slabside pearlymussel and fluted

kidneyshell (*Ptychobranchus subtentum*) has also been negatively impacted by TVA's O&M activities at the dam.

Hydropower operations resulted in fluctuating water levels and de-watering areas of suitable habitat in the Elk River. Peaking flows from the dam resulted in daily water level fluctuations of over 5 ft in the mainstem at the Alabama state line (Shepard et al. 2009). This has resulted in erosion of riverbanks, sedimentation of stream substrate and decreased suitable instream habitat and habitat diversity. Native fish and mussel populations were adversely affected by the extreme variations in flow and temperature related to historical operation of the turbine at Tims Ford Dam. Releases of cold water through the hydroturbine reduced stream temperatures in the tailwaters throughout the entire Elk River from Tims Ford Dam to the backwaters of Wheeler Reservoir. It is believed that cold-water releases from Tims Ford Reservoir suppressed the boulder darter population size and affected their distribution in the Elk River. The releases resulted in thermal shock to boulder darters during their spawning season, and also affected growth of young boulder darters. Water temperature fluctuations, excessive sedimentation and low densities (or absence) of appropriate fish hosts, as a result of hydroturbine operations, likely hindered the reproductive success of freshwater mussels (Tennessee Valley Authority 2008).

TVA has improved the quality of water releases from Tims Ford Dam through an aeration project as part of its RRIP. In 2005, TVA initiated formal consultation with the Service regarding routine O&M of TVA's water control structures. As a result of this consultation, which concluded in 2006 (U.S. Fish and Wildlife Service 2006), TVA began to modify O&M at Tims Ford Dam in 2008 by reducing turbine operations and providing a combination of releases via the spillway and sluice of 200 to 300 cfs in an attempt to more closely simulate natural flow regimes and seasonal water temperatures downstream from the dam. These modifications are anticipated to aide in recovery of the boulder darter and other federally listed aquatic species in the Elk River. Current minimum summer flow releases at the dam average 210 cfs. TVA has foregone use of the large hydrogenation unit at Tims Ford Dam during these critical periods (U.S. Fish and Wildlife Service 2013).

If Tims Ford Dam modifications to address unnatural flow regimes and temperature fluctuations in the Elk River are unsuccessful, listed species will continue to occur in low numbers and be at risk of extinction. TVA is currently implementing an adaptive management process to determine which combination of sluicing, spilling, and hydropower generation at Tims Ford Dam will produce desired flow and temperature conditions for listed species. This process is ongoing, but is expected to improve habitat conditions for the boulder darter and federally listed freshwater mussels. In addition, the changes in O&M at Tims Ford Dam are anticipated to provide approximately 30 additional mi of boulder darter habitat by warming and stabilizing Elk River temperatures from approximately ERM 119 at the Beans Creek confluence, Lincoln County, Tennessee, downstream to ERM 90 at Fayetteville, allowing the darter to expand its current range upstream.

TVA's O&M modifications will require several years of studies and evaluation via a multi-agency working group, consisting of TVA staff and representatives from the Service, U.S. Geological Survey, and Alabama and Tennessee state fish and wildlife agencies, to assess

operational changes implemented due to TVA's 2005-2006 consultation and its effects to federally listed species.

Land use in the action area is rural with the primary land use being agriculture (non-irrigated crop production and livestock grazing). Corn, grain and silage, wheat and soybeans are the main crops grown within the action area and near vicinity. Pasturelands, supporting beef and dairy cattle, also occur within the action area (USGS 7.5 Minute Series, Boonhill Quadrangle Topographic Map; Natural Resources Conservation Service 2014).

A 97-RM reach of the Elk River in Giles, Lincoln, Moore and Franklin counties, Tennessee, from ERM 33 to ERM 130 is listed on the Nationwide Rivers Inventory. The action area lies within this reach. The National Park Service recognizes this segment of the river for its Outstanding Resource Values, including Scenery, Recreation, Fish, Wildlife, History and Culture (Tennessee Valley Authority 2008).

The State of Tennessee has listed 13.91 mi of the Elk River in Lincoln County as impaired on their Final YEAR 2012 303(d) LIST (List), the most current List available (Tennessee Department of Environment and Conservation 2014). On the List, *Escherichia coli* is identified as a pollutant occurring in this river reach and pasture grazing as the pollutant source. The reach was assessed as Category 5, which indicates that one or more designated uses are not being met and a Total Maximum Daily Load (TMDL) study is needed to address *Escherichia coli*. The TMDL is prioritized as "HIGH" on the List, denoting that, tools are available to produce the TMDL, the stream (i.e., the 13.91-RM reach) is in one of the watersheds being studied in the next two years, and the TMDL will be produced in the next two years (Tennessee Department of Environment and Conservation 2014).

Status of the species and critical habitat within the action area

The 17.7-ac project action area would be in Lincoln County, Tennessee, and contain the following aquatic and terrestrial areas: (1) approximately 7.5 ac of aquatic areas, which would encompass portions of the proposed project footprint, and include the entire active Elk River channel beginning approximately 50 ft upstream of the proposed water intake site at ERM 75.3 and extending downstream approximately 0.4-RM to ERM 74.9, and (2) terrestrial areas comprised of the 10.2-ac proposed plant site, which would encompass terrestrial portions of the project footprint, on the south riverbank and within the floodplain in the immediate vicinity of the proposed action at ERM 75.3. The action area was determined based upon information provided: (1) in the biological assessment (Tennessee Valley Authority 2014a), (2) communication with TVA (Strickland, personal communication, 2014; Howard, personal communication, 2014a, 2014b), (3) recent occurrence records of boulder darters in the vicinity of the proposed project site (Rakes and Shute 2006; Saylor, personal communication, 2011a, 2011b), (4) the final rule, designating critical habitat for the fluted kidneyshell and slabside pearlymussel (78 FR 59556 – 59620), and (5) assessments by the Tennessee Valley Authority (2014a) and the Service, regarding the nature of proposed work activities to potentially affect boulder darters.

Based upon the following occurrence records, a total of 13 boulder darters have been collected or observed in the action area since 2000: (1) five individuals sampled by TVA at ERM 75 on July 26, 2000 (Saylor, personal communication, 2011a), (2) six individuals sampled by CFI at ERM 75 on August 25, 2005 (Rakes and Shute 2006), (3) one individual sampled by TVA at ERM 75 on August 8, 2006 (Saylor, personal communication, 2011a), and (4) one individual sampled by TVA and TTU at ERM 75.3 in November 2011 (Saylor, personal communication, 2011b). Therefore, based upon these recent occurrences within the action area, the Service assumes that boulder darters likely continue to occur there, and work activities associated with the proposed action could potentially affect any individuals present within the action area.

Critical habitat for the fluted kidneyshell (Critical Habitat Unit FK 22) and Slabside Pearlymussel (Critical Habitat Unit SP 10) was recently designated throughout approximately 102.1 RMs of the Elk River from its inundation at Wheeler Reservoir in Limestone County, Alabama (approximately ERM 21.9), upstream to its confluence with Farris Creek at the dividing line between Franklin and Moore counties, Tennessee (approximately ERM 124) (78 FR 59556 – 59620). The 0.4-RM action area (approximately ERM 74.9 – ERM 75.3) would be located within the designated critical habitat units, and work activities associated with the proposed action could potentially impact this critical habitat.

Factors affecting the species and critical habitat within the action area

While TVA modified annual O&M at Tims Ford Dam in 2008 and continue to operate under this scenario in an attempt to ameliorate the effects of the dam on federally listed aquatic species (previously described in the "Environmental Baseline"), the previous O&M scenario involved year-round cold water releases and peaking hydropower flows which affected listed aquatic species from Tims Ford Dam at ERM 133.3 in Franklin County, Tennessee, downstream to approximately ERM 28 (the slackwaters of Wheeler Reservoir) in Limestone County, Alabama) over nearly a 40-year period. The action area is located at ERM 75.3, within this 105, plus (+) mi reach of the Elk River where listed species were affected by TVA's prior O&M activities. Impacts from these historical O&M activities (reduced habitat, riverbank erosion, etc.) continue to affect the boulder darter and recently designated (2013) critical habitat for the fluted kidneyshell and slabside pearlymussel within the action area. Therefore, this section also includes a discussion on the effects of historical O&M activities on the boulder darter and critical habitat for the fluted kidneyshell and slabside pearlymussel in the action area. Hydropower operations continue to be implemented at Tims Ford Dam throughout winter months (October 16 – April 30) and emergency hydro-generation initiated on an as-needed basis.

Storage-peaking facilities can have far-reaching effects on aquatic life (Fraley 2002). Dams with hypolimnetic, or bottom intakes can discharge water that is substantially colder than previous pre-impoundment conditions and cause significant effects in dam tailwaters (Ward and Stanford 1979a; Watters 2000; Miller et al. 1984). These colder conditions can significantly alter ecological processes and aquatic community structure (Fraley 2002). The only naturally occurring boulder darter population, rare mussel species and fish species, which serve as hosts for rare mussel species during their reproductive periods, were affected by pulses of cold water from Tims Ford Dam O&M activities; these pulses reduced water temperatures in the tailwaters

for many miles downstream and likely resulted in thermal shock to these species, for nearly four decades.

Water quality degradation as a result of cold water releases through Tim's Ford Dam have impacted the mussel fauna in the Elk River (Ahlstedt 1986), including the action area. Mussel growth, condition, and short term survival can be adversely affected by cold tailwater conditions (Cahn 1936; Isom 1971). Cold water conditions can directly curtail reproduction in many mussel species, apparently through physiological changes that can disrupt gamete production (Heinricher and Layzer 1999; McMahon 1991; Yokely 1972). Cold tailwaters can also indirectly affect mussel reproduction by eliminating warm-water fish hosts (Tarzwell 1939; Dendy and Stroud 1949; Pfitzer 1962).

One of the most obvious downstream effects produced by storage-peaking hydroelectric facilities is an altered flow regime or stream hydrology. Flow is altered in two fundamental ways in tailwaters downstream from these dams: (1) daily flow variability is increased and (2) seasonal variability is decreased. These alterations can affect a stream many miles downstream from a dam, often much farther than any other dam-related effect. The result is a hydrograph that has little in common with natural cycles or historical flow patterns (Fraley 2002).

Prior to construction of Tims Ford Dam, annual high flows during spring months flushed the Elk River of sediments. These natural events no longer occurred after Tims Ford Dam was constructed and closed, except at random intervals when implementation of flood control operations was necessitated. Peaking hydropower operations caused fluctuations in Elk River water levels that de-watered and fragmented areas supporting suitable habitat for the boulder darter and freshwater mussels, including the fluted kidneyshell and slabside pearlymussel, resulting in erosion of riverbanks and increased sedimentation of the river and increased habitat instability (Tennessee Valley Authority 2008). Activities that contribute sediment discharges into a stream system can lead to destruction of riparian vegetation, bank collapse, excessive instream sediment deposition, and increased water turbidity and temperatures (Waters 1995).

In free-flowing rivers, spatial distribution and species composition of mussel communities are influenced directly and indirectly by characteristics of the flow regime (Di Maio and Corkum 1995; Layzer and Madison 1995; Strayer 1993, 1999; Vannote and Minshall 1982). Alterations to these natural characteristics and patterns of flow typically result in adverse effects on mussel communities in tailwaters (Fraley 2002). Daily fluctuations for peaking power production can dewater shallow areas in the tailwater; mussels cannot tolerate prolonged periods of dewatering (Blinn et al. 1995; Fisher and LaVoy 1972; Moog 1993; Neck and Howells 1994). Observations in the Cherokee Dam tailwater of the Holston River in eastern Tennessee indicate that mussels have been eliminated from shallow riffles that were dewatered more or less daily over several decades prior to adoption of minimum flow releases (TVA unpublished data, as cited in Fraley 2002). Mussel reproductive activities may be affected by both daily and seasonal variations in flow (Fraley 2002). The cycle of low flow periods that allow shallow areas to warm followed by abrupt cold water releases from the reservoir's hypolimnion can result in rapid temperature fluctuations that can cause some gravid mussels to abort developing glochidia (Matteson 1948).

Recruitment of juvenile mussels may also be affected by altered flow regimes. Mussels evolved in free-flowing streams with certain natural, seasonal characteristics of discharge. Daily peaking discharge and seasonal storage (late winter-spring) and release (late summer-autumn) result in a hydrograph that rarely, or only inconsistently, resembles the natural, seasonal patterns. Many mussel reproductive strategies appear to be adapted to typical seasonal flow patterns and the resulting host fish behavioral patterns (Fraley 2002).

Studies indicate that higher density mussel beds are often associated with relatively lower velocities at the stream bottom (Way et al. 1989; Strayer and Ralley 1993; Layzer and Madison 1995). Moreover, near-bottom shear stresses and other complex hydraulic variables associated with high flows may inhibit settlement and subsequent recruitment of juvenile mussels, when high flows coincide with time periods when early juveniles drop from their fish hosts (Layzer and Madison 1995; Hardison and Layzer 2001). Peaking discharges can result in daily flows that may approximate several flood events in a given season (especially mid-summer through mid-autumn); as a result, settlement of juvenile mussels in suitable habitats may be inhibited (Fraley 2002).

Changes in fish and macroinvertebrate communities in cold tailwaters are generally drastic and can happen relatively quickly following impoundment (Pfitzer 1962; Ward and Stanford 1979b). While boulder darters have continued to persist in the action area, every life history stage of the species has been affected in the action area and at other sites within the 105+ mi reach of the Elk River, impacted by past Tims Ford Dam O&M activities (U.S. Fish and Wildlife Service 2006). Minimum flows of 80 cfs at Tims Ford Dam and 120 cfs at Fayetteville have created marginally suitable habitat conditions for spawning, development of fry and growth of juvenile boulder darters at a few sites scattered throughout approximately 64 RMs of the Elk River, including portions of the action area. The species is apparently not resilient to habitat changes (i.e., when crevices under slab rocks become obstructed with silt, the fish no longer use those areas for spawning and cover) and seek out and utilize what little remaining suitable habitat is available.

Because fish host species for the fluted kidneyshell and slabside pearlymussel persist in the Elk River and a limited number of mussel surveys have been conducted in the Elk River in recent decades, the fluted kidneyshell could continue to exist in the Elk River and both mussel species may potentially occur within the action area, albeit in low numbers. According to Layzer et al. (1993) and Ahlstedt and Fraley (2000), some individual adult mussels may persist for many years following impoundment; although, most mussel species are eventually eliminated entirely from cold tailwaters (Ahlstedt 1983, 1984; Layzer et al. 1993; Miller et al. 1984; Yeager et al. 1987).

Annual operational changes initiated by TVA at Tims Ford Dam in 2008 involve a combination of sluicing, spilling and hydro-generation with the intent of simulating, as near as reasonably possible, in light of the existence of the dam, natural flow regimes and water temperatures downstream of the dam. This process is expected to reduce unnatural flow variability and warm spring and summer tailwater temperatures, improving habitat conditions for the boulder darter, fluted kidneyshell, slabside pearlymussel and other listed mussel species in the action area and the rest of the 105+ RM reach of the Elk River where the species was affected by TVA's

historical O&M activities, and assist in recovery of these species. It remains too early to determine if the recent changes in O&M at Tims Ford Dam will aide in their recovery.

Structured decision making/adaptive management models are currently under development to further guide TVA in modifying operations associated with hydropower generation at Tims Ford Dam to aide in recovery of listed aquatic species and monitor effects of operational changes. Hydro-generation which results in peaking operations and variable flows throughout winter months (October 16–April 30) continues to contribute to riverbank erosion and result in sedimentation of stream substrate, decreasing habitat suitability and diversity throughout the action area and at other sites within the Elk River, downstream of Tims Ford Dam, and remains a threat to the continued existence and recovery of the boulder darter and designated critical habitat for the fluted kidneyshell and slabside pearlymussel in the action area.

Other threats to the boulder darter and designated critical habitat for the fluted kidneyshell and slabside pearlymussel in the action area include human-induced physical habitat destruction, siltation, NPS pollution, agricultural practices and potential toxic chemical spills (U.S. Fish and Wildlife Service 1989, 2013; Tennessee Department of Environment and Conservation 2014); often impacts to these species are a result of a combination of several of these threats. Physical habitat destruction results from a variety of human-induced impacts such as removal of riparian vegetation, and modification of the stream channel and floodplain for agricultural, road building and maintenance and urban development activities. Siltation caused by excessive releases of sediment into waterways from activities such as poor agricultural practices (absence of pasture rotation plans, failure to restrict grazing during wet periods, lack of contour farming practices, not planting permanent vegetative cover, failure to return crop residue to the soil, etc.), and road construction and maintenance results in significant impacts to aquatic life (Waters 1995; Natural Resources Conservation Service 2014).

NPS pollution from land surface runoff can originate from virtually any land use activity within the action area and may be correlated with impervious surfaces and storm water runoff. Pollutants may include sediments, fertilizers, herbicides, pesticides, animal wastes, septic tank and gray-water leakage, and petroleum products (Tennessee Department of Environment and Conservation 2014). These pollutants tend to increase concentrations of nutrients and toxins in waterways and alter water chemistry, negatively impacting habitat and food sources for fish and freshwater mussels. Road construction and maintenance activities typically involve earth-moving activities that can increase sediment loads into nearby streams. Other siltation sources, including clearing of riparian vegetation and agricultural practices, allow exposed earth to enter waterways during or after precipitation events (U.S. Fish and Wildlife Service 2013).

Sediment has been shown to abrade and/or suffocate bottom-dwelling algae and other organisms by clogging gills; reducing aquatic insect diversity and abundance; impairing fish feeding behavior by altering prey base and reducing visibility of prey; impairing reproduction by burying nests; and, ultimately, negatively impacting fish growth, survival and reproduction (Waters 1995). Wood and Armitage (1997) identified at least five impacts of sedimentation on fish, including (1) reduction of growth rate, disease tolerance, and impairment of gill function; (2) reduction of spawning habitat and egg, larva, and juvenile development; (3) modification of

migration patterns; (4) reduction of food availability through the blockage of primary production; and (5) reduction of foraging efficiency.

Ellis (1936) found that mussels could not survive in substrate on which approximately 0.25 to 1-in of silt was allowed to accumulate; death was attributed to interference with feeding and suffocation. Ellis (1936) further determined that siltation from soil erosion reduced light penetration, altered heat exchange in the water, and allowed organic and toxic substances to be carried to the bottom where they were retained for long periods of time. This resulted in further oxygen depletion and possible absorption of these toxicants by mussels (Harman 1974). Sediment loads during high discharge may be abrasive to mollusk shells (U.S. Fish and Wildlife Service 1984). Erosion of the periostracum allows carbonic and other acids to reach and corrode underlying shell layers (Harman 1974). Feeding mollusks respond to heavy siltation by instinctive closure of their valves, since irritation and clogging of the gills and other feeding structures occurs when suspended sediments are siphoned from the water column (Loar et al. 1980). Numerous studies have documented the adverse effects of human-induced sedimentation on fish communities, but few studies have examined how these effects influence the availability of suitable host fish for freshwater mussels; more quantitative work is needed to document the specific effects that changes in sediment regimes have on host fish-mussel interactions, including how increased turbidity affects the reproductive success of mussels that use visual lures to attract hosts (Brim Box and Mossa 1999). The effects of threats contributing to sedimentation in the action area will likely increase as human populations grow in the Elk River watershed in response to human demands for food resources, housing, transportation, and places of employment (U.S. Fish and Wildlife Service 2012).

The boulder darter's limited geographic range in the Elk River drainage leaves the species extremely vulnerable to localized extinctions from accidental toxic chemical spills or other stochastic disturbances and to decreased fitness from reduced genetic diversity. Sources of such spills could include potential accidents in the action area involving vehicles transporting chemicals on roads adjacent to or crossing over the Elk River and accidental or intentional release into streams of chemicals used in agricultural or residential applications. Species that are restricted in range and population size are more likely to suffer loss of genetic diversity due to genetic drift, potentially increasing their susceptibility to inbreeding depression and decreasing their ability to adapt to environmental changes (Allendorf and Luikart 2007).

Designated critical habitat for the slabside pearlymussel (Critical Habitat Unit SP 10) continues to be occupied by the species at some localities in the Elk River. However, a recent mussel survey found no slabside pearlymussels within the action area, and a sparse mussel community with at least 12 live species occurring at very low densities and unfavorable habitat conditions (bedrock in a portion of the river channel) in the immediate vicinity of the proposed project (Lewis Environmental Consulting, LLC 2010). Designated critical habitat for the fluted kidneyshell (Critical Habitat Unit FK 22) in the Elk River is currently unoccupied by the species. The PCEs are the same for both species, with the exception of PCE Five) (i.e., the host fish species are different for the fluted kidneyshell and slabside pearlymussel, as indicated in "Species/critical habitat description", under the "Status of the Species/Critical Habitat" section). Therefore, any factors affecting their critical habitat in the action would be similar.

EFFECTS OF THE ACTION

Factors to be considered

This section includes an analysis of the direct and indirect effects of the proposed action on the species and/or critical habitat and its interrelated and interdependent activities.

Proximity of the action:

The action area would be located within: (1) the known, occupied range of the federally listed boulder darter, (2) designated critical habitat for the federally listed fluted kidneyshell (Critical Habitat Unit FK 22), and (3) designated critical habitat for the federally listed slabside pearlymussel (Critical Habitat Unit SP 10). As mentioned in the "Analysis of the species/critical habitat likely to be affected", other federally listed species are not addressed in this biological opinion because it has been determined that the proposed action would not likely adversely affect them.

The proposed action would occur within the mainstem Elk River, on the left descending riverbank and in adjacent floodplain areas, south of the river, in west-central Lincoln County, Tennessee. The action area would contain approximately 17.7 ac, including the full, wetted channel width of the Elk River beginning approximately 50 ft upstream of the proposed water intake site at ERM 75.3 and extending downstream approximately 0.4-RM to ERM 74.9, and all terrestrial lands within the proposed project footprint. The action area would be in a rural setting, comprised of the river channel, riparian corridor, small woodlots, agricultural lands (pasture and crop lands) and roads.

The boulder darter would likely occur in the action area based upon boulder darter occurrence records documenting presence in the action area at the proposed project site (ERM 75.3) and approximately 0.3-RM downstream (ERM 75) of the proposed project site (Rakes and Shute 2006; Saylor, personal communication, 2011a, 2011b). Designated critical habitat for the fluted kidneyshell is currently presumed to be unoccupied in the Elk River, and therefore, would be unoccupied in the action area. Slabside pearlymussels have been observed in designated critical habitat in the Elk River (Tennessee Valley Authority 2009; 77 FR 60811-60812), but none have been found within the action area.

The project action area has been defined based upon an assessment of where direct and indirect effects, caused by the action, could occur to boulder darters and designated critical habitat for the fluted kidneyshell and slabside pearlymussel; these effects could include temporary increases in suspended sediments in the Elk River and accidental spilling of petroleum products as a result of proposed instream and terrestrial work activities, and could transpire at the proposed project site and up to an estimated 0.4-RM distance downstream of the project site.

Distribution:

The action area would encompass the project footprint and all other areas where the boulder darter would be directly and indirectly affected, and designated critical habitat for the fluted kidneyshell and slabside pearlymussel would be indirectly affected by the proposed action. The action area would: (1) total approximately 17.7 ac; (2) include approximately 7.5 ac of aquatic area below the OHW, averaging 150 ft wide in the Elk River, from ERM 75.3 downstream 0.4-RM to ERM 74.9; and (3) include 10.2 ac of terrestrial area above the OHW, comprised of riverbank and floodplain areas (Tennessee Valley Authority 2014a).

The project footprint would include a total of approximately 1.6 ac of aquatic and terrestrial areas. Approximately 0.08-ac of the project footprint would include those aquatic areas below the OHW that would be directly affected by proposed instream construction activities in the Elk River (areas where cofferdam construction, and riverbank fill excavation and removal would occur) (Tennessee Valley Authority 2014a; Howard, personal communication, 2014a). The remaining 1.5 ac of the project footprint would occupy terrestrial areas above the OHW (areas where water treatment plant construction, crane operation, equipment staging (cleaning, refueling and storage), work/laydown, fill excavation, water intake construction, ground disturbance, vegetation removal, excavated fill placement, waterline path excavation and equipment transportation would occur) (Tennessee Valley Authority 2014a; Strickland, personal communication, 2014a; Howard, personal communication, 2014a).

Timing:

The proposed action can be divided into essentially two periods, an implementation (construction) phase and a post-implementation (operational) phase. Boulder darters and designated critical habitat for the fluted kidneyshell and slabside pearlymussel could potentially be affected during one or both of the two phases.

Young-of-year (YOY) boulder darters could be affected during the implementation phase because LCBPU has indicated that proposed instream construction activities would occur from June 1 to September 1 (Howard, personal communication, 2014c), a period when larval boulder darters could drift through and/or juveniles might occupy the action area (any time between approximately April 1 and September 30 [Rakes and Shute, personal communication, 2014]). YOY could also be affected during the post-implementation phase if larval boulder darters became impinged on the intake screen or entrained within the proposed intake structure during project operations.

Individuals at various life stages, occupying areas downstream of the project footprint, could be affected during the implementation phase as a result of water quality impacts (suspended sediments and potential spills of petroleum products) created by construction activities. The post-implementation phase of the proposed action would occur year-round into the foreseeable future and could also potentially affect boulder darters at various life stages if any of the proposed project components malfunctioned (e.g., riverbank sloughing due to banks not being properly stabilized during the implementation phase, etc.).

Designated critical habitat for the fluted kidneyshell and slabside pearlymussel could be affected by proposed instream construction activities during the implementation phase and failure of project components during the post-implementation phase (e.g., riverbank sloughing due to banks not being properly stabilized, etc.).

Nature of the effects:

It is possible that the proposed action could have a variety of effects on individual boulder darters and designated critical habitat for the fluted kidneyshell and slabside pearlymussel. Depending upon when proposed implementation and post-implementation activities would occur, the lifecycles of the boulder darter and fish host species for the fluted kidneyshell and slabside pearlymussel could potentially be disturbed or disrupted.

The proposed action could potentially result in the following effects to the boulder darter: (a) direct injury or mortality as a result of being crushed or becoming physically impaired due to proposed instream construction activities (excavation of the riverbank and riverbed for installation of the new surface water intake structure, construction of the intake structure, placement of fill around the intake structure, construction of the cofferdam, and dewatering of areas inside of the cofferdam), (b) direct injury or mortality as a result of turbidity and/or deposition of sediment, created by instream construction activities and/or construction activities adjacent to the Elk River (erosion as a result of heavy equipment disturbing soils, removing riparian vegetation, etc.), obstructing their gills, and reducing their ability to feed or respire in the project vicinity, (c) direct injury or mortality as a result of pollutants (spills of petroleum products from hydraulic, fuel and power systems, etc.) accidentally entering the Elk River from construction equipment, affecting water quality and food sources, and in turn their respiration and feeding capabilities in the project vicinity, (d) direct injury or mortality as a result of becoming impinged against the intake screen or passing through the screen and becoming entrained within the intake structure, (e) indirect injury as a result of turbidity and/or deposition of sediment from upstream construction activities, compelling individuals to swim to other areas with potentially less suitable forage and habitat conditions, (f) indirect injury or mortality as a result of pollutants (spills of petroleum products from hydraulic, fuel and power systems, etc.) accidently entering the Elk River from construction equipment adjacent to the river, affecting water quality and food sources, and in turn respiration and feeding capabilities of individuals downstream of project construction, (g) indirect injury as a result of elevated levels of suspended sediments impacting water quality and flushes of sediment covering suitable habitat downstream of the project site, caused by post-project failure(s), reducing their ability to feed and/or respire, and/or increasing their vulnerability to disease, and (h) indirect injury as a result of changes in channel morphology at the project site during the post-implementation phase, caused by the intake structure and fill occupying areas of the river channel and bank, and the intake withdrawing instream flows, reducing available habitat for the species in the immediate project vicinity.

The proposed action could potentially result in the following effects to designated critical habitat for the fluted kidneyshell and slabside pearlymussel: (a) indirect loss of PCE One because the geomorphic stability of the channel would be affected and the riverbed elevation degraded, as a result of a reduction in wetted channel perimeter from intake withdrawals, and the intake

structure and fill materials (shot rock, native material and excess excavated materials) occupying areas in the river channel and on the bank, altering channel form and function at the site, including the bankfull width, bankfull mean and maximum depths, entrenchment ratio, width/depth ratio, bankfull cross-sectional area, discharges, velocities, flow patterns, and potentially other morphological characteristics, (2) indirect loss of PCE Five because the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel, could be affected as a result of being crushed or becoming physically impaired due to proposed instream construction activities (excavation of the riverbank and riverbed for installation of the new surface water intake structure, construction of the intake structure, placement of fill around the intake structure, construction of the cofferdam, and dewatering of areas inside of the cofferdam), (3) indirect loss of PCE Five because the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel, could be affected as a result of turbidity and/or deposition of sediment, created by instream construction activities and/or construction activities adjacent to the Elk River (erosion as a result of heavy equipment disturbing soils, removing riparian vegetation, etc.), obstructing their gills, and reducing their ability to feed or respire in the project vicinity, (4) indirect loss of PCE Five because the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel, could be affected as a result of pollutants (spills of petroleum products from hydraulic, fuel and power systems, etc.) accidentally entering the Elk River from construction equipment, affecting water quality and food sources, and in turn their respiration and feeding capabilities in the project vicinity and downstream of project construction, (5) indirect loss of PCE Five because the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel, could be affected as a result of becoming impinged against the intake screen or passing through the screen and becoming entrained within the intake structure, (6) indirect loss of PCE Five because the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel, could be affected as a result of turbidity and/or deposition of sediment from upstream construction activities, compelling individuals to swim to other areas with potentially less suitable forage and habitat conditions, and (7) indirect loss of PCE Five because the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel, could be affected as a result of elevated levels of suspended sediments impacting water quality and flushes of sediment covering suitable habitat downstream of the project site, caused by post-project failure(s), reducing their ability to feed and/or respire, and/or increasing their vulnerability to disease.

Duration:

During the implementation phase, potential effects to boulder darters and designated critical habitat for the fluted kidneyshell and slabside pearlymussel in the action area would be temporary and could be the result of boulder darters and host fish species for the fluted kidneyshell and slabside pearlymussel colliding with instream equipment, increased turbidity levels and sediment deposition in the Elk River from proposed construction activities, and/or accidental spills of petroleum products into the Elk River.

The post-implementation phase could potentially include a combination of temporary, long-term duration and/or permanent effects to boulder darters and designated critical habitat for the fluted

kidneyshell and slabside pearlymussel in the action area. Temporary effects might include, increased turbidity levels downstream of the site during the first several days following installation of the intake structure, placement of fill in the riverbank surrounding the intake structure and removal of the cofferdam. Whereas, long-term or permanent effects might include, changes in stream hydraulics and channel stability as a result of the intake structure and fill material (shot rock, native material and excess excavated materials) being placed in the river channel and bank, loss of wetted-channel perimeter and suitable boulder darter habitat and designated critical habitat for the fluted kidneyshell and slabside pearlymussel in the vicinity of the intake structure, and impingement of boulder darter larvae and host fish species for the fluted kidneyshell and slabside pearlymussel against the intake screen or larvae passing through the screen where they could become entrained within the intake structure. Failure of the project (riverbank sloughing, intake structure design not conducive to minimizing impingement and entrainment impacts of boulder darters and host fish species for the fluted kidneyshell and slabside pearlymussel, etc.) during the post-implementation phase could result in either temporary effects (e.g., a brief episode of turbidity and/or sedimentation to downstream locations caused by minor erosion, and/or the intake screen being damaged or dislodged by debris, causing entrainment of boulder darters and host fish species for the fluted kidneyshell and slabside pearlymussel within the intake structure over several hours or days, until repaired), long-term (e.g., continued turbid conditions and flushes of sediment covering habitat downstream of the project site due to ongoing riverbank and/or channel stability issues at the project site, and/or the intake design resulting in impingement and entrainment of boulder darters and host fish species for the fluted kidneyshell and slabside pearlymussel, and not being addressed over a period of months or years), or permanent (e.g., the character of the stream channel would be permanently changed due to catastrophic bank failure, or loss of suitable habitat for boulder darters and designated critical habitat for the fluted kidneyshell and slabside pearlymussel in the vicinity of the intake would result in boulder darters and host fish species for the fluted kidneyshell and slabside pearlymussel no longer inhabiting this area); these effects would be caused by flawed intake structure design and lack of project effectiveness monitoring, and/or lack of project maintenance). The effects of potential operational changes would not be known until sufficient post-implementation monitoring were conducted to determine if installed project components had resulted in any effects to boulder darters, impacts to boulder darters' suitable habitat, and/or effects to designated critical habitat for the fluted kidneyshell and slabside pearlymussel, including their host fish species.

Disturbance frequency:

Any disturbances to boulder darters and host fish species for the fluted kidneyshell and slabside pearlymussel during the implementation phase would be restricted to the proposed April 3, 2018 through September 19, 2020, construction window (Howard, personal communication, 2014c). Instream work activities would have the greatest potential to disturb boulder darters and host fish species for the fluted kidneyshell and slabside pearlymussel, and could occur within the proposed instream construction window from June 1 through September 1, 2018 (Howard, personal communication, 2014c). Proposed construction activities have the potential to temporarily alter flows, increase turbidity levels and sediment deposition, and/or accidentally result in accidental spills of petroleum products into the Elk River, but overall would likely only produce these effects over a short-time period. Individual boulder darters and host fish species for the fluted

kidneyshell and slabside pearlymussel could also inadvertently be injured or killed by heavy equipment operating in the Elk River during the proposed instream work period.

Disturbances during the post-implementation phase could vary in frequency from a one-time event, multiple occurrences, frequent occurrences or be continuous, depending upon the nature of the disturbance (e.g., disturbance frequency associated with bank failure and subsequent downstream turbidity and sedimentation could be continuous if bank sloughing was ongoing).

Disturbance intensity:

During the implementation phase, the disturbance intensity would be highest in the action area where instream work activities would be carried out (approximately 0.08-ac) in suitable boulder darter habitat and designated critical habitat for the fluted kidneyshell and slabside pearlymussel in the right descending half of the Elk River channel (Tennessee Valley Authority 2014a). Such activities would potentially have the greatest risk of mortality or injury to boulder darters and host fish species for the fluted kidneyshell and slabside pearlymussel. The disturbance intensity during the implementation phase would decrease in portions of the action area containing suitable boulder darter habitat and designated critical habitat for the fluted kidneyshell and slabside pearlymussel, further downstream from the 0.08-ac area where instream construction would occur because boulder darters, host fish species for the fluted kidneyshell and slabside pearlymussel, and their habitats would be greater distances from project construction. The disturbance intensity during the implementation phase would be lowest in downstream portions of the action area not containing suitable habitat for the boulder darter because the species would be unlikely to occupy such localities; designated critical habitat for the fluted kidneyshell and slabside pearlymussel would be present in these areas, but is assumed to be unoccupied by the fluted kidneyshell (as elsewhere in the Elk River) and is not currently known to be occupied by the slabside pearlymussel (although the species has recently been found in other reaches of the Elk River).

Because intrusive instream construction activities and their effects (increased turbidity and/or deposition of sediment, potential petroleum product spills, etc.) would no longer be occurring during the post-implementation phase (unless there would be post-project failures resulting in increased erosion and sediment delivery to the river), the disturbance intensity would be anticipated to be much lower throughout the entire action area during the post-implementation phase than during the implementation phase. Properly functioning, post-construction best management practices (BMPs) would also be expected to minimize and stabilize project-related disturbances to boulder darters and designated critical habitat for the fluted kidneyshell and slabside pearlymussel during the post-implementation phase. However, for any disturbances that might potentially occur during the post-implementation phase, disturbance intensity would be similar to disturbance intensity during the implementation phase, in the regard that higher intensities would occur in suitable habitat for the boulder darter and designated critical habitat for the fluted kidneyshell and slabside pearlymussel, and lower intensities would occur in areas not containing suitable habitat for the boulder darter, again, because the boulder darter would be unlikely to occupy marginal or unsuitable habitat; as previously stated, designated critical habitat for the fluted kidneyshell and slabside pearlymussel would be present in these areas, but neither species is believed to currently occur within the action area.

Although the Elk River and several of its tributaries (Indian, Richland and Shoal creeks) support the only naturally occurring boulder darter population, the total number of boulder darters that would be affected by the proposed action's implementation and post-implementation phases, relative to its range-wide distribution in the Elk River basin, would be small. Therefore, a very low percentage of boulder darters, range-wide, would likely be affected as a result of exposure to the action's higher disturbance intensities.

Critical habitat for the fluted kidneyshell and slabside pearlymussel has been designated throughout 102.1 RMs of the Elk River (78 FR 59556 – 59620). Designated critical habitat for these species occurs throughout the 0.4-RM action area. Therefore, a minimal amount of designated critical habitat for the fluted kidneyshell and slabside pearlymussel could potentially be affected (0.4-RM [2,112 linear ft]) by the proposed action's implementation and post-implementation phases, relative to the total amount of critical habitat designated for these species in the Elk River (102.1 RMs [539,088 linear ft]), and a much smaller amount of critical habitat (0.06-RM [325 linear ft]) would likely be affected as a result of exposure to the action's higher disturbance intensities.

Disturbance severity:

The 64-RM boulder darter occupancy reach of the mainstem Elk River, contains pockets of suitable boulder darter habitat scattered throughout approximately 1,164 ac (337,920 linear ft x 150 ft wide / 43,560 ft² [1 ac]). Designated critical habitat for the fluted kidneyshell and slabside pearlymussel occurs throughout 102.1 RMs or approximately 1,856 ac (539,088 linear ft x 150 ft wide / 43,560 ft² [1 ac]) of the Elk River (78 FR 59556 – 59620). Within the action area, the highest disturbance severity to the boulder darter and designated critical habitat for the fluted kidneyshell and slabside pearlymussel would occur in the 0.08-ac (3,398 ft²) portion of the project footprint where instream construction activities would occur (below the OHW and within the active channel of the Elk River).

The disturbance severity of the project implementation phase would be minimal to boulder darters and designated critical habitat for the fluted kidneyshell and slabside pearlymussel because the total area of disturbance below the OHW of the Elk River would be small. The size of this area would be approximately 0.08-ac (3,398 ft^2) (Tennessee Valley Authority 2014a; Howard, personal communication, 2014a). Pockets of suitable boulder darter habitat would be scattered throughout it. This 0.08-ac area would represent only 0.007% (0.08-ac x 100% / 1,164 ac) of the boulder darter's total 1,164 ac occupancy area. Assuming that approximately 10% of the total area of disturbance (0.08-ac x 10% / 100% = 0.008-ac) consisted of suitable boulder darter habitat and that approximately 10% of the boulder darter's total occupancy area (1,164 ac x 10% / 100% = 116.4 ac) consists of suitable habitat, only 0.007% (0.008-ac x 100% / 116.4 ac) of suitable boulder darter habitat would be disturbed during the project implementation phase. The 0.08-ac disturbance area would represent only 0.004% (0.08-ac x 100% / 1,856 ac) of 102.1 RMs (approximately 1,856 ac) of designated Elk River fluted kidneyshell and slabside pearlymussel critical habitat that would be disturbed during the project implementation phase.

The disturbance severity of the post-implementation phase would be minimal to boulder darters and designated critical habitat for the fluted kidneyshell and slabside pearlymussel because the total area of disturbance below the OHW of the Elk River, related to operational aspects of the proposed project, would be small. The size of this area would be approximately 1.1 ac (refer to "Operational Impacts" on page 9, under "Description of the Project"), with pockets of suitable boulder darter habitat scattered throughout it. This 1.1 ac area would represent only 0.10% (1.1 ac x 100% / 1,164 ac) of the boulder darter's total 1,164 ac occupancy area. Assuming that approximately 10% of the total area of disturbance (1.1 ac x 10% / 100% = 0.11-ac) consisted of suitable habitat and that approximately 10% of the boulder darter's total occupancy area (1,164 ac x 10% / 100% = 116.4 ac) consists of suitable habitat, only 0.10% (1.1 ac x 100% / 116.4 ac) of suitable boulder darter habitat would be disturbed during the post-implementation phase. The 1.1 ac disturbance area would represent only 0.06% (1.1 ac x 100% / 1,856 ac) of 102.1 RMs (approximately 1,856 ac) of designated Elk River fluted kidneyshell and slabside pearlymussel critical habitat that would be disturbed during the post-implementation phase.

Taken as a whole, the overall disturbance severity is minor. The estimated 0.08-ac area in the Elk River, disturbed during the implementation phase, would be encompassed by the larger 1.1 ac area, disturbed during the post-implementation phase, and included as part of the total suitable boulder darter habitat and designated fluted kidneyshell and slabside pearlymussel critical habitat affected by the proposed action. Approximately only 0.10% of all suitable boulder darter habitat (relative to the boulder darter's current distribution in the mainstem Elk River) and only 0.06% of all designated critical habitat for the fluted kidneyshell and slabside pearlymussel in the Elk River (relative to the estimated total of 1,856 ac of designated critical habitat) would be affected by the proposed action. Range-wide, the boulder darter is scattered throughout approximately 64 mi of the Elk River from ERM 28 upstream to ERM 91.8, and in several Elk River tributaries, including the lower 0.5-CM of Shoal Creek, the lower 0.5-CM of Indian Creek and the lower 2.1 mi of Richland Creek (based on 1986 through spring of 2014 occurrence data). Therefore, from a range-wide perspective, the disturbance severity to the boulder darter would be less than 0.10%. Range-wide, the Service has designated 1,180.5 RMs of critical habitat for the fluted kidneyshell and 970.3 RMs of critical habitat for the slabside pearlymussel. The 102.1 RMs of designated critical habitat in the Elk River represents 8.7% of all critical habitat throughout the fluted kidneyshell's range and 10.5% of all critical habitat throughout the slabside pearlymussel's range. Based on our earlier assumption that the 102.1 RMs of designated fluted kidneyshell and slabside pearlymussel critical habitat in the Elk River totals 1,856 ac and that the proposed action would affect approximately 1.1 ac (0.06%) of that critical habitat, approximately 0.06-RM of designated critical habitat in the Elk River (0.06% x 102.1 RMs / 100%) would be affected by the proposed action. Therefore, from a range-wide perspective, the disturbance severity to the fluted kidneyshell's designated critical habitat would be 0.005% (0.06-RM x 100% / 1,180.5 RMs), and the disturbance severity to the slabside pearlymussel's designated critical habitat would be 0.006% (0.06-RM x 100% / 970.3 RMs).

Analyses for effects of the action

Beneficial effects:

No wholly beneficial effects have been identified or would occur. The proposed action would result in adverse effects to the boulder darter within the action area.

Direct effects:

No direct effects would occur to designated critical habitat for the fluted kidneyshell and slabside pearlymussel as a result of the proposed action.

In order to be directly affected by the proposed action, boulder darters would need to be present in the 0.08-ac area of aquatic habitat where instream construction activities would occur during the implementation phase. Direct effects could occur to boulder darters in this area as a result of proposed instream construction activities (excavation of the riverbank and riverbed for installation of the new surface water intake structure, construction of the intake structure, placement of fill around the intake structure, construction of the cofferdam, and dewatering of areas inside of the cofferdam). Such activities could result in boulder darters accidently being crushed or physically impaired by construction equipment, workers or construction materials (sand bags used to construct the cofferdam, shot rock or other fill, etc.), resulting in injury or mortality. Proposed instream work could also increase turbidity and/or sediment deposition in the Elk River water column, obstructing the gills of boulder darters, and reducing their ability to feed and/or respire, resulting in injury or mortality.

Proposed construction activities on the riverbank, terraces and floodplain within the project footprint (vegetation disturbance and removal, riverbank excavation and fill placement, intake structure construction, waterline trench excavation, etc.) could cause erosion and result in turbid instream conditions and/or sediment deposition from overland and bank runoff, also directly affecting boulder darters in the immediate project vicinity by obstructing their gills and reducing their ability to feed and/or respire, resulting in injury or mortality.

Direct effects could occur to boulder darters in the immediate project vicinity as a result of pollutants (spills of petroleum products from hydraulic, fuel and power systems, etc.) accidentally entering the Elk River from construction equipment in the project area during project implementation, affecting water quality and food sources, and in turn their respiration and feeding capabilities, resulting in injury or mortality.

The raw water intake structure and screen, proposed to be constructed at ERM 75.3, could also directly affect the boulder darter. Following construction and after the project would be placed into operation (post-implementation phase), boulder darter larvae could become impinged against the intake screen or pass through the screen and become entrained within the intake structure, resulting in direct injury or mortality. This could occur if they drifted near the intake screen during the few days they were in a larval form. Impingement and/or entrainment of adult and juvenile boulder darters (in addition to larvae), could also be possible. However, because the intake structure would be designed to pass low velocities (approximately 0.5 fps at the intake

screen) to minimize potential impingements and/or entrainments of adults and juveniles (U.S. Environmental Protection Agency 2011; Tennessee Valley Authority 2014a), such effects to adults and juveniles would be much less likely to occur. All life stages of boulder darters (adult, juvenile and larval) could potentially be affected by impingement and/or entrainment if: (1) the intake structure design would prove to not be conducive to minimizing impingement and entrainment of more advanced life stages, (2) the intake screen would be temporarily damaged or dislodged by debris, causing entrainment of boulder darters within the intake structure, and/or (3) the condition of the intake structure/intake screen would not be adequately maintained or monitored, and/or effectiveness monitoring of the intake structure/intake screen would not occur for long periods of time or on a continuous basis, resulting in boulder darters being impinged against the intake screen or entrained within the intake. LCBPU has agreed to allow TVA to establish a monitoring station at the intake site to monitor boulder darter use of the area and document any trends in the number of individuals (either up or down) occupying the area (Tennessee Valley Authority 2014a). This should partially address effectiveness monitoring of the intake structure/intake screen.

In summary, the following direct effects to the boulder darter are possible:

1. Injury or mortality as a result of individuals being crushed or becoming physically impaired due to instream construction activities;

2. Injury or mortality to individuals in the immediate project vicinity as a result of turbidity and/or deposition of sediment, created by instream construction activities and construction activities adjacent to the river, obstructing their gills and reducing their ability to feed and/or respire;

3. Injury or mortality to individuals in the immediate project vicinity as a result of pollutants from the project's construction equipment accidentally entering the Elk River, affecting water quality and food sources, and in turn respiration and feeding capabilities;

4. Injury or mortality from becoming impinged against the intake screen or passing through the screen and becoming entrained within the intake structure.

Interrelated and interdependent actions:

No interrelated and interdependent actions have been identified for this project.

Indirect effects:

Any boulder darters downstream of the proposed project area could potentially be indirectly affected by proposed instream construction activities (excavation of the riverbank and riverbed for installation of the new surface water intake structure, construction of the intake structure, placement of fill around the intake structure, construction of the cofferdam, and dewatering of areas inside of the cofferdam) and/or proposed construction activities on the riverbank, terraces and floodplain adjacent to the Elk River (vegetation disturbance and removal, riverbank

excavation and fill placement, intake structure construction, waterline trench excavation, etc.) resulting in injury. These instream and near stream activities could result in suspended sediments being transported by flows to downstream areas and disturbing occupied boulder darter habitat by creating turbid conditions and/or depositing sediment on substrate, compelling individuals to relocate to other areas with potentially less suitable forage and habitat conditions, resulting in indirect injury.

Boulder darters in the action area, downstream of the proposed project site, could also be indirectly affected by accidental spills of petroleum products from hydraulic, fuel and power systems entering the Elk River during project implementation, resulting in injury or mortality. This would occur as a result of petroleum products from project construction equipment adjacent to the river (within the equipment staging areas, which would include an equipment cleaning, fueling, and storage site, and a work/laydown site) and operating on the riverbank accidently entering the river, affecting water quality and food sources, and in turn respiration and feeding capabilities of boulder darters.

Boulder darters in the action area, downstream of the project site, could be indirectly affected during the post-implementation phase by elevated levels of suspended sediments (turbidity) and flushes of sediment covering suitable habitat, as a result of failure(s) at the project site (e.g., riverbank sloughing due to banks not being properly stabilized during the implementation phase, etc.). Post-project failures could range from brief episodes of turbidity and/or sedimentation of substrate, ongoing riverbank and/or channel stability issues, or permanent changes in the character of the river channel due to catastrophic bank failure(s), impacting water quality in the Elk River, and reducing the ability of boulder darters to feed and/or respire and/or increasing their vulnerability to disease, resulting in indirect injury.

Changes in channel morphology at the project site would occur as a result of a reduction in wetted channel perimeter from the intake withdrawing instream flows, and the intake structure and fill materials (shot rock, native material and excess excavated materials) occupying areas in the river channel and on the bank, altering channel form and function at the site (bankfull width, bankfull mean and maximum depths, entrenchment ratio, width/depth ratio, bankfull cross-sectional area, discharges, velocities, flow patterns and potentially other morphological characteristics) during the post-implementation phase. These changes would indirectly affect the boulder darter by reducing available suitable habitat for the species in the immediate project vicinity, resulting in indirect injury. The changes would also result in an indirect loss of designated critical habitat for the fluted kidneyshell and slabside pearlymussel by impacting the geomorphic stability of the channel and degrading the riverbed elevation (PCE One). The Tennessee Valley Authority (2014a) indicated that a reduction in wetted channel perimeter, as a result of the proposed 4.0 mgd maximum intake withdrawals (approximately 5.6% of minimum flow), would result in approximately a 0.3 – 0.5-in (2.5 - 3.5%) decrease in depth in the project vicinity, based upon preliminary modeling included in LCBPU's TVA 26a Permit Application and considered this loss of a small amount of aquatic habitat discountable. The minimum flow at the location of the proposed water intake would be approximately 205 cfs, based upon the critical low flow rate derived by using USGS minimum low flow criterion for watersheds with sensitive species (Griggs & Maloney, Inc. 2012). This area of aquatic habitat was previously described (see "Operational Impacts" in the "Description of the Project" on page 9, and as indicated there,

the Service has increased the total operational impact area from 0.6-ac to 1.1 ac (encompasses and includes the 0.08-ac aquatic area, where instream work activities would occur during the project implementation phase) to reflect what we believe is the true extent of the impact area. The Service believes that the work implemented on the riverbank, and placement of the new intake structure and fill materials in the river channel and on the bank would also contribute to changes in channel morphology at the project site, which is why we have included it as part of the changes that would indirectly affect the boulder darter and designated critical habitat for the fluted kidneyshell and slabside pearlymussel. While the loss of habitat may be small and discountable (the Service estimates that the impact area would contain only 0.10% of all suitable boulder darter habitat in the in the mainstem Elk River and only 0.06% of all designated critical habitat for the fluted kidneyshell and slabside pearlymussel in the Elk River), it would still occur and, therefore, has been included as an indirect effect.

Indirect effects could occur to designated critical habitat for the fluted kidneyshell and slabside pearlymussel in the aquatic project footprint as a result of proposed instream construction activities (excavation of the riverbank and riverbed for installation of the new surface water intake structure, construction of the intake structure, placement of fill around the intake structure, construction of the cofferdam, and dewatering of areas inside of the cofferdam). Such activities could result in fish host species for the fluted kidneyshell and/or slabside pearlymussel accidently being crushed or physically impaired by construction equipment, workers or construction materials (sand bags used to construct the cofferdam, shot rock or other fill, etc.), resulting in an indirect loss of PCE Five (the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel).

Proposed instream work and/or construction activities adjacent to the Elk River (erosion as a result of heavy equipment disturbing soils, removing riparian vegetation, etc.) could also indirectly affect designated critical habitat for the fluted kidneyshell and slabside pearlymussel in the proposed project vicinity by increasing turbidity and/or sediment deposition in the Elk River water column, which could obstruct the gills of fish hosts for the fluted kidneyshell and/or slabside pearlymussel, and reduce their ability to feed and/or respire, resulting in an indirect loss of PCE Five (the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel).

Designated critical habitat for the fluted kidneyshell and slabside pearlymussel in the project vicinity and downstream of proposed project construction could be indirectly affected as a result of pollutants (spills of petroleum products from hydraulic, fuel and power systems, etc.) accidentally entering the Elk River from construction equipment, affecting water quality and food sources for fluted kidneyshell and/or slabside pearlymussel fish hosts, and in turn their respiration and feeding capabilities, resulting in an indirect loss of PCE Five (the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel).

The raw water intake structure and screen, proposed to be constructed at ERM 75.3, could indirectly affect designated critical habitat for the fluted kidneyshell and slabside pearlymussel. Following construction and after the project would be placed into operation (post-implementation phase), fish host species' larvae for the fluted kidneyshell and slabside

pearlymussel could become impinged against the intake screen or pass through the screen and become entrained within the intake structure, resulting in an indirect loss of PCE Five (the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel). This could occur if they drifted near the intake screen during the few days they were in a larval form. Impingement and/or entrainment of adult and juvenile fish hosts (in addition to larvae), could also be possible. However, because the intake structure would be designed to pass low velocities (approximately 0.5 fps at the intake screen) to minimize potential impingements and/or entrainments of adult and juvenile fish (U.S. Environmental Protection Agency 2011; Tennessee Valley Authority 2014a), such effects to adults and juveniles would be much less likely to occur.

Designated critical habitat for the fluted kidneyshell and slabside pearlymussel downstream of the proposed project area could potentially be indirectly affected by proposed instream construction activities (excavation of the riverbank and riverbed for installation of the new surface water intake structure, construction of the intake structure, placement of fill around the intake structure, construction of the cofferdam, and dewatering of areas inside of the cofferdam) and/or proposed construction activities on the riverbank, terraces and floodplain adjacent to the Elk River (vegetation disturbance and removal, riverbank excavation and fill placement, intake structure construction, waterline trench excavation, etc.). These instream and near stream activities could result in suspended sediments being transported downstream by flows to create turbid conditions and/or deposit sediment on substrate within designated critical habitat for the fluted kidneyshell and slabside pearlymussel, compelling fish host species for the fluted kidneyshell and slabside pearlymussel to relocate to other areas with potentially less suitable forage and habitat conditions, resulting in an indirect loss of PCE Five (the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel).

Designated critical habitat for the fluted kidneyshell and slabside pearlymussel in the action area, downstream of the project site, could be indirectly affected during the post-implementation phase by elevated levels of suspended sediments (turbidity) and flushes of sediment covering suitable habitat, as a result of failure(s) at the project site (e.g., riverbank sloughing due to banks not being properly stabilized during the implementation phase, etc.). Post-project failures could range from brief episodes of turbidity and/or sedimentation of substrate, ongoing riverbank and/or channel stability issues, or permanent changes in the character of the river channel due to catastrophic bank failure(s), impacting water quality in the Elk River, and, in turn, reducing the ability of fish host species for the fluted kidneyshell and slabside pearlymussel to feed and/or respire and/or increasing their vulnerability to disease, resulting in an indirect loss of PCE Five (the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel).

In summary, the following indirect effects to the boulder darter and designated critical habitat for the fluted kidneyshell and slabside pearlymussel are possible:

1. Injury to the boulder darter as a result of turbidity and/or deposition of sediment, created by upstream construction activities, compelling individuals to swim to other areas with potentially less suitable forage and habitat conditions;

2. Injury or mortality to the boulder darter as a result of pollutants (spills of petroleum products from hydraulic, fuel and power systems, etc.) accidentally entering the Elk River from project construction equipment adjacent to the river, affecting water quality and food sources, and in turn, respiration and feeding capabilities of individuals downstream of the project site;

3. Injury to the boulder darter as a result of elevated levels of suspended sediments impacting water quality and flushes of sediment covering suitable habitat downstream of the project site, caused by post-project failure(s), reducing their ability to feed and/or respire, and/or increasing their vulnerability to disease;

4. Injury to the boulder darter as a result of changes in channel morphology at the project site during the post-implementation phase, caused by the intake structure and fill occupying areas of the river channel and bank, and the intake withdrawing instream flows, reducing available habitat for the species in the immediate project vicinity;

5. Loss of designated critical habitat for the fluted kidneyshell and slabside pearlymussel as a result of changes in channel morphology at the project site during the post-implementation phase, caused by the intake structure and fill occupying areas of the river channel and bank, and the intake withdrawing instream flows, impacting the geomorphic stability of the channel and degrading the riverbed elevation (PCE One);

6. Loss of designated critical habitat for the fluted kidneyshell and slabside pearlymussel as a result of fish host species for the fluted kidneyshell and slabside pearlymussel being crushed or becoming physically impaired due to instream construction activities, reducing the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel (PCE Five);

7. Loss of designated critical habitat for the fluted kidneyshell and slabside pearlymussel as a result of turbidity and/or deposition of sediment, created by instream construction activities and construction activities adjacent to the river, obstructing the gills of fish host species for the fluted kidneyshell and slabside pearlymussel and reducing their ability to feed and/or respire, decreasing the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel (PCE Five);

8. Loss of designated critical habitat for the fluted kidneyshell and slabside pearlymussel as a result of pollutants from the project's construction equipment (spills of petroleum products from hydraulic, fuel and power systems, etc.) accidentally entering the Elk River, affecting water quality and food sources for fluted kidneyshell and/or slabside pearlymussel fish hosts, and in turn their respiration and feeding capabilities, reducing the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel (PCE Five);

9. Loss of designated critical habitat for the fluted kidneyshell and slabside pearlymussel as a result of fish host species for the fluted kidneyshell and slabside pearlymussel becoming impinged against the intake screen or passing through the screen and becoming entrained within the intake structure, reducing the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel (PCE Five);

10. Loss of designated critical habitat for the fluted kidneyshell and slabside pearlymussel as a result of turbidity and/or deposition of sediment, created by upstream construction activities, compelling fish host species for the fluted kidneyshell and slabside pearlymussel to swim to other areas with potentially less suitable forage and habitat conditions, reducing the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel (PCE Five);

11. Loss of designated critical habitat for the fluted kidneyshell and slabside pearlymussel as a result of elevated levels of suspended sediments impacting water quality and flushes of sediment covering designated critical habitat downstream of the project site, caused by post-project failure(s), reducing the ability of fish host species for the fluted kidneyshell and slabside pearlymussel to feed and/or respire, and/or increasing their vulnerability to disease, decreasing the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel (PCE Five).

Species' response to a proposed action

Numbers of individuals/populations in the action area affected:

Species survey and occurrence records indicate boulder darter presence within the project action area (Rakes and Shute 2006; Saylor, personal communication, 2011a, 2011b). The boulder darter is a rare species, and the only remaining indigenous population occurs in the Elk River basin. Based upon available survey data and species occurrence records, the Service has determined that the species occurs in sparse densities in small pockets of suitable habitat throughout the action area.

Sensitivity to change:

The degree to which boulder darters are sensitive to change when disturbed is unknown. Cold-water releases from Tims Ford Reservoir are believed to have suppressed the boulder darter population, affecting distribution of the species in the Elk River (Tennessee Valley Authority 2008, 2012). The quantity and diversity of suitable boulder darter habitat has been diminished in the Elk River due to Tims Ford Dam hydropower operations fluctuating water levels, de-watering areas of suitable habitat, and eroding riverbanks, which resulted in sedimentation of substrate. Land use impacts, involving (1) removal of riparian vegetation, and modification of the river channel and floodplain for agricultural, road building and maintenance and urban development activities, (2) poor agricultural practices, and (3) NPS pollution runoff, have

resulted in releases of sediment into the Elk River and increased concentrations of nutrients and toxins in the river; these impacts have also reduced the amount of suitable habitat and limited the range of the boulder darter in the Elk River.

Suspended sediments and/or deposition of sediment from proposed project activities could obstruct boulder darters' gills, reducing their ability to respire or feed. However, fish, including boulder darters, have the ability to swim to other areas to avoid water quality disturbances and associated potential effects (i.e., sediment obstructing gills) under most circumstances. Larval boulder darters are small and because they are found within water columns, they are transported with the current. Therefore, they would be at the greatest risk of all life stages of the species if they drifted through the area of disturbance during project construction because they would lack the ability to independently relocate to safer areas.

Boulder darters could become impinged against the intake screen or pass through the screen and become entrained within the intake structure. If the intake structure and screen are properly designed, constructed, monitored and maintained, the probability of adult and/or juvenile boulder darters being impinged against the intake screen and/or passing through the screen and being entrained within the intake structure, is low. However, the likelihood of larval boulder darters drifting through the project site during the post-implementation phase and being impinged against the intake screen and/or passing through the screen and being entrained within the intake structure, is much higher due to their smaller size and inability to swim.

Any impacts to aquatic habitat, associated with construction activities (altered flows, increased turbidity levels and/or sediment deposition), during the project's implementation phase would be temporary and not result in a permanent loss of suitable boulder darter habitat. A permanent loss of aquatic habitat would occur during the post-implementation phase, as a result of the intake structure and fill materials (shot rock, native material and excess excavated materials) occupying a portion of the Elk River channel and riverbank, and the intake withdrawing instream flows, reducing the wetted channel perimeter. However, this loss would include only a small amount of suitable boulder darter habitat (approximately 0.11-ac as previously estimated under "Disturbance severity"), and the total number of boulder darters that would be affected by this small reduction in suitable habitat, relative to their range-wide distribution in the Elk River basin, would be insignificant.

In summary, the proposed action would pose the greatest risk to larval boulder darters, as opposed to other life stages of the species, due to their smaller size and lack of ability to independently relocate to safer areas. LCBPU has indicated that project construction would commence on April 3, 2018 and conclude on September 19, 2020, with proposed instream work activities occurring June 1 - September 1, 2018 (Howard, personal communication, 2014c). Larval boulder darters could potentially inhabit the action area from April 1 – July 31 (Rakes and Shute, personal communication, 2014). Therefore, based upon LCBPU's construction schedule, larval boulder darters could be affected during the proposed project's implementation phase. They also could be affected during the post-implementation phase because the intake structure and screen would be operational following 2020 project completion, with the potential to annually affect boulder darter larvae that might inhabit the vicinity of the intake structure from April 1 – July 31, after onset of surface water withdrawals.

Resilience:

Resilience relates to the characteristics of populations or a species that allow them to recover from different magnitudes of disturbance. The boulder darter is assumed to be a relatively resilient species, given its perseverance in the highly impacted Elk River. The species has managed to persist for over four decades following construction of and O&M at Tims Ford Dam.

In regards to the proposed action, the total area of direct and indirect effects would occur throughout the estimated 17.7-ac action area, a small area relative to the overall range-wide geographic distribution of the species. Within the action area, we have estimated that boulder darters likely only occur in sparse numbers in pockets of suitable habitat throughout approximately 1.8 ac (10% of the action area) within a 0.4-RM reach of the Elk River. Effects resulting from project construction would be temporary in duration. A small amount of suitable boulder darter habitat would be lost as a result of the action, affecting a small number of boulder darters, relative to their range-wide distribution in the Elk River basin, this effect would be insignificant. Post-project failures would only occur if project components were improperly engineered or constructed, and/or if the appropriate BMPs were not in place. Regularly scheduled maintenance and frequent effectiveness monitoring should minimize or prevent the possibility of adult and juvenile boulder darters being impinged against the intake screen and/or entrained within the intake structure.

The highest magnitude of disturbance to the boulder darter would occur during its larval life stage. The potential exists for larval boulder darters to become impinged against the intake screen and/or pass through the screen and become entrained within the intake structure. For this to occur, the larvae would need to drift in the immediate vicinity of the intake structure. Post-implementation (operational) effects to larval boulder are difficult to quantify because they generally cannot be detected at that early life stage and there is currently no methodology to monitor boulder darter larvae. Because project operations would occur year-round on a permanent basis, there is potential for boulder darter larvae to be affected annually during this life stage, approximately any time between April 1 – July 31 (Rakes and Shute, personal communication, 2014). The number of individuals annually affected would likely be few because they would need to drift in the immediate proximity of the intake. However, after several years, the cumulative number of individuals affected could be more significant.

Overall, assuming that the flow characteristics (including velocities in the vicinity of the raw water intake structure) and habitat conditions in the action area would not appreciably change as a result of construction and operation of the proposed project, the magnitude of disturbance would likely be low and boulder darter resilience would not be expected to change from its current level. However, this could only be determined through monitoring the population and habitat over time.

Recovery rate:

In this biological opinion, the recovery rate relates to the time required for the boulder darter population to return to equilibrium after exposure to a disturbance. While the level of successful

recruitment is unknown, it is unlikely that recruitment would differ significantly from current conditions because the proposed action is anticipated to affect only a very small number of individuals inhabiting the action area, relative to their range-wide distribution in the Elk River basin. Provided LCBPU would undertake measures to minimize and avoid disturbance to the species, the recovery rate for boulders darters in the action area is not expected to change. Such measures would include proper project design, installation of appropriate BMPs and assurance they were functioning as intended following their installation, and adequate maintenance and monitoring of the project (riverbank stability, intake structure and screen, etc.) during operations (post-implementation).

CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future federal actions that are unrelated to the action are not considered in this section because they require separate consultation under section 7 of the Act.

The action area would be located on a reach of the mainstem Elk River within Lincoln County, Tennessee. The purpose of the proposed action is to supplement water supplies for unincorporated areas in Lincoln County. LCBPU currently serves an approximate population of 24,678, with a total average water use of approximately 2,437,600 gpd. By 2030, LCBPU projects they will serve an approximate population of 27,446, with a total average water use of 2,557,264 gpd (Tennessee Valley Authority 2014a).

Past agricultural, road building and maintenance activities have occurred within or in the near vicinity of the action area by state, local, and private entities that have impacted the Elk River and its tributaries and affected native fauna; such activities had no federal involvement. We are reasonably certain that similar activities are likely to occur in the future, and cumulative effects from these activities are likely to continue into the foreseeable future at a comparable pace. Future developments could include additional surface water withdrawals for irrigation and potable water, and treated wastewater discharge from residential housing and manufacturing, which might further affect the boulder darter and its suitable habitat and designated critical habitat for the fluted kidneyshell and slabside pearlymussel, within the action area. Construction of additional homes and roadways could also increase stormwater runoff into the Elk River within the action area. Therefore, cumulative effects, as defined by the Act, are expected to occur.

CONCLUSION

(NOTE: This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR. 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat. Under the statutory provisions of the Act, we determine destruction or adverse modification on the basis of whether, with implementation of the proposed federal action, the affected critical habitat would continue to serve its intended conservation role

for the species. Our analysis follows the guidance provided in Service Memorandum FWS/AES/DCHRS/019634, dated December 9, 2004 [U.S. Fish and Wildlife Service 2004].)

After reviewing the current status of the boulder darter and designated critical habitat for the fluted kidneyshell and slabside pearlymussel, the environmental baseline for the action area, the effects of the proposed surface water withdrawal facility, and the cumulative effects, it is the Service's biological opinion that the Lincoln County Water Intake and Treatment Facility to be constructed on the Elk River at ERM 75.3 in west-central Lincoln County, Tennessee, as proposed, is not likely to jeopardize the continued existence of the boulder darter, and is not likely to destroy or adversely modify designated critical habitat for the fluted kidneyshell and slabside pearlymussel because: 1) the action area would be small relative to the boulder darter's range-wide distribution in the Elk River basin and the total amount of critical habitat designated for the fluted kidneyshell and slabside pearlymussel in the Elk River, and therefore, only small fractions of the boulder darter population and designated critical habitat for the fluted kidneyshell and slabside pearlymussel would be affected by the action, 2) potential effects to the boulder darter and designated critical habitat for the fluted kidneyshell and slabside pearlymussel, as a result of construction activities during the implementation phase, would be temporary and of short duration, 3) the likelihood of lethal take of the boulder darter would be low with properly engineered and correctly installed project components, adherence to BMPs, regular maintenance of the intake structure/intake screen, and effectiveness monitoring to ensure the intake structure, intake screen and other project components are functioning as intended (i.e., with minimal or no apparent effects to the boulder darter), 4) the likelihood of fish host species for the fluted kidneyshell and slabside pearlymussel being impacted (reducing the presence of abundant fish hosts, necessary for recruitment of the fluted kidneyshell and slabside pearlymussel (PCE Five) would be low with properly engineered and correctly installed project components, adherence to BMPs, regular maintenance of the intake structure/intake screen, and effectiveness monitoring to ensure the intake structure, intake screen and other project components are functioning as intended (i.e., with minimal or no apparent effects to designated critical habitat for the fluted kidneyshell and slabside pearlymussel), and 5) changes in channel morphology would be minimal because only a minor reduction in wetted channel perimeter would occur as a result of the intake withdrawals (a 0.3 – 0.5-in decrease in depth, isolated to the immediate project vicinity, based upon preliminary modeling, included in LCBPU's TVA 26a Permit Application), and, therefore, any losses of suitable boulder darter habitat and designated critical habitat for the fluted kidneyshell and slabside pearlymussel from intake operations (impacting the geomorphic stability of the channel and degrading the riverbed elevation (PCE One) would be small and discountable.

No critical habitat has been designated for the boulder darter; therefore, none would be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulation under section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly

impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions (T&Cs) of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the TVA and Corps, so that they become binding conditions of any grant, permits or contracts, as appropriate, for the exemption in section 7(o)(2) to apply. The TVA and Corps have a continuing duty to regulate the activity covered by this Incidental Take Statement. If the TVA and Corps (and ultimately their Permittee, LCBPU): (1) fail to assume and implement the T&Cs or (2) fail to adhere to the T&Cs of the Incidental Take Statement through enforceable terms that are added to the grant, permit or contract, the protective coverage of section 7(o)(2) may lapse. In order to monitor the effect of incidental take, the TVA must report the progress of the action and its effect on the species to the Service as specified in the Incidental Take Statement. [50 CFR § 402.14 (1)(3)].

AMOUNT OR EXTENT OF TAKE

A total of 13 boulder darters have been collected or observed in the action area since 2000 (Saylor, personal communication, 2011a, 2011b; Rakes and Shute 2006), including one individual collected at the project site in 2011 (Saylor, personal communication, 2011b). Therefore, it is reasonable to assume boulder darters currently occur within the action area. The Service presumes that resident (all life stages) and transient (larvae drifting downstream) individuals, both, occur within the action area.

The Service believes that incidental take of boulder darters, as a result of the action, would be difficult to detect for the following reasons:

1. boulder darters are small, secretive fish that spend much of their time in crevices between substrate and large slab boulders;

2. finding a dead or impaired individual would be difficult, with the unlikely exception (due to the intake and intake screen being designed to minimize effects to aquatic species with input from the Service and TWRA) of a juvenile or adult boulder darter being found impinged in the intake screen or entrained within the intake structure;

3. in the improbable event that dead or injured larvae were encountered, identifying the species at such an early life stage would be problematic;

4. the boulder darter lives in an environment in which river currents could easily carry a dead or injured individual downstream undetected for long distances;

5. attributing death or impairment of an individual to a particular project-related activity would be problematic at best, with the possible exception of an individual impinged in the intake screen or entrained within the intake structure.

However, the action can be expected to result in incidental take of boulder darters in the Elk River due to instream construction activities (implementation phase) and operation of the intake (post-implementation phase) within the project footprint at ERM 75.3. The Service estimates that a small, unknown number of boulder darters would be taken throughout the project footprint, a 1.1-ac area where direct, instream construction and operational impacts would occur. The Service believes that any boulder darters taken within this area would be taken in the form of lethal, harm or harass. We further believe that the number of individuals taken as a result of the action would be few because: (1) boulder darters have been documented as occurring in low densities in scattered patches of suitable habitat within the action area (Saylor, personal communication, 2011a, 2011b; Rakes and Shute 2006), (2) adult and juvenile boulder darters have the ability to independently swim to other areas to avoid instream construction and water quality disturbances under most circumstances, (3) larval boulder darters could drift through the project footprint when instream construction is occurring and would lack the ability to independently move out of harm's way; however, the number of larvae that would be directly affected by instream work would likely be minimal because their presence in the footprint during instream construction would be a one-time occurrence during their approximate April 1 – July 31 larval life stage (Rakes and Shute, personal communication, 2014) in 2018, the year identified for instream work (Howard, personal communication, 2014c), and they would have to drift through the left, descending half of the channel (location of the footprint) during the hours that instream work would be occurring and in the immediate vicinity of instream construction activities to be directly affected, and (4) the potential for larval boulder darters drifting through the project footprint during the post-implementation phase and becoming impinged against the intake screen and/or passing through the screen and being entrained within the intake structure poses the greatest likelihood of incidental take, due to their smaller size, inability to swim, and intake operations continuing annually during the April 1 – July 31 larval life stage into the foreseen future (Rakes and Shute, personal communication, 2014); however, the number of individuals annually affected would likely be few because they would need to drift in the immediate proximity of the intake.

In summary, the Service estimates that a small, unknown number of boulder darters within 1.1 ac aquatic habitat within the Elk River would be taken in the form of either lethal, harm or harass.

In the "Analyses for Effects of the Action", the Service determined that the proposed action would result in incidental take of bouders darters in several forms including:

(a) lethal from: 1) being crushed by construction equipment, workers or construction materials during instream work, 2) turbidity and/or deposition of sediment in the immediate project vicinity, created by instream construction activities and construction activities adjacent to the river, obstructing their gills and reducing their ability to respire, 3) pollutants from construction equipment (spills of petroleum products from hydraulic, fuel and power systems, etc.) accidentally entering the Elk River, affecting water quality,

and in turn respiration capabilities of individuals in the immediate project vicinity, 4) pollutants (spills of petroleum products from hydraulic, fuel and power systems, etc.) accidentally entering the Elk River from project construction equipment adjacent to the river, affecting water quality, and in turn, respiration of individuals downstream of the project site, and 5)impingement against the intake screen or entrainment within the intake structure;

(b) harm from: 1) being injured by construction equipment, workers or construction materials during instream work, 2) turbidity and/or deposition of sediment in the immediate project vicinity, created by instream construction activities and construction activities adjacent to the river, reducing their ability to feed, 3) pollutants from construction equipment (spills of petroleum products from hydraulic, fuel and power systems, etc.) accidentally entering the Elk River, affecting water quality and food sources, and in turn feeding capabilities of individuals in the immediate project vicinity, 4) being injured due to impingement against the intake screen or entrainment within the intake structure, 5) pollutants (spills of petroleum products from hydraulic, fuel and power systems, etc.) accidentally entering the Elk River from project construction equipment adjacent to the river, affecting water quality and food sources, and in turn, feeding capabilities of individuals downstream of the project site, 6) post-project failure(s), causing elevated levels of suspended sediments to impact water quality and flushes of sediment to cover suitable habitat downstream of the project site, reducing their ability to feed and/or respire, and/or increasing their vulnerability to disease, and 7) changes in channel morphology at the project site during the post-implementation phase, caused by the intake structure and fill occupying areas of the river channel and bank, and the intake withdrawing instream flows, reducing available habitat for the species in the immediate project vicinity.

(c) harassment from: 1) turbidity and/or deposition of sediment, created by upstream construction activities, compelling individuals to swim to other areas with potentially less suitable forage and habitat conditions.

EFFECT OF THE TAKE

In the accompanying biological opinion, we determined that this level of expected take is not likely to result in jeopardy to the boulder darter and would not result in destruction or adverse modification of designated critical habitat for the fluted kidneyshell and slabside pearlymussel.

Previous biological opinions, completed by the TFO for the boulder darter population in the Elk River basin within Tennessee and Alabama, which identified incidental take, have been included in the table in Appendix C.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures (RPMs) are necessary and minimize effects of incidental take of the boulder darter:

1. The TVA and Corps must ensure that the proposed action will occur as designed, planned, and documented in the biological assessment, all supporting information provided by LCBPU and their consultants, and this biological opinion.

2. The TVA and Corps must ensure that LCBPU implements measures to minimize or eliminate effects from construction and operations activities.

3. The TVA and Corps must ensure that LCBPU adequately monitors the level of boulder darter take associated with the proposed action.

4. The TVA and Corps must ensure that LCBPU adequately monitors the proposed action to document potential changes to suitable habitat and water quality, resulting from the action.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the TVA, Corps and LCBPU must comply with the following T&Cs, which carry out the RPMs described above. While these T&Cs were specifically designed to address potential effects to the boulder darter, we believe that implementation of these measures would also minimize potential for impacts to designated critical habitat for the fluted kidneyshell and slabside pearlymussel. These T&Cs are non-discretionary.

1. LCBPU will agree to implement the proposed action as described in the biological assessment, the biological assessment's supporting documentation, and this biological opinion. This T&C supports RPM 1.

2. All rock materials transported to the work site will be durable and free of excessive fines.

3. All fill materials, either excavated on-site or transported to the project site during project implementation, must be placed outside of the active flow channel at a minimum distance of the first terrace to minimize the potential for runoff from these materials into the Elk River; storage of fill materials on the project site will be temporary and cease upon completion of all construction.

4. All heavy equipment and trucks will be cleaned, refueled and stored, when not in use, in a designated staging area, located a minimum of 300 ft from the OHW of the Elk River.

5. All heavy equipment will carry oil-absorbent booms at all times when operating; each piece of equipment shall carry a boom with no less than 15-gallon absorbency capacity.

6. The project shall be completed expeditiously, and the river bottom, riverbank, riparian corridor and any areas disturbed with the floodplain (including the staging areas, where equipment storage, cleaning and fueling, and work/laydown would occur, and equipment access points) shall be restored as close to pre-implementation conditions as possible.

7. Water pumped out of the area enclosed by the cofferdam shall be held in a constructed settling basin(s) or filtered to ensure it is clean prior to its discharge back into the Elk River.

8. If concrete is poured in or near the river during project implementation, an aquatic biologist or hydrologist must be present to monitor pH levels in the Elk River. If spillage or leakage of concrete into the Elk River is observed, pouring will cease immediately and not resume until the source of the spill or leak is located, the Service is notified of the spill or leak, and corrective action is taken to prevent further spillage or leakage.

9. Removal of riparian vegetation will be kept to a minimum. Following completion of construction activities, disturbed riverbank and floodplain areas will be immediately replanted with native tree and shrub species, and/or native or close equivalent grass species. All banks disturbed by project activities will be inspected, and replanted as needed, until vegetation is successfully reestablished. The Service's TFO in Cookeville, Tennessee (telephone: 931/528-6481), Lincoln County, Tennessee, Soil Conservation District (telephone: 931/438-2450, ext. 3), or University of Tennessee Extension Lincoln County (telephone: 931/433-1582) can be contacted for assistance in selecting the appropriate plant species and can provide information regarding planting methods.

10. Use of bioengineering methods (soft, vegetative approaches) is preferred for long-term stabilization of riverbanks and is recommended over excessive use of hard structures (e.g., riprap) to minimize potential impacts to the boulder darter and other aquatic organisms, water quality, and riparian and instream habitats. Bioengineering techniques might include, but not be limited to, use of geotextile fabrics, layering with willow cuttings, construction of brush mattresses, fascines or vegetated geogrids, joint-planting willows into riprap, and use of a stinger to plant cuttings on upper riverbanks.

11. The water intake screen design will minimize the potential uptake of boulder darters. LCBPU and/or their consultants will allow adequate time to coordinate with and obtain approval from the Service and TWRA regarding the intake screen design, prior to construction of the intake, and the final design will incorporate recommendations from the Service and TWRA to minimize impacts to the boulder darter.

12. Instream work is scheduled to occur in 2018 (Howard, personal communication, 2014c). The TVA and Corps will ensure pre-construction boulder darter monitoring is conducted annually over a minimum of three consecutive years and post-construction boulder darter monitoring is conducted annually over a minimum of five consecutive years. TVA will establish a monitoring station at the intake site to monitor boulder darter use of the area and document any trends in the number of individuals (either up or down) occupying the area (Tennessee Valley Authority 2014a). Monitoring should also address effectiveness of the intake structure/intake screen in preventing incidental take of boulder darters and document any observed take associated with the intake or potential post-project failures (riverbank sloughing, channel instability issues, etc.). The first year of post-project monitoring should occur and be documented relatively soon after completion of construction. While boulder data collected from pre- and post-project monitoring efforts

can be included along with TVA's ongoing boulder darter monitoring efforts in the Elk River to assess population trends, the data will not be considered or used to satisfy any of TVA's required commitments in the 2006 Biological Opinion – Routine Operations and Maintenance of TVA's Water Control Structures in the Tennessee River Basin.

13. Because project implementation will not be initiated until 2018, LCBPU will repeat the mussel survey that was conducted from ERM 75 to ERM 75.8 during July 2010 (Lewis Environmental Consulting, LLC 2010) to ensure that the status of federally listed freshwater mussel species has not changed within and in the near vicinity of the action area (i.e., listed mussels would be found inhabiting this reach of the Elk River). This survey would occur within the 12-month period prior to project implementation.

14. LCBPU will revisit with the TVA and Corps within 3 to 6 months of project implementation to determine if any new species have been listed or critical habitat designated that may be affected by the action. If it is discovered that new species have been listed or critical habitat designated, reinitiation of formal consultation will be required.

Upon locating a dead, injured, or sick individual of an endangered or threatened species, initial notification must be made to the Fish and Wildlife Service Law Enforcement Office at 220 Great Circle Rd, Nashville, Tennessee (telephone: 615/736-5532). Additional notification must be made to the Fish and Wildlife Service, TFO at 446 Neal Street, Cookeville, Tennessee (telephone: 931/528-6481). Care should be taken in handling sick or injured individuals and in the preservation of specimens in the best possible state for later analysis of cause of death or injury.

The RPMs, with their implementing T&Cs, are designed to minimize the effect of incidental take that might otherwise result from the proposed action. The Service believes that no more than all boulder darters scattered throughout a 1.1-ac area in the Elk River will be incidentally taken. This area contains pockets of suitable boulder darter habitat (estimated at 10% or 0.11-ac), but it is likely that the species would be redistributed at times throughout the entire 1.1-ac area due to project-related disturbances. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the RPMs provided. The TVA and Corps must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the RPMs.

CONFERENCE REPORT

The Service concurs with TVA in that the proposed action, with the measures included in the biological assessment (Tennessee Valley Authority 2014a) to avoid adverse effects to the northern long-eared bat, would not jeopardize the continued existence of the northern long-eared bat.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help carry out recovery plans, or to develop information.

We offer the following conservation recommendation for consideration:

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification if any of the above conservation recommendations were to be carried out.

1. The TVA and Corps should coordinate with LCBPU and other entities requiring federal Clean Water Act permits in the Elk River drainage, well in advance of proposed actions, to develop conservation banks and other measures to assist in recovery of boulder darters and their habitat.

2. The TVA and Corps should coordinate with LCBPU to provide outreach materials and to educate water users about the sensitivity of natural resources in the Elk River, including the boulder darter and the listed mussel species included in this opinion.

3. The TVA and Corps should utilize any additional funds provided by LCBPU or other potential project proponents to increase boulder darter survey efforts in the Elk River and its tributaries and better assess population trends.

4. The TVA and Corps should utilize any additional funds provided by LCBPU or other potential project proponents to conduct a study with light traps to determine their effectiveness in sampling juvenile boulder darters in the Elk River.

5. LCBPU should continue to identify and significantly reduce water losses in its existing water supply system before increasing surface water withdrawals from the Elk River to the proposed 4.0 mgd maximum withdrawal rate.

REINITIATION NOTICE

This concludes formal consultation on the actions outlined in the consultation request. As written in 50 CFR Section 402.16, reinitiation of formal consultation is required where discretionary TVA and Corps involvement or control over the action have been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the TVA and Corps action that may affect listed species or critical habitat in a manner or to an extent not considered in this biological opinion; (3) the TVA and Corps action is later modified in a manner that causes an effect to the listed species or critical habitat not considered in this biological opinion; or (4) a new species is listed or critical habitat

REINITIATION NOTICE

This concludes formal consultation on the actions outlined m the consultation request. As written in 50 CPR Section 402.16, reinitiation of formal consultation is required where discretionary TVA and Corps involvement or control over the action have been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the TVA and Corps action that may affect listed species or critical habitat in a manner or to an extent not considered in this biological opinion; (3) the TVA and Corps action is later modified in a manner that causes an effect to the listed species or critical habitat not considered in this biological opinion ; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease until reinitiation.

For this biological opinion the incidental take would be exceeded when the take exceeds all boulder darters within 1.1 ac of aquatic habitat, which is what has been exempted from the prohibitions of section 9 by this biological opinion. The Service appreciates the cooperation of the TVA and Corps during this consultation. We would like to continue working with you and your staff regarding this project. For further coordination please contact Todd Shaw of my staff at 931/525-4985.

Mary E. Jennings

Mary E. Jennings, Field Supervisor

6/17/14

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APPENDIX A

Project Permit Application and Supporting Documention

(The following figures have been derived from Tennessee Valley Authority. 2014. Biological Assessment, Lincoln County Board of Public Utilities Water Supply Intake Facility, Lincoln County, Tennessee. Prepared By: Endangered Species Act Compliance, Charles S. Howard – Aquatic Endangered Species Biologist, John T. Baxter, Manager. Knoxville, Tennessee. 40pp. with figures, tables and appendices.)

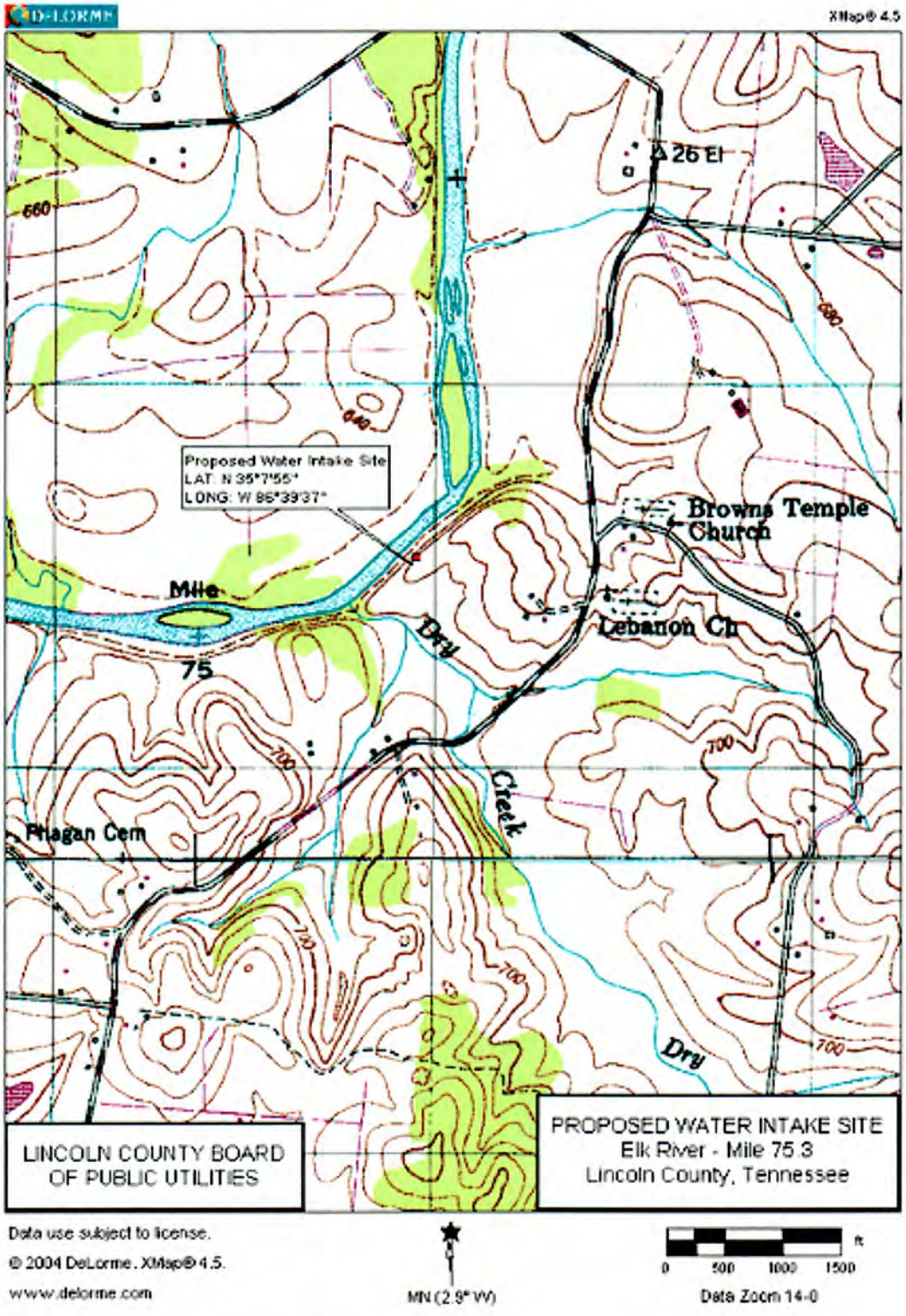


Figure 1. Location of proposed water intake site at Elk River mile 75.3.

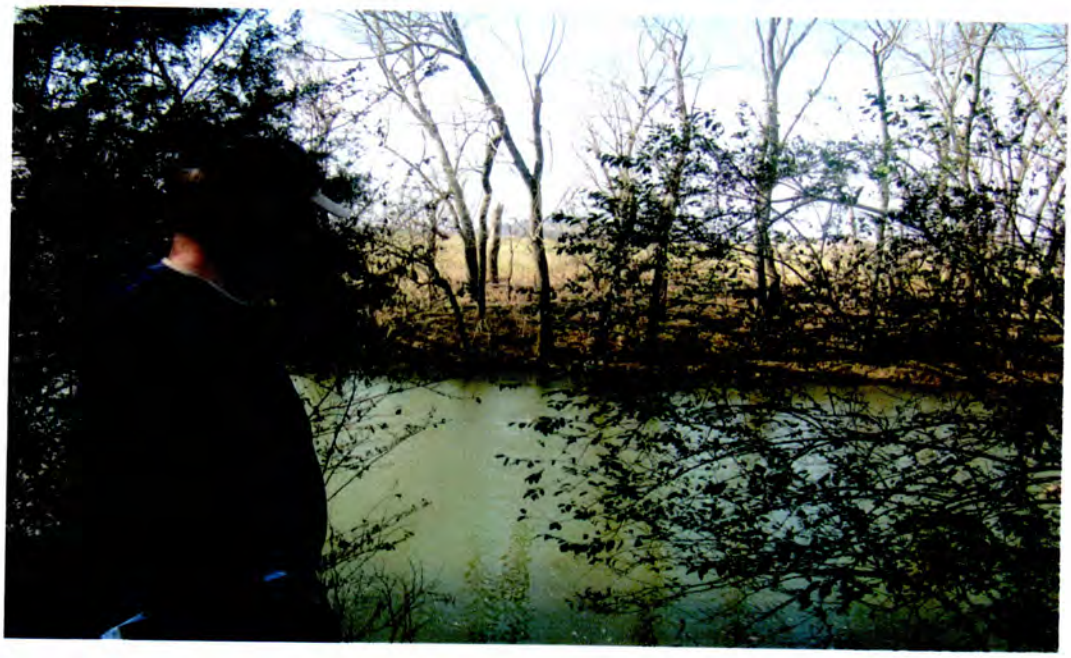
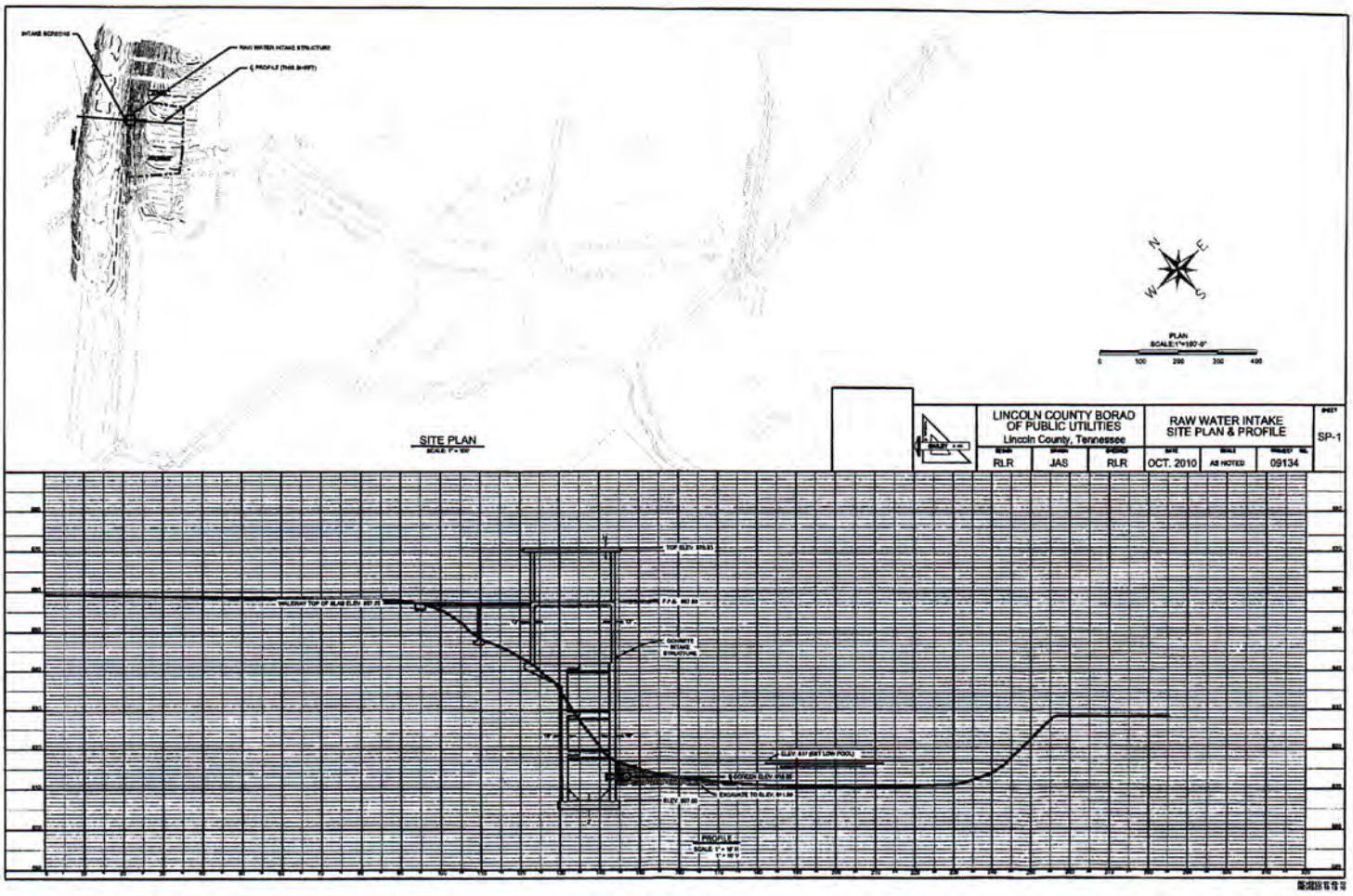


Figure 2. Photographs of the Elk River at the proposed water intake site (Elk River mile 75.3).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09134
TOP ELEV. 976.83
F/A. 957.83
CONCRETE INTAKE STRUCTURE
ELEV. 937.83 (NET LOW POOL)
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ELEV. 907.83
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SCALE: 1" = 60' V
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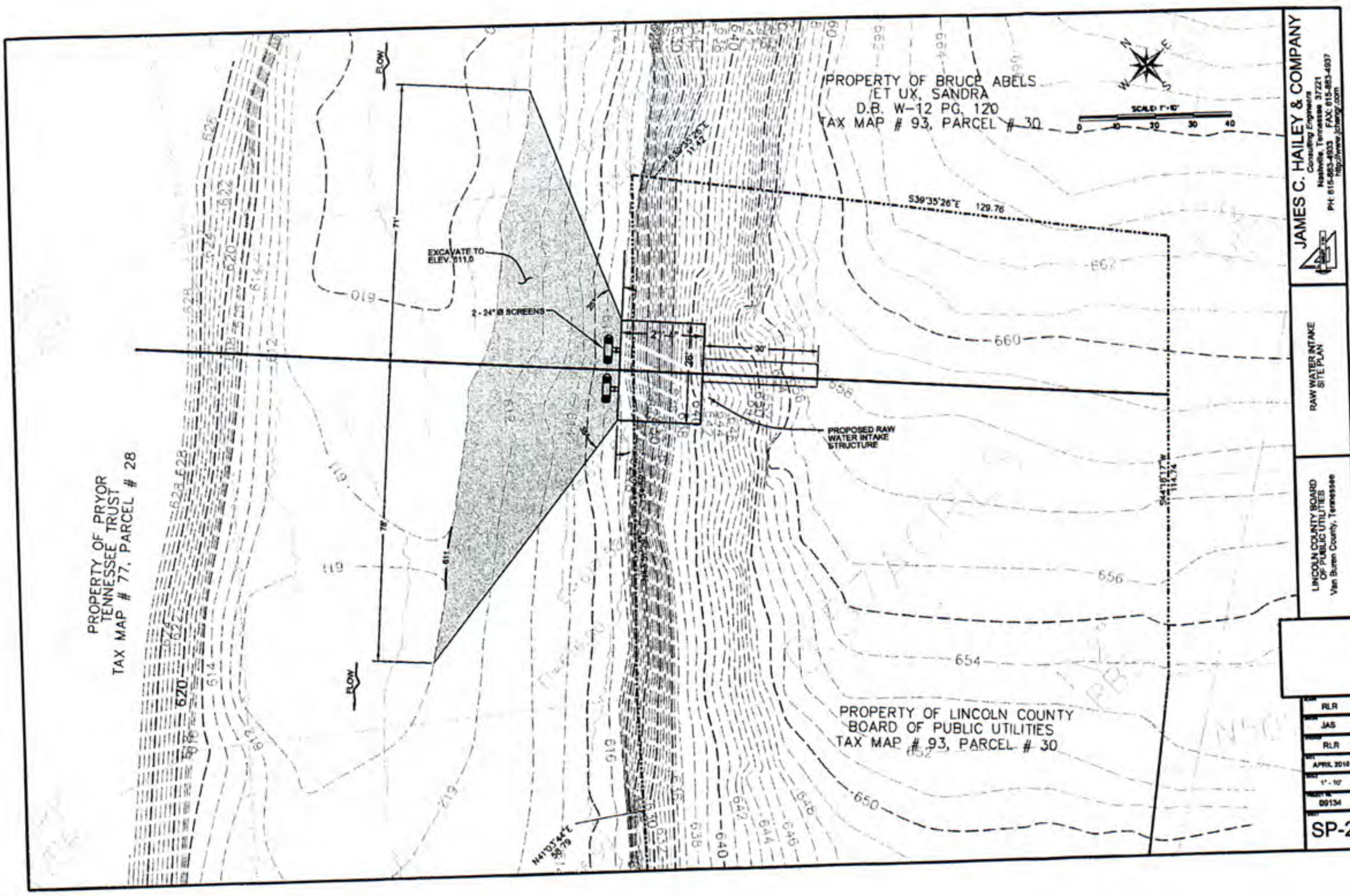
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PROPERTY OF PRYOR TENNESSEE TRUST
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PROPERTY OF LINCOLN COUNTY BOARD OF PUBLIC UTILITIES
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APPENDIX B

Project Permit Application and Supporting Documention

(The following figures have been derived from Tennessee Valley Authority. 2014. Biological Assessment, Lincoln County Board of Public Utilities Water Supply Intake Facility, Lincoln County, Tennessee. Prepared By: Endangered Species Act Compliance, Charles S. Howard – Aquatic Endangered Species Biologist, John T. Baxter, Manager. Knoxville, Tennessee. 40pp. with figures, tables and appendices.)

RLR-211556

OMB No 3316-0060
Exp Date 03/31/2007

JOINT APPLICATION FORM
Department of the Army/TVA

The Department of the Army (DA) permit program is authorized by **Section 10 of the Rivers and Harbors Act of 1899** and **Section 404 of the Clean Water Act (P.L. 95-217).** These laws require permits authorizing structures and work in or affecting navigable waters of the United States and the discharge of dredged or fill material into waters of the United States. **Section 26a of the Tennessee Valley Authority Act,** as amended, prohibits the construction, operation, or maintenance of any structure affecting navigation, flood control, or public lands or reservations across, along, or in the Tennessee River or any of its tributaries until plans for such construction, operation, and maintenance have been submitted to and approved by the Tennessee Valley Authority (TVA).

Name and Address of Applicant:	Name, Address, and Title of Authorized Agent:
Billy Joe Wiley Lincoln County Board of Public Utilities 2863 Huntsville Highway Fayetteville, TN 37334	
Telephone Number: Home _____ Office (931) 433-2259	Telephone Number: Home _____ Office _____

Location where activity exists or will occur *(include Stream Name and Mile, if known)*:

Application submitted to ☐ DA ☒ TVA

Date activity is proposed to commence: _____ Date activity is proposed to be completed: _____

Describe in detail the proposed activity, its purpose and intended use *(private, public, commercial, or other)*. Describe structures to be erected including those placed on fills, piles, or floating platforms. Also describe the type, composition, and quantity of materials to be discharged or placed in the water; the means of conveyance; and the source of discharge or fill material. Please attach additional sheets if needed

Please See Attachments

OFF CAT 3

Pickwick - Wheeler Watershed Team	
✓ JKA	JDS ✓
CLC	SJS
SAH	SST
WRM	
RLM	
SDM	
HLM	
RJM	
JGP	
RLP	
AMP	
DJS	Files
Received: 1/31/11	

Application is hereby made for approval of the activities described herein. I certify that I am familiar with the information contained in this application, and that to the best of my knowledge and belief such information is true, complete, and accurate. I further certify that I possess the authority to undertake the proposed activities. **I agree that, if this application is approved by TVA, I will comply with the attached terms and conditions and any special conditions that may be imposed by TVA at the time of approval. Please note the U.S. Army Corps of Engineers may impose additional conditions or restrictions.**

9-29-10
Date

Billy Joe Wiley
Signature of Applicant

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of The United States knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or device a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years, or both. The appropriate DA fee will be assessed when a permit is issued.

Names, addresses, and telephone numbers of adjoining property owners, lessees, etc., whose properties also join the waterway:

1. Bruce & Sandra S. Ables ....216 Old Molina Road, Fayetteville, TN 37334

RLR-211556

List of previous DA/TVA permits/approvals ☐ DA _____ (Permit Number) ☐ TVA _____ (Date)

Is any portion of the activity for which authorization is sought now complete? ☐ Yes ☒ No *(If "Yes" attach explanation)*
Month and year the activity was completed: _____. Indicate the existing work on the drawings.

List all approvals or certifications required by other federal, interstate, state, or local agencies for any structures, construction, discharges, deposits, or other activities described in this application.

Issuing Agency	Type Approval	Identification No.	Date of Application	Date of Approval
TDEC	A.R.A.P.	N/A	Oct. 2010	N/A
TVA	404(e)		Oct. 2010	N/A

Has any agency denied approval for the activity described herein or for any activity directly related to the activity described herein?
☐ Yes ☒ No *(If "Yes" attach explanation)*

Project plans or drawings should accompany the application. These should be on paper suitable for reproduction no larger than 11 x 17 inches or contained on a 3-1/2 inch floppy computer disc in "dxf" format, and should be submitted to the appropriate TVA and U.S. Army Corps of Engineers offices. An application that is not complete will be returned for additional information.

U.S.A.C.E. Offices		TVA Office Location
U.S. Army Corps of Engineers Eastern Regulatory Field Office Spring Cress Business Park 501 Adessa Blvd., Suite 250 Lenoir City, Tennessee 37771 (865) 986-7296	U.S. Army Corps of Engineers Savannah District The Plaza, Suite 130 1590 Adamson Parkway Morrow, Georgia 30260-1763 (678) 422-2729	Tennessee Valley Authority
U.S. Army Corps of Engineers Regulatory Branch 3701 Bell Road Nashville, Tennessee 37214 (615) 369-7500	U.S. Army Corps of Engineers Western Regulatory Field Office 2042 Beltline Road, SW, Bldg C, Suite 415 Decatur, Alabama 35602 (256) 350-5620	
U.S. Army Corps of Engineers Norfolk District P.O. Box 338 Abingdon, Virginia 24212 (276) 623-5259	U.S. Army Corps of Engineers Asheville Regulatory Field Office 151 Patton Avenue, Room 208 Asheville, North Carolina 28801-5006 (828) 271-4856	

Privacy Act Statement

This information is being requested in accordance with Section 26a of the TVA Act as cited on the front page of this form. Disclosure of the information requested is voluntary; however, failure to provide any required information or documents may result in a delay in processing your application or in your being denied a Section 26a permit. An application that is not complete will be returned for additional information. TVA uses this information to assess the impact of the proposed project on TVA programs and the environment and to determine if the project can be approved. Information in the application is made a matter of public record through issuance of a public notice if warranted. Routine uses of this information include providing to federal, state, or local agencies, and to consultants, contractors, etc., for use in program evaluations, studies, or other matters involving support services to the program; to respond to a congressional inquiry concerning the application or Section 26a program, and for oversight or similar purposes, corrective action, litigation or law enforcement.

Burden Estimate Statement

Public reporting burden for this collection of information is estimated to average 1.5 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Agency Clearance Officer, Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402; and to the Office of Management and Budget, Paperwork Reduction Project (3316-0060), Washington, D.C. 20503.

TABLE 1

Current Lincoln County WTP Flow Rates

		Taft	Elora	Flintville	
				Raw	Finished
		(gpd)	(gpd)	(gpd)	(gpd)
Jan	2007	1237258	196210	629677	632290
Feb	2007	1241196	224136	649464	651929
Mar	2007	1228961	230242	692806	692645
Apr	2007	1299427	216243	703700	703967
May	2007	1306400	241229	751968	750097
Jun	2007	1334490	236637	763967	756167
Jul	2007	1294523	191319	691355	690903
Aug	2007	1233705	190329	752290	753387
Sept	2007	1201776	163253	697067	701333
Oct	2007	1119707	113197	664161	680839
Nov	2007	1010942	131280	639967	666267
Dec	2007	923381	114955	623645	658032
Jan	2008	978523	143129	680419	707516
Feb	2008	1015780	113024	673552	701000
Mar	2008	974076	118000	649226	668516
Apr	2008	947824	117933	707333	679633
May	2008	912793	135226	717226	695065
Jun	2008	910063	156023	738967	716767
Jul	2008	953471	178661	766161	748581
Aug	2008	958044	146768	691032	679710
Sept	2008	997301	153340	658333	664667
Oct	2008	928667	120668	633032	638677
Nov	2008	991177	107817	640100	648067
Dec	2008	1079099	122574	674194	686613

Average	1086607.667	160924.708	687068.417	690527.833
MGD	1.087	0.161	0.687	0.691

Summation of Average	1.938	MGD

- Denotes Raw, held from summation of average.

Although no exact population is available for the District, estimates of the population of the unincorporated areas of Lincoln County are available the mission of LCBPU is to serve the entire unincorporated population of lincolin county. Presently the District serves 8,226 customers or an approximate population of 24,678. The population of the unincorporated areas of Lincolin County is approximately 25,000 people. Or approximately 98% of the unincorporated population. This is consistent with the minor number of roards unserved. A estimate for the number of anticipated customers and population served by the District through the year is presented in Table 3-1.

Table 3-1
Population Projections
Unincorporated Areas of Lincolin County

	Population
2010	25,247
2015	26,163
2020	26,709
2025	27,077
2030	27,446

Over the years LCBPU has actively looked for and repaired leaks in the distribution system. This effort has resulted in little or no impact on the water losses. Apparently the water loss is a result of losses that can not be accounted for, small leaks, service theft, and metering inaccuracies. The current efforts will be continued to reduce the apparent water loss.

Projecting future water demands in a largely rural community is best accomplished by establishing present water demands on a per customer basis and extrapolating with projected customer growth. The most recent twelve month period of water produced and water purchased was used to determine that the water needed per customer was approximately 7,800 gallons per month or 277 gpd per customer. The maximum daily demand should be approximately 130 percent of the average daily demand or 360 gallons per connection per day. Using the above, Table 3-3, summarizes the present and anticipated water demand.

Table 3-3
Projected Water Demands

Year	Customers	Daily Average (gpd)	Daily Peak (gpd)
2010	8,492	2,352,284	3,057,120
2015	8,800	2,437,600	3,168,000
2020	8,984	2,488,568	3,234,240
2025	9,108	2,522,916	3,278,880
2030	9,232	2,557,264	3,323,520

TABLE 5

Elk River Low Flow Data

7Q10	=	110.83	cfs
3Q20	=	100.30	cfs

*** Flow data provided by George S. Law, USGS Hydrologist*

TABLE 3

Initial Instantaneous Withdrawal Rate Schedule

7:00 AM		MGD
8:00 AM	3	MGD
9:00 AM	3	MGD
10:00 AM	3	MGD
11:00 AM	3	MGD
12:00 PM	3	MGD
1:00 PM	3	MGD
2:00 PM	3	MGD
3:00 PM	3	MGD
4:00 PM	0	MGD
5:00 PM	0	MGD
6:00 PM	0	MGD
7:00 PM	0	MGD
8:00 PM	0	MGD
9:00 PM	0	MGD
10:00 PM	0	MGD
11:00 PM	0	MGD
12:00 PM	0	MGD
1:00 AM	0	MGD
2:00 AM	0	MGD
3:00 AM	0	MGD
4:00 AM	0	MGD
5:00 AM	0	MGD
6:00 AM	0	MGD
TOTAL	1.00	MGD

** INITIALLY ONLY 1.00 MILLION GALLONS A DAY WILL BE PUMPED TO THE PLANT FOR TREATMENT AND DISTRIBUTION THIS TABLE SHOWS THE APPROXIMATE WITHDRAWAL SCHEDULE OVER A 8 HOUR (1SHIFT) PERIOD.

JAMES C. HAILEY & COMPANY

Consulting Engineers

7518 Highway 70 S
Suite 100
Nashville, Tennessee 37221
Telephone: 615-883-4933
Fax: 615-883-4937

JAMES C. HAILEY, P.E
NEAL WESTERMAN, P.E.

ROBERT L. RAMSEY, P.E.
JAMES W. GARRETT, P.E.
ANTHONY L. PELHAM, P.E.
MATTHEW R. TUCKER, E.I.T
MICHAEL N. GREEN, E.I.T.

April 11, 2012

Ms. Samantha J. Strickland
Watershed Representative
TVA Pickwick-Wheeler Watershed Team
PO Box 1010; SB 1H-M
Muscle Shoals, AL 35662-1010

Re: TVA 26a Permit Application
File No. 211556
Raw Water Intake – Elk River Mile 75.3
Lincoln County, Tennessee

Dear Ms. Strickland:

On behalf of the Lincoln County Board of Public Utilities, enclosed herewith is additional information requested relative to the 26a application to construct a raw water intake structure on the Elk River at Mile 75.3.

Please contact me at 615-883-4933 (ext. 213) if you have any questions.

Sincerely,

JAMES C. HAILEY & COMPANY
Consulting Engineers

Bob Ramsey

Robert L. Ramsey, P.E.

enclosures

cc: Mr. Ronnie Braden, Superintendent, LCBPU

TVA
Muscle Shoals, AL
Received 4/18/2012
Paid
Date Paid
Amt Check No.
Invoice
Shortcode

JCH # 07334

PROPOSED RAW WATER INTAKE – ELK RIVER MILE 75.3

LINCOLN COUNTY, TENNESSEE

INTAKE LOCATION SELECTION:

Several sites for the future intake were considered by Lincoln County Board of Public Utilities (LCBPU) in the preliminary stage of this project. At least three trips were made by boat in various reaches of the Elk River to locate potential sites. The following criteria were considered in evaluating and selecting the final site at Mile 75.3:

1. Proximity to the Elk River and potential water treatment plant sites
2. Availability of land
3. Availability of three-phase power
4. Location relative to 100-year flood plain
5. Access to the site
6. Depth of water in river
7. River channel properties
8. Temporary and permanent effects on the river and boaters

The site selected was highly favorable in all the criteria listed above except access to the site and river channel properties. The land was purchased from a local property owner out of a large tract on Old Molino Road with an easement to construct an access drive and run utilities to the site. A gated gravel drive has now been constructed by LCBPU in the easement. In addition, LCBPU was able to purchase property across Old Molino Road for a water treatment plant site. Three-phase power runs cross-country

in the area and is easily accessible to both sites. The site is well above the floodplain and the water depth in the river channel was measured to be 6 to 8 feet deep during a drought period. The bank of the river at the site is a rock bluff which will increase the construction cost of the intake structure, however the increased cost is outweighed by the other favorable site conditions. The construction of the intake structure should have little effect upon the river environment. The bluff is mostly rock which will limit potential sedimentation. The site allows for construction of a cofferdam around the intake which will protect the river from raw construction materials and excavation. The stream bottom at the site is fractured and weathered rock with little silt accumulation. The completed structure will have no discharge of materials to the river other than air wash of the screens. The river is wide enough at the intake site to allow boaters to safely pass during and after construction.

WATER LOSS AFFECTS ON WITHDRWAL:

The Lincoln County Board of Public Utilities has initiated an aggressive campaign to combat water loss. Water loss over the last 10 years has generally ranged from 43% to 48%. Currently the water loss ranges from 39% to 43%. Most of the reduction is from a change in water loss accounting practices. LCBPU has contracted with professional leak detection services in the past to locate leaks, but it has done little to curb the loss rate. Most leaks found were small service line leaks around corporation and curb stops. As leaks were repaired, they would surface in another area. LCBPU maintains leak detection equipment and their staff uses it almost daily to search for leaks to be repaired by their repair crew. They have purchased three Model LD12 Professional's Water Leak Detectors in the last few years from SubSurface Leak Detection, Inc. at a cost of approximately $9,000.

LCBPU has also constructed several water line replacement projects within the system aimed at replacing lines that are subject to continuous leak problems. In the early 1980's, many miles of 3" Class 160 PVC water line was constructed in areas of solid rock and high pressure. The lines were a major source of leaks due to poor construction and marginal pipe pressure rating. Some were repaired almost weekly.

Beginning in the late 1990's, LCBPU has worked to replace those lines, particularly in the Elkton Pike and Molino Road areas. They adopted a "War on Leaks" policy, including soliciting the public to report any suspected leaks that may surface. In 2008, LCBPU replaced approximately 11,500 linear feet of leaking water line, which did very little in the way of decreasing water loss. LCBPU is currently replacing approximately 22 miles of brittle asbestos cement water line in the Park City area. With this large-scale project, it is estimated that the loss rate could be decreased by as much as 20,000 gpd or about 2.2%.

LCBPU is currently pumping 20 to 23 hours per day at their largest treatment plants at Taft and Flintville, which is at or near full capacity, allowing for downtime for filter backwash and maintenance. If LCBPU was able to reduce their water loss from 43% to a more reasonable 28%, the 15% reduction would result in a reduced water demand of approximately 306,000 gallons per day. Pumping time at the two plants would be reduced by an average of 3.5 hours per day to approximately 16.5 to 19.5 hours per day. While this would be a significant accomplishment, it does not eliminate the need for a river plant, but would allow time to obtain permits, secure funding, and construct new water supply facilities and transmission lines.

It is important to note that LCBPU is committed to lowering their water loss rate, thus requiring less pumping at their well sites and at the proposed Elk River intake site. In accordance with TCA 7-82-702 and 68-221-1009(a), the Utility Management Review Board and the Water and Wastewater Financing Board have set an excessive water loss percentage at 35%. That means that any water system reporting a water loss of 35% or higher (using the current method) in its annual financial statements will be referred to the appropriate board for further action. This determination was made at the joint meeting of the Boards held on October 7, 2010. With current demand and certain growth in the area due to the service area proximity to the City of Huntsville, Alabama, a reduction of water loss does not eliminate the need for a river intake site.

INFEASIBILITY OF REGIONAL WATER SUPPLY:

At more than 8,300 customers, the Lincoln County Board of Public Utilities has by far the largest customer base and the most potential to increase that base in Lincoln County and the surrounding areas. Lincoln County also sells water to a small number of customers in Moore County, Bedford County, Franklin County, and Giles County along the county lines. Other municipal water systems in Lincoln County include the cities of Ardmore, Fayetteville, and Petersburg. Ardmore receives its water from wells and also purchases water from Limestone County, Alabama. Fayetteville receives its water from an intake on the Elk River and Petersburg purchases water from Fayetteville. Nearby municipal systems in surrounding counties include Huntland in Franklin County, Moore County, and Marshall County. To the west, Tarpley Shop Utility District and South Giles Utility District in Giles County purchase water from the City of Pulaski. Huntland receives its water from wells. Moore County receives its water from a lake and Marshall County receives its water from the City of Lewisburg via the Duck River. To combine all of these predominantly rural water systems into a regional system would require a source such as the Tennessee River in Alabama, which is approximately 55 miles to the south. Costs for raw water lines, a regional treatment facility, and transmission mains to all of the systems would cost in excess of $250,000,000. Cooperation with the State of Alabama and municipalities in Alabama and Tennessee would be required to condemn property along the pipeline routes. These obstacles make the project infeasible at this time.

DESIGN OF INTAKE

The proposed intake structure will consist of a 26' x 21'4" reinforced concrete building atop a 26' x 13'6" reinforced concrete pump shaft. The concrete shaft will extend approximately 5 feet below the riverbed to increase water depth on the pumps and allow sediment storage for reduced maintenance. The pumps will consist of approximately three vertical turbine pumps with pump columns extending into the shaft below. Flow into the structure will pass through two 21-inch diameter, tee-shape, stainless steel, wedge

wire screens with 16-inch inlet pipes that will be bolted onto the intake structure. The screens will be cleaned periodically with an air wash system.

RATE OF WITHDRAWAL – PROPOSED INITIAL AND EVENTUAL FLOW RATES:

The proposed initial rate of withdrawal from the river will be approximately 1 MGD over a 12-hour day or 1440 gpm peak pumping rate. The proposed eventual rate of withdrawal will be 4 MGD occurring over a 24-hour day or 2880 gpm. The latter represents the highest rate expected to be withdrawn from the Elk River due to operation of the intake.

INTAKE SCREEN SLOT VELOCITY:

To protect aquatic life in the river, the slot velocity through the screens at the proposed intake will be designed to be less than 0.5 feet per second. Using two 21" diameter tee-screens with 0.125" slots attached to the intake structure, the velocity at the proposed initial withdrawal rate of 1,440 gpm will be approximately 0.17 fps and the velocity at the eventual withdrawal rate of 2,880 gpm will be 0.35 fps.

DROUGHT IMPACTS:

The extreme drought of 2007-2008 in Lincoln County caused LCBPU to make public requests for customers to reduce water use and discontinue activities such as lawn and garden watering. Water levels in the storage tanks were low and the City of Fayetteville was unable to supply no more than 100,000 gpd through the connection at the Wells Hill Pump Station and at times they were unable to supply any water. The largest well supplying the Taft Water Treatment Plant went dry during the period. The water bearing formation for most of the wells is only 55 to 60 feet. Monitoring well data for USGS Site 350034086422800, located at the Taft Water Treatment Plant, was obtained and a graph of average daily depth to water over time for the period of Jan. 1, 2006 to Dec. 31, 2008 was plotted to show the severe effects of the drought on the water table. Monitoring well data and the graph are attached. Maximum recorded depth to water was more than 36 feet. To replace the dry well, emergency wells had to be constructed west of Taft at a cost of more than $500,000. Complaints from residents in the area that the

municipal wells are lowering the output of their private wells has made the County hesitant about drilling any more wells in the Taft area. The effect of the drought of 2007 was to speed up LCBPU's resolve to establish a water supply on the river. In 2011, LCBPU adopted a "Drought Management Plan" to establish written procedures for conserving water during a drought.

20-YEAR WATER SUPPLY NEEDS:

(See attached table)

USGS MONITORING WELL DATA AND GRAPH:

(See attached printout and graph)

ELK RIVER HYDROLOGIC MODELING :

(See attached report by Griggs and Maloney, Inc. dated Feb. 2, 2012)

Projected 20-Year Water Supply Needs for Lincoln County Board of Public Utilities

Taft, Elora, and Flintville Zones

Year	Total System* Customers	TEF * Customers	TEF Average Demand (MGD)	TEF Peak Demand (MGD)
2009	8,300	7,815	1.938	2.229
2010	8,351	7,863	1.958	2.251
2011	8,693	7,911	1.970	2.265
2012	8,746	7,960	1.982	2.279
2013	8,800	8,009	1.994	2.293
2014	8,854	8,058	2.006	2.307
2015	8,909	8,108	2.019	2.322
2016	8,964	8,158	2.031	2.336
2017	9,019	8,208	2.044	2.350
2018	9,074	8,258	2.056	2.365
2019	9,130	8,309	2.069	2.379
2020	9,186	8,360	2.082	2.394
2021	9,243	8,412	2.094	2.409
2022	9,300	8,463	2.107	2.423
2023	9,357	8,515	2.120	2.438
2024	9,414	8,568	2.133	2.453
2025	9,472	8,621	2.146	2.468
2026	9,530	8,674	2.160	2.484
2027	9,589	8,727	2.173	2.499
2028	9,648	8,781	2.186	2.514
2029	9,707	8,835	2.200	2.530
2030	9,767	8,889	2.213	2.545

Year	New Farm ** Customers	Demand (MGD)
2009	0	0.000
2010	0	0.000
2011	1	0.008
2012	1	0.008
2013	1	0.008
2014	1	0.008
2015	2	0.016
2016	2	0.016
2017	2	0.016
2018	2	0.016
2019	3	0.024
2020	3	0.024
2021	3	0.024
2022	3	0.024
2023	4	0.032
2024	4	0.032
2025	4	0.032
2026	4	0.032
2027	5	0.040
2028	5	0.040
2029	5	0.040
2030	5	0.040

Year	Total TEF Average Demand (MGD)	Total TEF Peak Demand (MGD)
2009	1.938	2.229
2010	1.958	2.251
2011	1.978	2.265
2012	1.990	2.279
2013	2.002	2.293
2014	2.014	2.307
2015	2.035	2.322
2016	2.047	2.336
2017	2.060	2.350
2018	2.072	2.365
2019	2.093	2.379
2020	2.106	2.394
2021	2.118	2.409
2022	2.131	2.423
2023	2.152	2.438
2024	2.165	2.453
2025	2.178	2.468
2026	2.192	2.484
2027	2.213	2.499
2028	2.226	2.514
2029	2.240	2.530
2030	2.253	2.545

*The percent increase in customers based on U. S. Census Bureau population projection of 0.615% increase per year.

** Chicken house farms estimated at 8,000 gallons per day. Numbers represent total new chicken house farms since 2009.

TEF = Taft, Elora, and Flintville zones

Average water pumped per customer/day = 248.0 gallons

GRIGGS & MALONEY
INCORPORATED
Engineering & Environmental Consulting

MEMORANDUM

DATE: 2 FEB 2012
TO: BOB RAMSEY, P.E.-JAMES C. HAILEY AND COMPANY, INC.
FROM: RICHARD D. MARTIN, P.G.
RE: ELK RIVER HYDROLOGIC MODELING RESULTS

This memorandum presents the results obtained to-date in determining acceptable low flow rates in the Elk River at mile 75.3 that would allow the Lincoln County Utility District (LCUD) to withdraw raw water without creating negative impact to the river's wetted usable area (WUA).

The request for characterizing the impact, or lack thereof, from the proposed water treatment plant came from the Tennessee Valley Authority (TVA), who has been established as the lead agency among the host of environmental regulatory agencies who must permit this activity.

I contacted Scott Gain, Director of the United States Geological Survey (USGS) Water Center in Nashville, to discuss our task related to performing hydrologic modeling of the Elk River at mile 75.3. I described in detail LCUD's desire to install a water intake at this location and the Tennessee Valley Authority's (TVA) concern relative to potential habitat impact on the Boulder Darter (*Etheostoma wapiti*)-a listed species that has been documented to inhabit this reach of the river.

My original intent was to enlist someone at USGS to provide peer review of the LCUD PHABSIM model's output (since it was originally developed by this agency).

Due to the intensive field data collection burden required under a wide range of river flows to calibrate the model, coupled with PHABSIM's focus on microhabitat; USGS has developed a regional approach to derive minimum flows that are adequate to protect species of concern. Otherwise stated, Gain considers PHABSIM and similar models capable of providing a characterization of wetted perimeter within a stream at a given point in time, i.e. when the cross-sections were made-but does not necessarily extend beyond this single reference.

The regional minimum flow criterion, while complex in development, is quite simple to implement. USGS recommends applying a standard of 0.05 to 0.2 cubic feet per second (cfs) stream discharge per square mile of drainage at the given point of interest to determine acceptable flow for sustaining aquatic biota. (This applies to both regulated and non-regulated streams.) The 0.05 criterion is applied to streams that do not possess any identified species of concern and the most conservative (0.2) could be

applied to streams that possess extremely sensitive species. He further stated that 0.1 was frequently applied as the "sweet spot" that, in his opinion, was adequately protective in most cases.

I calculated the drainage area at Elk River Mile 75.3, utilizing the USGS StreamStats model, and arrived at 1,023 square miles. Applying USGS's factors to this drainage basin, a critical low stream flow of 102 cfs (66 mgd) was derived at the 0.1 factor and at the more stringent 0.2 application factor (which might be required in lieu of the presence of the Boulder Darter); ~205 cfs (132 mgd) is calculated as the tipping point. Given that the proposed water intake resides between the Fayetteville and Prospect gages, it is proposed that the downstream (Prospect) gage be established as the point of flow reference. The drainage basin at the Prospect Gage is 1,805 $mi.^2$;therefore, the critical low flow criterion, according to the USGS regional model, would be 361 cfs (~233 MGD) at the 0.2 application factor and 180 cfs (~116 MGD), if the less stringent 0.1 application factor could be demonstrated as adequate.

This would, of course, require LCUD to monitor the river's flow (via Internet) and on the rare occasion(s) when it approached this critical flow rate plant operation would be altered to either reduce or cease water withdrawal. Another option would be for LCUD to install a staff gage near the water plant intake location and develop an independent stage / discharge rating curve for the river at this point.

Notwithstanding the aforementioned regional approach, Edward M. Polk, P.E., who has contracted with Griggs & Maloney to assist with this project, developed a simulation of decrease in wetted usable area versus flow rate based on river cross sections obtained by your firm in the immediate vicinity of the proposed intake. As is demonstrated in the model's results, applied to even lower stream flow ranges (123 to 160 cfs) than that prescribed by the USGS regional model, the channel surface width (wetted perimeter) at the intake location would reduce by only 0.338 ft. (4 in.), which equates to a reduction of 2 inches at each bank in the pool area. It stands to reason that the wetted perimeter would reduce even less in constricted riffle areas in other areas of the river and, therefore, have no discernible impact upon aquatic habitat. This simulation reflects even a more conservative approach than that previously described in the USGS regional model, thereby providing basis for utilizing the 0.1 factor previously described. Moreover, Polk's model is a subroutine of another empirical model (ESTIMHAB), which is a far more economical model for estimating the ecological impacts of flow alteration (modification of minimum flow rates) on rivers. The latter model does, however, require limited field studies, the most important of which is determining river cross sections under base flow conditions.

It is also noteworthy that we have performed intake velocity modeling of the proposed intake structure that revealed a velocity of approximately 0.5 feet per second would be achieved at the maximum intake rate, which is according to TVA and U.S. Fish and Wildlife Service personnel is adequate to protect the entrainment of larval fish.

Attached to this memorandum are copies of Mr. Polk's model, stream flow statistics for the Prospect gage, and the raw water intake model. (Please note that the stream flow data presented include 2007 [a severe drought year] median / minimum discharge rates and 5^{th} and 50^{th} percentile [median] for a 30 year period of record. These data demonstrate that the Elk River flow does occasionally drop below the preliminary "action level" criterion discussed herein.

Lastly, in our recent meeting with the environmental regulatory agencies, LCUD was requested to provide improved habitat for the species of interest, since the area where the intake will be located possesses a bedrock substrate. Limestone boulders of various sizes, ranging from 18" to 24 ", should be installed in this stream reach as boulder clusters, the location of which should be determined during low stream flow conditions. Figure 1 (shown below) provides a schematic of the habitat enhancement proposed for this river segment.

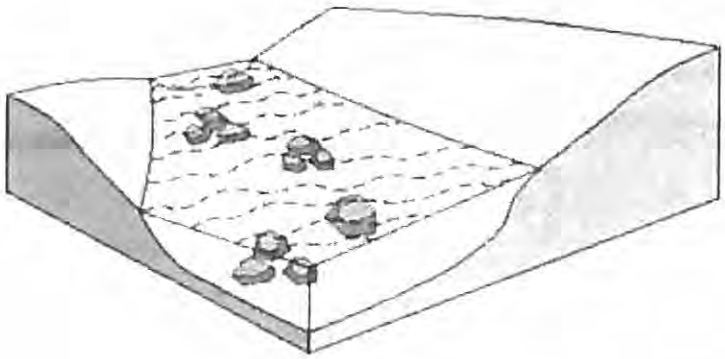


FIGURE 1. BOULDER CLUSTER SCHEMATIC

USGS has expressed willingness to assist us with developing the appropriate low flow criteria; however, they would like to observe and develop cross-sections downstream from the proposed intake at reduced stream flow conditions.

Attachments (3)

ATTACHMENT 1

MANNING EQUATION MODEL

ELK RIVER MILE 75.3

Manning Equation Preliminary Calculations for a Surveyed Elk River Cross-section at the Proposed LCUD Water Intake

Elevation ft.	Distance From Survey Starting Point, ft.*			Water Surface Width, ft.	Max Water Depth, ft.	Cross- Sectional Area, ft.2	Average Depth, ft.
	Left Bank	Center (Low Point)	Right Bank				
610.2	**205**	**205**	**205**	**0**	**0**	**0**	**0.0000**
611	**180**	**205**	**228**	**48**	**0.8**	**12.8**	**0.2667**
612	**168**	**205**	**235**	**67**	**1.8**	**43.3**	**0.6463**
612.05	167.45	205	235.125	67.675	1.85	48.6075	0.7182
612.1	166.9	205	235.25	68.35	1.9	53.915	0.7888
612.15	166.35	205	235.375	69.025	1.95	59.2225	0.8580
612.175	166.075	205	235.4375	69.3625	1.975	61.87625	0.8921
612.2	165.8	205	235.5	69.7	2	64.53	0.9258
612.25	165.25	205	235.625	70.375	2.05	69.8375	0.9924
612.3	164.7	205	235.75	71.05	2.1	75.145	1.0576
612.35	164.15	205	235.875	71.725	2.15	80.4525	1.1217
612.4	163.6	205	236	72.4	2.2	85.76	1.1845
612.45	163.05	205	236.125	73.075	2.25	91.0675	1.2462
612.5	162.5	205	236.25	73.75	2.3	96.375	1.3068
612.55	161.95	205	236.375	74.425	2.35	101.6825	1.3662
612.6	161.4	205	236.5	75.1	2.4	106.99	1.4246
612.7	160.3	205	236.75	76.45	2.5	117.605	1.5383
612.8	159.2	205	237	77.8	2.6	128.22	1.6481
612.9	158.1	205	237.25	79.15	2.7	138.835	1.7541
613	**157**	**205**	**237.5**	**80.5**	**2.8**	**149.45**	**1.8565**
614	**151**	**205**	**241**	**90**	**3.8**	**234.75**	**2.6083**

* Bolded values are measured from the graphical display of the survey cross-section, and non-bolded values are calculated by linear extrapolation.

Manning Equation:

V = (1.486/n) * R^(2/3) * S^ (1/2)
V=Average Velocity = Flow/Cross-sectional Area = Q/A
R= Hydraulic Radius = cross-sectional area, A divided by the wetted perimeter, P = A/P
S = Energy Slope which is assumed to = bottom slope for the Elk River
n = roughness coefficient
For the cross-section as shown above, the wetted perimeter, P is within 0.5% of the water surface width, W
Thus P can be approximated as the surface width, W, and
The area, A = the average depth, D times the surface width, W
Thus A/P = (W*D)/W = D, the average depth
Substituting the above into the Manning equation:
Q/A = (1.486/n) * D^(2/3) * S^ (½), or
Q = A*(1.486/n)*D^(2/3)*S^(1/2)
Substituting W*D for A, the equation becomes
Q = W*(1.486/n)*D^(1.6667)*S^(1/2)

Other Assumptions:

Minimum flow range before proposed withdrawal, Q =	160 to 130	cfs = 7Q10 low flow, Fayetteville/Prospect Gages
Maximum withdrawal by LCUD	6.2	cfs
Flow following withdrawal	153.2 to 123.2	cfs

Mannings n = Use values of 0.03 and 0.04
Slope: Measurements of stream slope are not currently available, so a range of values have been evaluated
Use stream slope values of: 3 ft/1000 ft, 4ft/1000 ft, 5 ft/1000 ft, and 6 ft/1000 ft

Values of depth and width from the above cross-section data have been selected to calculate values of Q in the range of 123 to160cfs

Cal. Flow Q, cfs	Slope S, ft/ft	Manning's n	Avg Depth D, ft.	Surface Width W, ft	D^(1.667)	S^(1/2)	Avg. Velocity V, ft/sec	Surface Width Change, ft.
153.9	0.006	0.04	0.8580	69.025	0.775	0.077	2.60	
140.5	0.005	0.04	0.8580	69.025	0.775	0.071	2.37	
134.7	0.004	0.04	**0.8921**	**69.363**	0.827	0.063	2.18	**0.338**
144.0	0.004	0.04	**0.9258**	**69.700**	0.879	0.063	2.23	
141.4	0.003	0.04	0.9924	70.375	0.987	0.055	2.02	
124.2	0.006	0.03	0.6463	67.000	0.483	0.077	2.87	
161.2	0.005	0.03	0.7888	68.350	0.673	0.071	2.99	
144.2	0.004	0.03	0.7888	68.35	0.673	0.063	2.67	
145.1	0.003	0.03	0.8580	69.025	0.775	0.055	2.45	

From the above table a slope of 0.004 and a Manning's n of .04 were chosen, and the depth reduced by .0337ft (0.4 inches). This results in a flow change of 5.3 cfs (see numbers in bold) and a width change of .338 ft (4 inches total, or 2 inches width reduction at each bank).
A stream width reduction of 4 inches in a cross-section that is 69.7 ft wide represents less than ½ of 1 percent change which should have no measurable impact to aquatic life considering the normal flow fluctuation in the stream due to release patterns from Tims Ford Dam.

ATTACHMENT 2

USGS DISCHARGE DATA

ELK RIVER AT PROSPECT, TN

USGS 03584600 ELK RIVER AT PROSPECT, TN - 2007 MEDIAN DAILY FLOW

Giles County, Tennessee
Hydrologic UnitCode 06030004
Latitude 35°00'50.95", Longitude 86°59'40.74" NAD27
Drainage area 1,805 square miles
Gage datum 558.70 feet above NGVD29

00060, Discharge, cubic feet per second,

50th percentile (median) of daily mean values for each day for 1 - 1 years of record in, cfs (Calculation Period 2006-10-01 -> 2008-09-30)
Period-of-record for statistical calculation restricted by user

Day of month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	9,910	1,210	2,160	606	625	280	282	302	224	150	194	355
2	5,510	1,150	11,200	598	584	298	272	291	222	151	191	335
3	3,990	1,190	8,600	591	582	322	290	270	208	149	191	341
4	3,110	1,040	4,360	766	628	347	260	268	189	148	190	369
5	13,100	862	3,000	802	722	330	241	255	188	148	188	383
6	13,700	1,230	2,350	741	754	307	260	256	188	150	188	365
7	7,040	2,230	1,980	660	753	288	338	246	185	150	188	330
8	7,820	1,920	1,730	619	667	280	400	251	184	154	192	305
9	6,630	2,030	1,540	601	593	292	340	302	180	150	192	291
10	5,650	1,830	1,380	585	549	289	319	351	181	147	192	282
11	4,660	1,350	1,260	680	614	294	471	244	196	148	190	276
12	4,150	753	1,150	1,280	666	276	513	226	198	144	192	276
13	3,770	722	1,070	1,380	681	265	432	223	225	142	195	530
14	2,680	887	1,020	1,070	577	254	376	222	261	142	199	559
15	1,630	1,250	977	1,590	491	243	346	226	226	152	351	843
16	1,760	1,240	983	2,310	460	249	330	225	225	164	335	553
17	3,300	1,300	947	1,550	435	238	317	220	221	166	300	455
18	3,540	1,160	863	1,230	412	236	325	216	198	181	264	412
19	2,960	918	821	1,070	407	266	321	221	181	188	239	377
20	2,900	853	787	932	402	358	328	209	171	192	230	360
21	2,800	826	763	820	396	383	301	179	165	190	226	422
22	5,150	799	745	746	381	351	308	161	158	182	345	641
23	4,230	749	730	690	363	277	300	153	157	212	467	638
24	3,250	710	701	658	348	256	288	149	156	334	395	658
25	2,500	1,110	682	628	333	252	274	221	150	355	334	603
26	2,090	2,960	666	834	325	254	280	983	146	310	569	556
27	1,820	2,210	651	1,020	317	258	336	725	152	270	727	504
28	1,620	1,720	647	925	304	311	335	375	148	241	654	532
29	1,370		670	769	296	271	334	281	149	219	503	1,370
30	1,220		654	682	294	262	332	263	151	207	406	1,520
31	1,160		624		287		345	232		199		1,060

USGS 03584600 ELK RIVER AT PROSPECT, TN - 2007 MINIMUM DAILY FLOW

Giles County, Tennessee
Hydrologic Unit Code 06030004
Latitude 35°00'50.95", Longitude 86°56'40.74" NAD27
Drainage area 1,805 square miles
Gage datum 558.70 feet above NGVD29

00060, Discharge, cubic feet per second,

Day of month	Minimum of daily mean values for each day for 1 - 1 years of record in, cfs (Calculation Period 2006-10-01 -> 2008-09-30) Period-of-record for statistical calculation restricted by user											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	9,910	1,210	2,160	606	625	280	282	302	224	150	194	355
2	5,510	1,150	11,200	598	584	298	272	291	222	151	191	335
3	3,990	1,190	8,600	591	582	322	290	270	208	149	191	341
4	3,110	1,040	4,360	766	628	347	260	268	189	148	190	369
5	13,100	862	3,000	802	722	330	241	255	188	148	188	383
6	13,700	1,230	2,350	741	754	307	260	256	188	150	188	365
7	7,040	2,230	1,980	660	753	288	338	246	185	150	188	330
8	7,820	1,920	1,730	619	667	280	400	251	184	154	192	305
9	6,630	2,030	1,540	601	593	292	340	302	180	150	192	291
10	5,650	1,830	1,380	585	549	289	319	351	181	147	192	282
11	4,660	1,350	1,260	680	614	294	471	244	196	148	190	276
12	4,150	753	1,150	1,280	666	276	513	226	198	144	192	276
13	3,770	722	1,070	1,380	681	265	432	223	225	142	195	530
14	2,680	887	1,020	1,070	577	254	376	222	261	142	199	559
15	1,630	1,250	977	1,590	491	243	346	226	226	152	351	843
16	1,760	1,240	983	2,310	460	249	330	225	225	164	335	553
17	3,300	1,300	947	1,550	435	238	317	220	221	166	300	455
18	3,540	1,160	863	1,230	412	236	325	216	198	181	264	412
19	2,960	918	821	1,070	407	266	321	221	181	188	239	377
20	2,900	853	787	932	402	358	328	209	171	192	230	360
21	2,800	826	763	820	396	383	301	179	165	190	226	422
22	5,150	799	745	746	381	351	308	161	158	182	345	641
23	4,230	749	730	690	363	277	300	153	157	212	467	638
24	3,250	710	701	658	348	256	288	149	156	334	395	658
25	2,500	1,110	682	628	333	252	274	221	150	355	334	603
26	2,090	2,960	666	834	325	254	280	983	146	310	569	556
27	1,820	2,210	651	1,020	317	258	336	725	152	270	727	504
28	1,620	1,720	647	925	304	311	335	375	148	241	654	532
29	1,370		670	769	296	271	334	281	149	219	503	1,370
30	1,220		654	682	294	262	332	263	151	207	406	1,520
31	1,160		624		287		345	232		199		1,060

USGS 03584600 ELK RIVER AT PROSPECT, TN

Giles County, Tennessee
Hydrologic Unit Code 06030004
Latitude 35°00'50.95", Longitude 86°59'40.74" NAD27
Drainage area: 1,805 square miles
Gage datum 558.70 feet above NGVD29

00060, Discharge, cubic feet per second,

50th percentile (median) of daily mean values for each day for 26 - 29 years of record in, cfs (Calculation Period 1979-10-01 -> 2011-09-30)
Period-of-record for statistical calculation restricted by user

Day of month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	4,690	2,500	3,520	2,980	1,690	1,000	900	587	421	469	631	2,890
2	4,190	2,790	3,550	2,890	1,720	1,270	689	493	406	471	1,020	3,450
3	4,050	2,480	3,410	2,770	1,720	1,310	826	531	376	464	1,090	3,300
4	4,200	2,630	3,690	3,390	1,610	1,020	638	676	386	467	1,150	2,880
5	4,060	2,660	3,750	3,090	1,530	1,210	660	619	429	488	1,460	2,390
6	4,100	2,690	3,840	3,310	1,520	932	517	583	423	480	1,270	2,930
7	4,010	2,550	3,250	3,160	1,380	820	735	520	400	498	1,220	2,380
8	3,980	2,550	2,830	3,900	2,090	714	610	503	386	484	1,260	2,800
9	2,980	2,520	2,860	3,580	2,130	832	547	548	406	548	921	2,880
10	3,400	2,330	3,350	3,860	1,780	884	629	550	400	511	1,500	3,090
11	3,880	2,580	2,780	3,010	1,480	865	671	536	445	472	1,340	3,190
12	4,000	2,620	2,870	2,760	1,670	788	762	532	476	517	1,380	3,250
13	3,310	2,750	3,280	2,870	1,470	779	803	488	404	537	1,460	3,020
14	3,370	3,950	2,990	3,260	1,390	808	752	444	412	510	1,280	3,580
15	2,690	4,290	3,450	3,160	1,210	858	754	460	379	526	1,220	4,070
16	2,500	4,050	4,130	2,690	1,090	798	682	461	460	495	1,890	4,070
17	2,750	3,890	3,650	2,710	1,020	706	605	455	531	450	2,100	4,510
18	3,310	3,510	3,210	2,270	1,040	744	601	529	472	626	1,730	4,300
19	4,310	3,350	3,260	2,170	1,210	695	565	522	516	606	1,780	3,880
20	3,690	3,060	2,950	2,410	1,090	692	635	439	489	560	2,120	3,340
21	4,730	2,790	3,080	1,990	859	703	575	453	464	577	1,660	3,420
22	4,760	3,100	2,940	2,460	1,070	744	613	431	457	685	2,030	3,890
23	4,080	3,040	3,230	1,880	1,200	728	508	406	505	553	1,900	3,810
24	3,500	3,000	2,900	1,840	971	653	587	418	498	602	2,180	4,150
25	3,820	2,560	2,950	1,550	831	606	536	400	501	968	2,400	4,310
26	4,060	2,960	2,730	1,530	771	666	516	425	532	640	2,330	4,550
27	3,780	2,290	2,340	1,580	820	758	519	469	512	1,060	1,860	3,780
28	2,990	2,920	2,220	1,770	1,040	691	559	440	519	1,150	2,160	4,080
29	2,810	2,000	2,070	1,200	903	757	590	455	438	957	2,300	4,410
30	2,410		3,010	1,530	965	1,060	508	440	467	904	2,690	4,250
31	2,250		2,460		838		577	428		778		4,630

USGS 03584600 ELK RIVER AT PROSPECT, TN
Giles County, Tennessee
Hydrologic Unit Code 06030004
Latitude 35°00'50.95", Longitude 86°59'40.74" NAD27
Drainage area 1,805 square miles
Gage datum 558.70 feet above NGVD29

00060, Discharge, cubic feet per second,

05th percentile of daily mean values for each day for 26 - 29 years of record in, cfs (Calculation Period 1979-10-01 -> 2011-09-30)
Period-of-record for statistical calculation restricted by user

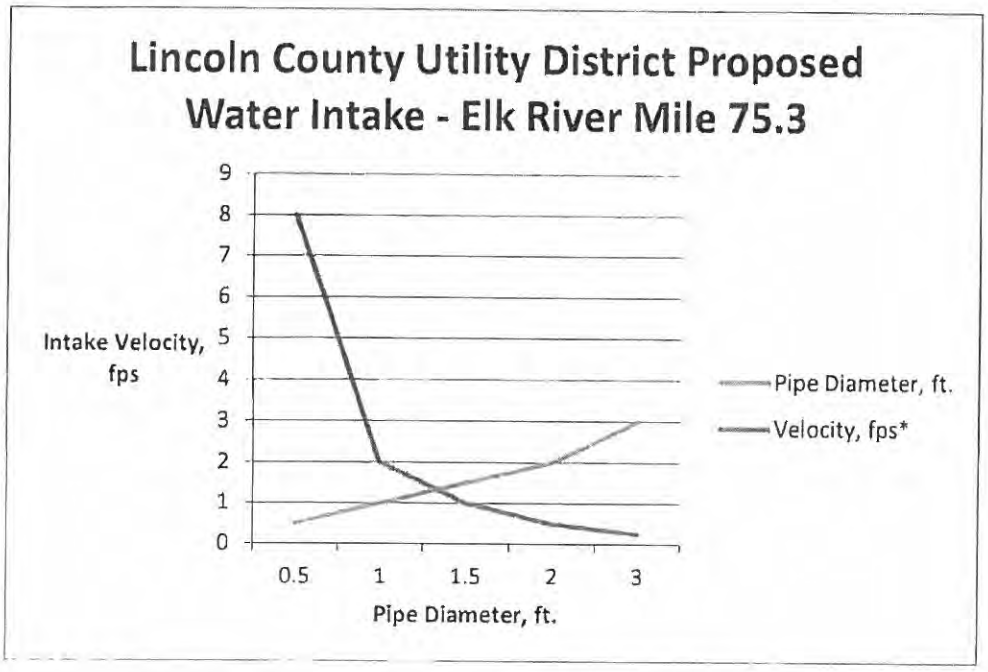
Day of month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	690	821	887	698	462	258	220	214	136	168	201	418
2	577	823	907	706	429	260	225	210	127	167	198	368
3	543	814	850	702	441	258	244	217	125	167	198	359
4	506	790	1,080	806	435	267	249	227	120	166	197	502
5	465	863	967	813	422	254	266	214	142	162	204	606
6	604	831	890	773	438	241	251	201	131	162	197	505
7	545	825	826	710	460	232	238	207	145	161	195	429
8	492	769	775	733	467	227	249	226	149	167	196	361
9	617	670	807	720	426	223	236	218	150	158	199	391
10	616	659	808	692	427	213	240	204	149	155	278	371
11	546	665	876	713	438	208	269	187	140	156	261	388
12	508	787	921	831	439	204	283	177	145	153	260	341
13	655	861	984	775	432	207	269	180	145	152	261	557
14	654	993	814	745	422	200	319	180	151	150	257	417
15	580	1,160	754	733	403	182	321	215	149	154	321	647
16	526	896	738	726	386	188	332	205	150	161	301	571
17	503	855	824	689	371	184	297	195	163	167	382	663
18	489	929	860	691	357	183	255	192	188	182	287	455
19	461	910	720	766	357	195	234	197	179	186	242	405
20	476	860	627	756	355	279	217	191	176	178	318	385
21	545	836	637	735	347	279	265	198	192	182	311	419
22	579	810	783	701	334	221	256	168	189	179	363	540
23	589	768	786	677	341	218	271	166	177	181	383	747
24	571	748	741	635	350	283	289	168	175	213	383	662
25	502	911	722	594	354	280	281	181	182	192	354	642
26	481	920	721	652	347	229	272	174	166	177	551	608
27	567	951	699	589	328	215	276	152	166	230	542	566
28	756	895	675	553	308	223	258	160	163	222	532	570
29	725		673	537	295	199	236	158	167	222	553	498
30	874		733	499	283	198	223	157	172	215	501	699
31	862		730		270		221	154		207		621

ATTACHMENT 3

INTAKE VELOCITY MODEL

ELK RIVER MILE 75.3

Pipe Diameter, ft.	Velocity, fps*	Area, ft.2
0.5	8	0.78
1	2	3.14
1.5	1	7.06
2	0.5	12.56
3	0.25	28.27



* Assumes intake volume of 4.0 MGD

APPENDIX C

The following list includes previous biological opinions, issued for adverse effect and completed for boulder darter populations within Tennessee and Alabama, which identified incidental take:

OPINIONS (year)	INCIDENTAL TAKE NUMBER	CRITICAL HABITAT	HABITAT
2006	individuals downstream of Tim's Ford Dam between ERM 90 to ERM 120	N/A	not to exceed more than a total of 2 mi of suitable habitat
2013	95% of the overall, range-wide boulder darter population	N/A	N/A