U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NUREG–2226, Vol. 2

Environmental Impact Statement for an Early Site Permit (ESP) at the Clinch River Nuclear Site

Draft Report for Comment

Appendices A-M

U.S. Nuclear Regulatory Commission
Office of New Reactors
Washington, DC 20555-0001

U.S. Army Corps of Engineers
Nashville District
Nashville, Tennessee 37203

US Army Corps of Engineers®

AVAILABILITY OF REFERENCE MATERIALS IN NRC PUBLICATIONS

NRC Reference Material

As of November 1999, you may electronically access NUREG-series publications and other NRC records at NRC's Library at www.nrc.gov/reading-rm.html. Publicly released records include, to name a few, NUREG-series publications; *Federal Register* notices; applicant, licensee, and vendor documents and correspondence; NRC correspondence and internal memoranda; bulletins and information notices; inspection and investigative reports; licensee event reports; and Commission papers and their attachments.

NRC publications in the NUREG series, NRC regulations, and Title 10, "Energy," in the *Code of Federal Regulations* may also be purchased from one of these two sources.

1. **The Superintendent of Documents**
   U.S. Government Publishing Office
   Mail Stop IDCC
   Washington, DC 20402-0001
   Internet: bookstore.gpo.gov
   Telephone: (202) 512-1800
   Fax: (202) 512-2104

2. **The National Technical Information Service**
   5301 Shawnee Rd., Alexandria, VA 22312-0002
   www.ntis.gov
   1-800-553-6847 or, locally, (703) 605-6000

A single copy of each NRC draft report for comment is available free, to the extent of supply, upon written request as follows:

Address: **U.S. Nuclear Regulatory Commission**
Office of Administration
Publications Branch
Washington, DC 20555-0001
E-mail: distribution.resource@nrc.gov
Facsimile: (301) 415-2289

Some publications in the NUREG series that are posted at NRC's Web site address www.nrc.gov/reading-rm/doc-collections/nuregs are updated periodically and may differ from the last printed version. Although references to material found on a Web site bear the date the material was accessed, the material available on the date cited may subsequently be removed from the site.

Non-NRC Reference Material

Documents available from public and special technical libraries include all open literature items, such as books, journal articles, transactions, *Federal Register* notices, Federal and State legislation, and congressional reports. Such documents as theses, dissertations, foreign reports and translations, and non-NRC conference proceedings may be purchased from their sponsoring organization.

Copies of industry codes and standards used in a substantive manner in the NRC regulatory process are maintained at—

The NRC Technical Library
Two White Flint North
11545 Rockville Pike
Rockville, MD 20852-2738

These standards are available in the library for reference use by the public. Codes and standards are usually copyrighted and may be purchased from the originating organization or, if they are American National Standards, from—

American National Standards Institute
11 West 42nd Street
New York, NY 10036-8002
www.ansi.org
(212) 642-4900

Legally binding regulatory requirements are stated only in laws; NRC regulations; licenses, including technical specifications; or orders, not in NUREG-series publications. The views expressed in contractorprepared publications in this series are not necessarily those of the NRC.

The NUREG series comprises (1) technical and administrative reports and books prepared by the staff (NUREG–XXXX) or agency contractors (NUREG/CR–XXXX), (2) proceedings of conferences (NUREG/CP–XXXX), (3) reports resulting from international agreements (NUREG/IA–XXXX), (4) brochures (NUREG/BR–XXXX), and (5) compilations of legal decisions and orders of the Commission and Atomic and Safety Licensing Boards and of Directors' decisions under Section 2.206 of NRC's regulations (NUREG–0750).

NUREG–2226, Vol. 2

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Environmental Impact Statement for an Early Site Permit (ESP) at the Clinch River Nuclear Site

Draft Report for Comment

Appendices A-M

Manuscript Completed: April 2018
Date Published: April 2018

Office of New Reactors
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Nashville District
U.S. Army Corps of Engineers
Nashville, Tennessee 37203

US Army Corps of Engineers®

COMMENTS ON DRAFT REPORT

Any interested party may submit comments on this report for consideration by the NRC staff. Comments may be accompanied by additional relevant information or supporting data. Please specify the report number **NUREG-2226** in your comments, and send them by the end of the comment period specified in the *Federal Register* notice announcing the availability of this report.

Addresses: You may submit comments by any one of the following methods. Please include Docket ID **NRC-2016-0119** in the subject line of your comments. Comments submitted in writing or in electronic form will be posted on the NRC website and on the Federal rulemaking website http://www.regulations.gov.

NRC Project E-mail Address: Electronic comments may be sent by email to the NRC at ClinchRiverESPEIS@nrc.gov.

Federal Rulemaking Website: Go to http://www.regulations.gov and search for documents filed under Docket ID **NRC-2016-0119**. Address questions about NRC dockets to Jennifer Borges at 301-287-9127 or by e-mail at Jennifer.Borges@nrc.gov.

Mail comments to: May Ma, Division of Administrative Services, Office of Administration, Mail Stop:TWFN-07-A60, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

For any questions about the material in this report, please contact: Tamsen Dozier, Environmental Project Manager, 301-415-2272 or by email at Tamsen.Dozier@nrc.gov or contact Patricia Vokoun, Environmental Project Manager, 301-415-3470 or by email at Patricia.Vokoun@nrc.gov.

Please be aware that any comments that you submit to the NRC will be considered a public record and entered into the Agencywide Documents Access and Management System (ADAMS). Do not provide information you would not want to be publicly available.

ABSTRACT

This draft environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by the Tennessee Valley Authority (TVA) for an early site permit (ESP) for a site in Oak Ridge, Roane County, Tennessee, for new nuclear power units demonstrating small modular reactor (SMR) technology. The proposed action related to the TVA application is the issuance of an ESP for the Clinch River Nuclear (CRN) Site approving the site as suitable for the future demonstration of the construction and operation of two or more SMRs with characteristics presented in the application. The Nashville District, Regulatory Division, U.S. Army Corps of Engineers (USACE) is a cooperating agency with the NRC to verify that the information presented in this draft EIS is adequate to support a Department of the Army permit application, should TVA submit a Department of the Army permit application at a future date. The USACE is cooperating in the preparation of this draft EIS to streamline regulatory review processes, avoid unnecessary duplication of effort, and ensure issues and concerns related to impacts on waters of the United States and navigable waters of the United States are identified and addressed early in the NRC's review process. The NRC, its contractors, and USACE make up the review team.

This draft EIS documents the review team's preliminary analysis, which considers and weighs the environmental impacts of building and operating two or more SMRs at the CRN Site and at alternative sites, including measures potentially available for reducing or avoiding adverse impacts. This draft EIS also addresses Federally listed species, cultural resources, and plant cooling system design alternatives.

This draft EIS includes the evaluation of the proposed action's impacts on waters of the United States pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Appropriation Act of 1899. Upon receipt of an application, the USACE will conduct a public interest review in accordance with the guidelines promulgated by the U.S. Environmental Protection Agency under the authority of Section 404(b) of the Clean Water Act. The public interest review, which will be addressed in the USACE permit decision document, will include an alternatives analysis to determine the least environmentally damaging practicable alternative.

After considering the environmental aspects of the proposed action before the NRC, the NRC staff's preliminary recommendation to the Commission is that the ESP be issued as proposed. This recommendation is based on (1) the application, including the Environmental Report (ER), and supplemental information submitted by TVA; (2) consultation with Federal, State, Tribal, and local agencies; (3) the review team's independent review; (4) the consideration of public scoping comments received as part of the environmental review process; and (5) the assessments summarized in this draft EIS, including the potential mitigation measures identified in the ER and this draft EIS.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF FIGURES

LIST OF FIGURES (CONTINUED)

LIST OF FIGURES (CONTINUED)

LIST OF TABLES

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

EXECUTIVE SUMMARY

This draft environmental impact statement (EIS) presents the results of a U.S. Nuclear Regulatory Commission (NRC) environmental review of an application by the Tennessee Valley Authority (TVA) for an early site permit (ESP) at the Clinch River Nuclear (CRN) Site in Oak Ridge, Roane County, Tennessee, for a new nuclear power plant demonstrating small modular reactor (SMR) technology. The Nashville District, Regulatory Division, U.S. Army Corps of Engineers (USACE) is a cooperating agency with the NRC to verify that the information presented in this draft EIS is adequate to support a Department of the Army permit application if TVA submits a Department of the Army permit application at a future date. The USACE is cooperating in the preparation of this draft EIS to streamline regulatory review processes, avoid unnecessary duplication of effort, and ensure issues and concerns related to impacts on waters of the United States and navigable waters of the United States are identified and addressed early in the NRC's review process. The NRC, its contractors, and USACE make up the review team.

Background

On May 16, 2016, TVA submitted an application to the NRC for an ESP at the CRN Site. TVA subsequently provided supplemental information in support of the application. The staff determined that the application (with the subsequent submittals) was sufficient for docketing and issued a *Federal Register* (82 FR 3812) notice notifying the public of the NRC's acceptance of the CRN Site ESP application on January 12, 2017. On December 15, 2017, 2017, TVA submitted Revision 1 of its application, including the Environmental Report (ER) to the NRC.

Upon acceptance of TVA's application, the NRC review team began the environmental review process as described in Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR Part 52) by publishing a Notice of Intent to prepare an EIS and conduct scoping in the *Federal Register* on April 13, 2017 (82 FR 17885). As part of this environmental review, the review team did the following:

- considered comments received during a 60-day scoping process that began on April 13, 2017 and ended on June 12, 2017, and conducted related public scoping meetings on May 15, 2017 in Oak Ridge, Tennessee
- reviewed TVA's ER, as supplemented by TVA, and conducted a full scope environmental audit in May 2017
- conducted visits to the proposed CRN Site and alternative sites in May 2017
- consulted with Tribal Nations and other agencies such as the U.S. Fish and Wildlife Service, Advisory Council on Historic Preservation, Tennessee Historical Commission, Tennessee Department of Environment and Conservation, Tennessee Wildlife Resource Agency, and Alabama Department of Conservation and Natural Resources.

Proposed Action

The proposed action related to the TVA application is the issuance of an ESP for the CRN Site approving the site as suitable for the future demonstration of the construction and operation of two or more SMRs with characteristics presented in the application.

Purpose and Need for Action

The purpose of the proposed NRC action, issuance of the ESP, is to provide for early resolution of site safety and environmental issues, which provides stability in the licensing process. The NRC's purpose and need is further informed by the applicant's purpose and need. TVA's application provides TVA's analyses of the environmental impacts that could result from building and operating two or more SMRs with a maximum total electrical output of 800 MW(e) to demonstrate the capability of SMR technology.

The objective of the USACE review is to streamline its regulatory review process, avoid unnecessary duplication of effort, and ensure issues and concerns related to impacts on waters of the United States and navigable waters of the United States are identified and addressed early in the NRC's review process.

Public Involvement

A 60-day scoping period was held from April 13, 2017 to June 12, 2017. On May 15, 2017, the NRC held public scoping meetings in Oak Ridge, Tennessee. The review team received oral comments during the public meetings and a total of 74 pieces of scoping correspondence about topics such as surface-water hydrology, ecology, socioeconomics, and historic and cultural resources. The review team's responses to the in-scope public comments can be found in Appendix D of this draft EIS. The Scoping Summary Report (Agencywide Documents Access and Management System Accession Package No. ML17242A061) contains all of the comments and responses, including those considered out-of-scope.

Affected Environment

The CRN Site is located in Oak Ridge, Roane County, Tennessee (Figure ES-1). The CRN Site is located on the Clinch River arm of the Watts Bar Reservoir, adjacent to the existing U.S. Department of Energy's Oak Ridge Reservation. The CRN Site is situated in the southwestern part of the city limits of Oak Ridge approximately 10 mi south of the Oak Ridge urban center; 16 mi west of Knoxville, Tennessee; and 7 mi east of Kingston, Tennessee. The primary source of cooling water would be the Clinch River. The ultimate heat sink for the CRN SMRs would be the atmosphere, using mechanical draft cooling towers.

Evaluation of Environmental Impacts

This draft EIS evaluates the potential environmental impacts of the construction and operation of two or more SMRs at the CRN Site related to the following resource areas:

- land use
- air quality
- aquatic ecology
- terrestrial ecology
- surface water and groundwater
- waste
- human health (radiological and nonradiological)
- socioeconomics
- environmental justice
- cultural resources
- fuel cycle, decommissioning, and transportation.

The impacts are designated as SMALL, MODERATE, or LARGE. The incremental impacts related to the construction and operations activities requiring NRC authorization are described

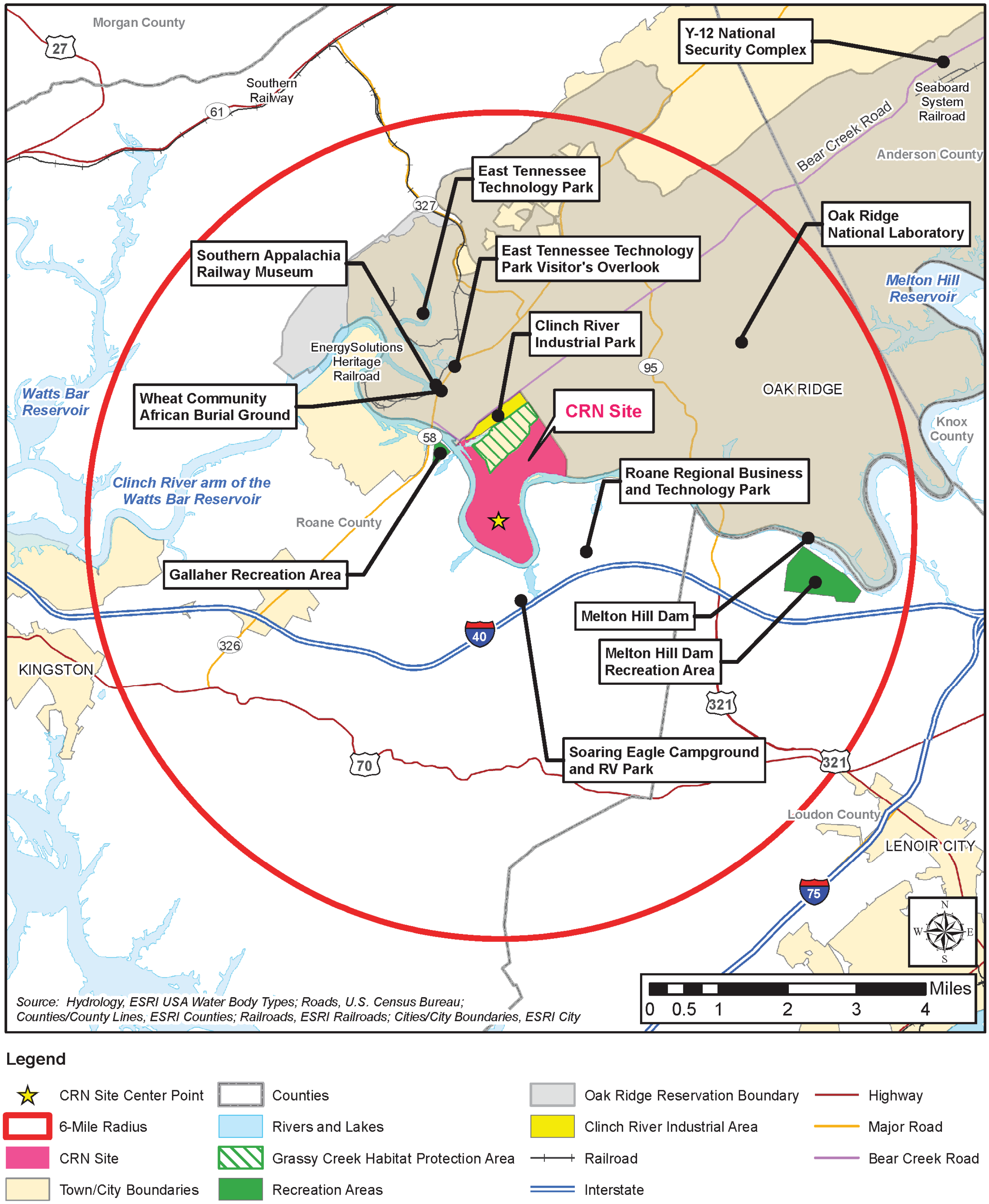


Figure ES-1. The CRN Site and Vicinity

and characterized, as are the cumulative impacts resulting from the proposed action when the effects are added to, or interact with, other past, present, and reasonably foreseeable future effects on the same resources. The construction and operation impacts are outlined in Table ES-1. Table ES-2 summarizes the review team's assessment of cumulative impacts. The review team's detailed analysis, which supports the impact assessment of the proposed new units, can be found in Chapters 4, 5, 6, and 7.

SMALL: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE: Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Table ES-1. Environmental Impact Levels at the CRN Site

Resource Category	Construction and Preconstruction	Operation
Land Use		
Site and Vicinity	MODERATE	SMALL
Water-Related		
Water Use – Surface Water	SMALL	SMALL
Water Use – Groundwater Use	SMALL	SMALL
Water Quality – Surface Water	SMALL	SMALL
Water Quality – Groundwater	SMALL	SMALL
Ecology		
Terrestrial Ecosystems	MODERATE	SMALL
Aquatic Ecosystems	SMALL	SMALL
Socioeconomic		
Physical Impacts	SMALL to MODERATE	SMALL to MODERATE (aesthetics)
Demography	SMALL	SMALL
Economic Impacts on the Community	SMALL (beneficial to the region)	SMALL (beneficial to the region)
Infrastructure and Community Services	SMALL (for all categories except traffic) and MODERATE to LARGE (for traffic)	SMALL to MODERATE (recreation)
Environmental Justice	NONE[(a)]	NONE[(a)]
Historic and Cultural Resources		
Onsite Direct and Indirect Effects Area of Potential Affect	MODERATE to LARGE	SMALL
Air Quality	SMALL	SMALL
Nonradiological Health	SMALL to MODERATE	SMALL to MODERATE
Radiological Health	SMALL	SMALL
Nonradioactive Waste	SMALL	SMALL
Postulated Accidents	NA	SMALL
Fuel Cycle, Transportation, and Decommissioning	NA	SMALL

(a) A determination of "NONE" for Environmental Justice analyses does not mean there are no adverse impacts on minority or low-income populations from the proposed project. Instead, an indication of "NONE" means that while adverse impacts do exist, they do not affect minority or low-income populations in any disproportionate manner relative to the general population.

Table ES-2. Cumulative Impacts on Environmental Resources, Including the Impacts of Proposed Action

Resource Category	Impact Level
Land Use	MODERATE
Water-Related	
Water Use – Surface Water	MODERATE
Water Use – Groundwater Use	SMALL
Water Quality – Surface Water	MODERATE
Water Quality – Groundwater	MODERATE
Ecology	
Terrestrial Ecosystems	MODERATE
Aquatic Ecosystems	LARGE
Socioeconomic	
Physical Impacts	SMALL to MODERATE
Demography	SMALL
Taxes and Economy	SMALL
Infrastructure and Community Services	MODERATE to LARGE
Environmental Justice	NONE[a]
Historic and Cultural Resources	MODERATE to LARGE
Air Quality	SMALL for criteria pollutants and MODERATE for GHGs
Nonradiological Health	SMALL to MODERATE
Nonradioactive Waste	SMALL
Radiological Health	SMALL
Postulated Accidents	SMALL
Fuel Cycle, Transportation, and Decommissioning	SMALL

(a) A determination of "NONE" for Environmental Justice analyses does not mean there are no adverse impacts on minority or low-income populations from the proposed project. Instead, an indication of "NONE" means that while adverse impacts do exist, they do not affect minority or low-income populations in any disproportionate manner relative to the general population.

Alternatives

The review team considered the environmental impacts associated with alternatives to issuing an ESP for the CRN Site. These alternatives included a no-action alternative (i.e., not issuing the ESP), siting locations, and system designs. The applicant's ER is not required to include a discussion of the alternative energy sources for an ESP (10 CFR 51.50(b)(2)).

The no-action alternative would result if NRC does not grant the ESP. If an ESP is not granted, construction and operation of new units at the CRN Site in accordance with the 10 CFR Part 52 (TN251) process referencing an approved ESP would not occur, nor would any benefits intended by an approved ESP be realized.

After comparing the cumulative effects of building and operating two or more SMRs at the proposed site against those at the alternative sites, the NRC staff concluded that none of the alternative sites would be environmentally preferable to the proposed site for building and operating two or more SMRs (Table ES-3). The alternatives sites selected were as follows (Figure ES-2 and ES-3):

- Oak Ridge Reservation (ORR) Site 2, in Oak Ridge, Tennessee
- ORR Site 8, in Oak Ridge, Tennessee
- Redstone Arsenal Site 12, in Huntsville, Alabama.

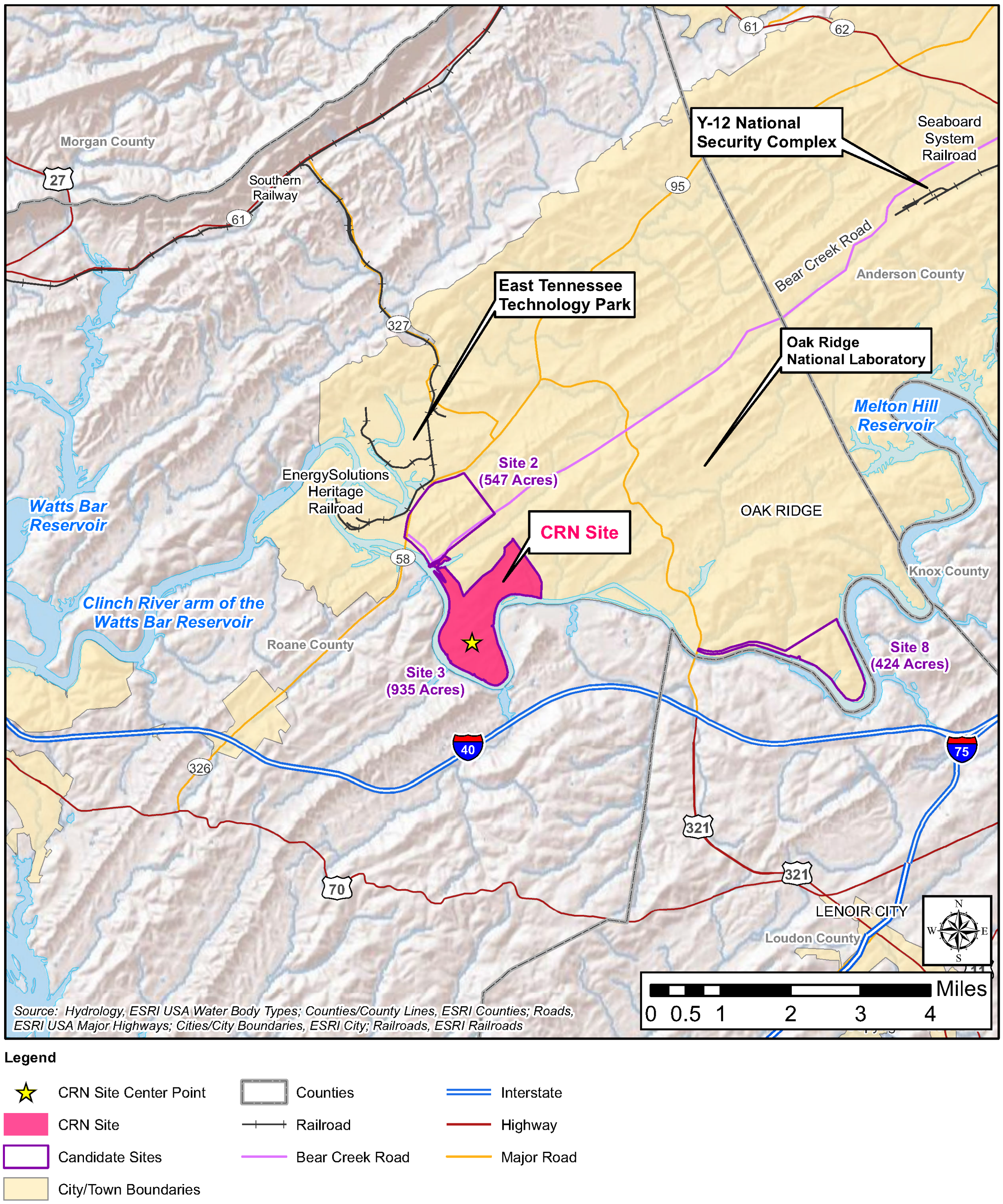


Figure ES-2. CRN Site (Site 3) and Alternative Sites 2 and 8 at Oak Ridge Reservation

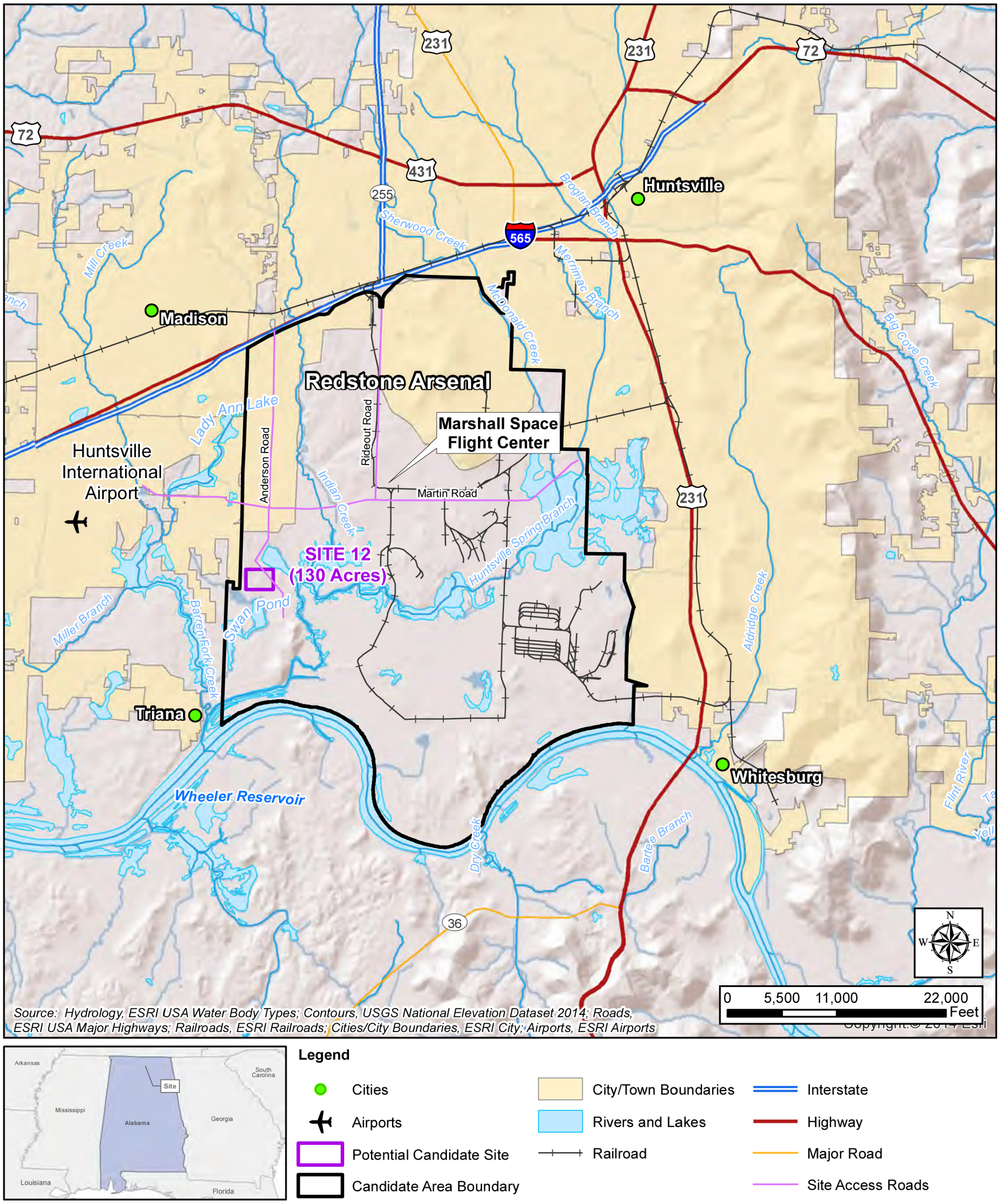


Figure ES-3. Alternative Site at Redstone Arsenal Site 12

Table ES-3. Comparison of Cumulative Impacts at the CRN Site and Alternative Sites

Resource Category	CRN Site (Site 3)[(a)]	ORR Site 2[(a)]	ORR Site 8[(b)]	Redstone Arsenal Site 12[(b)]
Land Use	MODERATE	MODERATE	MODERATE	MODERATE
Water-Related				
Surface-water use	MODERATE	MODERATE	MODERATE	MODERATE
Groundwater use	SMALL	SMALL	SMALL	MODERATE
Surface-water quality	MODERATE	MODERATE	MODERATE	MODERATE
Groundwater quality	MODERATE	MODERATE	MODERATE	MODERATE
Ecology				
Terrestrial ecosystems	MODERATE	LARGE	LARGE	MODERATE
Aquatic ecosystems	LARGE	LARGE	LARGE	LARGE
Socioeconomics				
Physical impacts	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Demography	SMALL	SMALL	SMALL	SMALL
Taxes and Economy	SMALL (beneficial)	SMALL (beneficial)	SMALL (beneficial)	SMALL (beneficial)
Infrastructure and community services	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE	MODERTE to LARGE
Environmental Justice	None[(c)]	None[(c)]	None[(c)]	None[(c)]
Historic and Cultural Resources	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE
Air Quality				
Criteria pollutants	SMALL	SMALL	SMALL	SMALL
Greenhouse gas emissions	MODERATE	MODERATE	MODERATE	MODERATE
Nonradiological Health	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Nonradioactive Waste	SMALL	SMALL	SMALL	SMALL
Radiological Health	SMALL	SMALL	SMALL	SMALL
Postulated Accidents	SMALL	SMALL	SMALL	SMALL

(a) Impact levels for all alternatives are for construction and operation but do not reflect cumulative impacts. Thus, the nuclear impacts identified here may differ from those used to compare the proposed site to the alternative sites, which reflect cumulative impacts.
(b) Impacts are from draft EIS Table 9-14. These conclusions for energy alternatives should be compared to NRC-authorized activities reflected in Chapters 4 and 5 and Sections 6.1 and 6.2.
(c) A determination of "NONE" for Environmental Justice analyses does not mean there are no adverse impacts on minority or low-income populations from the proposed project. Instead, an indication of "NONE" means that while adverse impacts do exist, they do not affect minority or low-income populations in any disproportionate manner, relative to the general population.

Table ES-3 provides a summary of the cumulative impacts for the proposed and alternative sites. The NRC staff concluded that all of the sites were generally comparable, and it would be difficult to state that one site is preferable to another from an environmental perspective. In such a case, the proposed site prevails because none of the alternatives is environmentally preferable to the proposed site.

The NRC staff considered various alternative system designs, including alternative heat-dissipation systems and multiple alternative intake, discharge, and water-supply systems. The review team identified no alternatives that were environmentally preferable to the proposed CRN SMR system design.

Benefits and Costs

TVA did not address the balance of benefits and costs in its ESP application for the CRN Site, because such an assessment is not required for an ESP application per 10 CFR 51.50, Section (b)(2) (TN250). Should the NRC ultimately determine to issue an ESP for the CRN site, and a CP or COL application that references such an ESP is docketed, these matters will be considered in the EIS prepared in connection with the review of that CP or COL application.

Recommendation

The NRC staff's preliminary recommendation to the Commission related to the environmental aspects of the proposed action is that the ESP should be issued.

This recommendation is based on the following:

- the application, including the ER and supplemental information submitted by TVA
- consultation with Federal, State, Tribes, and local agencies
- information gathered during the environmental audit and visits to the site and alternative sites
- consideration of public comments received during the environmental review
- the review team's independent review and assessment summarized in this draft EIS.

ABBREVIATIONS AND ACRONYMS

°C	degree(s) Celsius
°F	degree(s) Fahrenheit
µg	microgram(s)
µg/L	micrograms per liter
µm	micrometer(s)
µSv/cm	microsievert(s) per centimeter
χ/Q	atmospheric dispersion factor(s)
7Q10	7-day, 10-year low flow (i.e., the lowest flow for 7 consecutive days, expected to occur once per decade)
^{235}U	uranium-235
ac	acre(s)
AC	alternating current
ac-ft	acre-feet
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
AD	Anno Domini
ADAMS	Agencywide Documents Access and Management System
AECOM	AECOM Technical Services Inc.
ALARA	as low as is reasonably achievable
APE	area of potential effect
ARPA	Archaeological Resources Protection Act
BA	biological assessment
BC	Before Christ
BEIR	Biological Effects of Ionizing Radiation
bgs	below ground surface
BMP	best management practice
BSR	biodiversity significance rank
BTA	barge/traffic area
Btu	British thermal unit(s)
CDC	Centers for Disease Control and Prevention
CDF	core damage frequency
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
CFR	*Code of Federal Regulations*
cfs	cubic feet per second
CH_4	methane
Ci	curie(s)
cm	centimeter(s)

CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	CO_2 equivalent
COL	combined construction permit and operating license or combined license
COLA	combined license application
CP	construction permit
CR	Clinch River
CRBR	Clinch River Breeder Reactor
CRBRP	Clinch River Breeder Reactor Project
CRM	Clinch River mile
CRN	Clinch River Nuclear
CWA	Clean Water Act (aka Federal Water Pollution Control Act)
CWS	circulating water system
d	day
D/Q	deposition factor(s)
DASU	data acquisition switch unit
dB	decibel(s)
dBA	decibel(s) on the A-weighted scale
DBA	design basis accident
DCD	Design Control Document
DCG	derived concentration guide
DNL	day-night average sound level
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EAB	exclusion area boundary
EIS	environmental impact statement
ELF	extremely low frequency
EMF	electromagnetic field
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EPZ	Emergency Planning Zone
ER	Environmental Report
ESA	Endangered Species Act of 1973, as amended
ESP	early site permit
ESPA	early site permit application
ESRP	Environmental Standard Review Plan (NUREG–1555)
ETTP	East Tennessee Technology Park
FE	Federally Endangered
fps	feet per second

FR	*Federal Register*
ft	foot or feet
FT	Federally Threatened
ft^2	square foot or feet
ft^3	cubic foot or feet
FTE	full-time equivalent employee
FWS	U.S. Fish and Wildlife Service
g	gram(s)
GAI	geographic area of interest
gal	gallon(s)
GBq	gigabecquerel
GCRP	U.S. Global Change Research Program
GDNR	Georgia Department of Natural Resources
GEIS	*Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NUREG–1437)
GEIS-DECOM	GEIS-Decommissioning of Nuclear Facilities (NUREG–0586)
GHG	greenhouse gas
GI-LLI	gastrointestinal lining of lower intestine
gpd	gallon(s) per day
gpm	gallon(s) per minute
GWD	gigawatt day(s)
Gy	gray(s)
ha	hectare(s)
HLW	high-level waste
hr	hour(s)
Hz	hertz
IAEA	International Atomic Energy Agency
IBA	Important Bird Area
ICRP	International Commission on Radiological Protection
in.	inch(es)
IPPP	Integrated Pollution Prevention Plan
ISFSI	independent spent fuel storage installation
kg	kilogram(s)
kHz	kilohertz
km	kilometer(s)
km/hr	kilometer(s) per hour
km^2	square kilometer(s)
KSNPC	Kentucky State Nature Preserves Commission
kV	kilovolt(s)
kW	kilowatt(s)
kW(e)	kilowatt(s) (electrical)

kWh	kilowatt-hour(s)
kWp	kilowatt peak
L	liter(s)
lb	pound(s)
Ldn	day-night average sound level
L_{eq}	equivalent continuous sound level
LLC	Limited Liability Company
LLW	low-level waste
LOCA	loss of coolant accident
LOI	letter of interpretation
LOS	level of service
LPZ	low-population zone
LULC	land use and land cover
LWA	Limited Work Authorization
LWCF	Land and Water Conservation Fund
LWR	light water reactor
m	meter(s)
m/s	meter(s) per second
m^2	square meter(s)
m^3	cubic meter(s)
m^3/s	cubic meter(s) per second
MACCS2	Melcor Accident Consequence Code System Version 1.12
MEI	maximally exposed individual
mg	milligram(s)
Mgd	million gallon(s) per day
mGy	milligray(s)
mi	mile(s)
mi^2	square mile(s)
MIMS	Manifest Information Management System
min	minute(s)
MKAA	Metropolitan Knoxville Airport Authority
mL	milliliter(s)
mm	millimeter(s)
M	million
mo	month(s)
mph	mile(s) per hour
mrad	millirad(s)
mrem	millirem(s)
Mscf	thousand standard cubic feet
MSL	mean sea level
mSv	millisievert(s)

MT	metric ton(nes)
MTU	metric ton(nes) uranium
MW	megawatt(s)
MW(e)	megawatt(s) (electrical)
MW(t)	megawatt(s) (thermal)
MWd	megawatt-day(s)
MWd/MTU	megawatt-day(s) per metric ton of uranium
MWh	megawatt-hour(s)
N_2O	nitrous oxide
NA	not applicable
NAGPRA	Native American Graves Protection and Repatriation Act
NAVD	North American Vertical Datum (sea level reference point used in surveying)
NAVD88	North American Vertical Datum of 1988
NCRP	National Council on Radiation Protection and Measurements
NEI	Nuclear Electric Institute
NEPA	National Environmental Policy Act of 1969, as amended
NERP	National Environmental Research Park
NESC	National Electric Safety Code
NGVD29	National Geodetic Vertical Datum of 1929
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NLEB	northern long-eared bat
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NO_x	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NSA	Naval Support Activity
NTU	nephelometric turbidity unit(s)
NUREG	U.S. Nuclear Regulatory Commission technical document
NWS	National Weather Service
O_3	ozone
OL	operating license
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSCS	oriented spray cooling system
OSHA	Occupational Safety and Health Administration
PA	Programmatic Agreement
PAM	primary amebic meningoencephalitis

Pb	lead
PCB	polychlorinated biphenyl
pc/L	picocuries per liter
PEP	Plume Exposure Pathway
pH	measure of acidity or basicity in solution
PIR	public interest review
PIRF	public interest review factor
PM	particulate matter
PM_{10}	particulate matter with a mean aerodynamic diameter of 10 μm or less
$PM_{2.5}$	particulate matter with a mean aerodynamic diameter of 2.5 μm or less
PNNL	Pacific Northwest National Laboratory
ppb	part(s) per billion
PPE	plant parameter envelope
ppm	part(s) per million
ppt	part(s) per thousand
PRA	probabilistic risk assessment
psi	pound(s) per square inch
rad	radiation absorbed dose
RCRA	Resource Conservation and Recovery Act of 1976, as amended
rem	Roentgen equivalent man (a unit of radiation dose)
REMP	radiological environmental monitoring program
RG	Regulatory Guide
RHA	Rivers and Harbors Appropriation Act
ROI	region of interest
ROS	River Operations Study
Ryr	reactor-year(s)
s or sec	second(s)
SACTI	Seasonal and Annual Cooling Tower Impact (prediction code)
SAFSTOR	Safe Storage
scf	standard cubic feet
SER	safety evaluation report
SHPO	State Historic Preservation Office
SMR	small modular reactor
SMZ	streamside management zone
SO_2	sulfur dioxide
SOARCA	State-of-the-Art Reactor Consequence Analysis
SO_x	oxides of sulfur
SSAR	Site Safety Analysis Report
Sv	sievert
SWPPP	stormwater pollution prevention plan
SWS	service water system

T	ton(s)
TDEC	Tennessee Department of Environment and Conservation
TDHS	Tennessee Department of Human Resources
TDS	total dissolved solids
TEDE	total effective dose equivalent
THC	Tennessee Historical Commission
TIA	traffic impact analysis
TNHP	Tennessee Natural Heritage Program
TRAGIS	Transportation Routing Analysis Geographic Information System
TRM	Tennessee River Mile
TVA	Tennessee Valley Authority
TWh	terawatt-hour(s)
TWRA	Tennessee Wildlife Resources Agency
UPF	Uranium Processing Facility
U.S.	United States
UMTRI	University of Michigan Transportation Research Institute
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USCB	U.S. Census Bureau
USGS	U.S. Geological Survey
V	volt
VOC	volatile organic compound
WBN	Watts Bar Nuclear
WNS	white-nose syndrome
Y-12	Y-12 National Security Complex
yd	yard(s)
yd^3	cubic yard(s)
yr	year(s)
yr^{-1}	per year

APPENDIX A
CONTRIBUTORS TO THE ENVIRONMENTAL IMPACT STATEMENT

The overall responsibility for the preparation of this environmental impact statement was assigned to the Office of New Reactors, U.S. Nuclear Regulatory Commission. The U.S. Army Corps of Engineers is participating as a cooperating agency. This environmental impact statement was prepared by members of the Office of New Reactors with assistance from other U.S. Nuclear Regulatory Commission organizations, the U.S. Army Corps of Engineers, and Pacific Northwest National Laboratory.

Name	Affiliation	Function or Expertise
Nuclear Regulatory Commission		
Tamsen Dozier	Office of New Reactors	Environmental Project Manager
Patricia Vokoun	Office of New Reactors	Environmental Project Manager
Jack Cushing	Office of New Reactors	Plant Description; Cumulative Impacts
Jennifer Davis	Office of New Reactors	Historic and Cultural Resources
Mohammad Haque	Office of New Reactors	Hydrology
Daniel Barnhurst	Office of New Reactors	Hydrology
Andrew Kugler	Office of New Reactors	Alternative Sites; Alternative Systems
Daniel Mussatti	Office of New Reactors	Socioeconomics; Environmental Justice; Nonradiological Health; Nonradiological Waste Management
Laura Willingham	Office of New Reactors	Meteorology and Air Quality: Climate Change
Kevin Quinlan	Office of New Reactors	Meteorology and Air Quality
Peyton Doub	Office of New Reactors	Terrestrial Ecology; Aquatic Ecology; Land Use
Eva Eckert Hickey	Office of New Reactors	Radiological Health; Uranium Fuel Cycle; Decommissioning;
Donald Palmrose	Office of New Reactors	Postulated Accidents; Transportation of Radioactive Material
Michelle Hart	Office of New Reactors	Design Basis Accidents
U.S. Army Corps of Engineers		
Mark McIntosh	Nashville District	Regulatory Specialist, Regulatory Division
Casey H. Ehorn	Nashville District	Chief, East Branch, Regulatory Division
Tammy R. Turley	Nashville District	Chief, Regulatory Division
Pacific Northwest National Laboratory[(a)]		
Bruce McDowell		Team Lead; Cumulative Impacts
Kim Leigh		Deputy Team Lead
Michael Smith		Radiological Health; Uranium Fuel Cycle; Decommissioning
Eva Mart		Radiological Health; Uranium Fuel Cycle; Postulated Accidents
Katie Cort		Alternative Sites

Name	Affiliation	Function or Expertise
Dave Anderson		Socioeconomics; Environmental Justice; Land Use
Rebekah Krieg		Aquatic Ecology
Ellen Kennedy		Historic and Cultural Resources
Stephanie Liss		Aquatic Ecology
Bruce Napier		Postulated Accidents
Jeremy Rishel		Severe Accidents
Steven Maheras		Transportation
Philip Meyer		Hydrology; Alternative Systems
Marshall Richmond		Hydrology
Julia Flaherty		Meteorology and Air Quality
Lance Vail		Climate Change
Lara Aston		Nonradiological Health; Nonradioactive Waste
Jim Becker		Terrestrial Ecology
Nancy Kohn		Plant Description
Joanne Duncan		Cumulative Impacts; References
Kris Hand		GIS Mapping
Susan Loper		GIS Mapping
Sadie Montgomery		GIS Mapping
Mike Parker		Editor
Susan Ennor		Editor

(a) Pacific Northwest National Laboratory is managed for the U.S. Department of Energy by Battelle Memorial Institute.

APPENDIX B
ORGANIZATIONS CONTACTED

The following Federal, State, Tribal, regional, and local organizations were contacted during the review of potential environmental impacts from the building and operation of two or more small modular reactors (within the plant parameter envelope described in this environmental impact statement) at the Clinch River Nuclear Site in Roane County, Tennessee:

Advisory Council on Historic Preservation, Office of Federal Agency Programs, Washington, D.C.

Absentee Shawnee Tribe, Shawnee, Oklahoma

Alabama-Coushatta Tribe of Texas, Livingston, Texas

Alabama-Quassarte Tribal Town, Wetumka, Oklahoma

Alabama Department of Conservation and Natural Resources

Auburn University, Auburn, Alabama

Anderson County Chamber of Commerce, Clinton, Tennessee

Anderson County Economic Development Association, Clinton, Tennessee

Anderson County Sheriff's Department, Clinton, Tennessee

Cherokee Nation of Oklahoma, Tahlequah, Oklahoma

City of Knoxville, Knoxville, Tennessee

City of Oak Ridge, Oak Ridge, Tennessee

The Chickasaw Nation, Ada, Oklahoma

Choctaw Nation of Oklahoma, Durant, Oklahoma

Coushatta Tribe of Louisiana, Elton, Louisiana

Eastern Band of the Cherokee Indians, Cherokee, North Carolina

Eastern Shawnee Tribe of Oklahoma, Wyandotte, Oklahoma

Georgia Department of Natural Resources, Social Circle, Georgia

Governor of Tennessee, Nashville, Tennessee

Huntsville Utilities, Huntsville, Alabama

Jena Band of the Choctaw Indians, Jena, Louisiana

Kialegee Tribal Town, Wetumka, Oklahoma

Kentucky State Nature Preserves Commission, Frankfort, Kentucky

Knox County Government, Knoxville, Tennessee

Loudon County Economic Development Agency, Loudon, Tennessee

Loudon County Government, Loudon, Tennessee

Morgan County Government, Wartburg, Tennessee

Mississippi Band of Choctaw Indians, Choctaw, Mississippi

Muscogee (Creek) Nation of Oklahoma, Okmulgee, Oklahoma

Oak Ridge National Laboratory, Oak Ridge, Tennessee

Poarch Band of Creek Indians, Atmore, Alabama

Quapaw Tribe of Oklahoma, Quapaw, Oklahoma

Roane Alliance, Kingston, Tennessee

Roane County Government, Kingston, Tennessee

Roane County Sherriff's Office, Kingston, Tennessee

Seminole Tribe of Florida, Hollywood, Florida

Seminole Nation of Oklahoma, Wewoka, Oklahoma

Shawnee Tribe of Oklahoma, Miami, Oklahoma

Tennessee Department of Environment and Conservation, Nashville, Tennessee

Tennessee Department of Environment and Conservation, Knoxville Field Office, Tennessee

Tennessee Department of Transportation, Region 1, Knoxville, Tennessee

Tennessee Emergency Management Agency, Nashville, Tennessee

Tennessee Historical Commission, Nashville, Tennessee

Tennessee Housing Development Agency, Knoxville, Tennessee

Tennessee Wildlife Resource Agency, Crossville, Tennessee

Tennessee Wildlife Resource Agency, Nashville, Tennessee

Thlopthlocco Tribal Town, Okemah, Oklahoma

Trinity Outreach, Oak Ridge, Tennessee

United Keetoowah Band of Cherokee Indians, Tahlequah, Oklahoma

United Way of Anderson County, Oak Ridge, Tennessee

United Way of Loudon County, Lenoir City, Tennessee

United Way of Roane County, Harriman, Tennessee

U.S. Department of Energy, Oak Ridge Office of Environmental Management, Oak Ridge, Tennessee

U.S. Environmental Protection Agency, Region 4, Atlanta, Georgia

U.S. Federal Emergency Management Agency, Atlanta, Georgia

U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office, Cookeville, Tennessee

U.S. Fish and Wildlife Service, Alabama Ecological Services Field Office, Daphne, Alabama

U.S. House of Representatives, 2nd District, Knoxville Office, Knoxville, Tennessee

U.S. House of Representatives, 3rd District, Oak Ridge, Tennessee

U.S. Senate, District 15, Oak Ridge, Tennessee

University of Tennessee Baker Center for Public Policy, Knoxville, Tennessee

Watts Bar Utility District, Harriman, Tennessee

APPENDIX C
CHRONOLOGY OF NRC AND USACE STAFF ENVIRONMENTAL REVIEW CORRESPONDENCE RELATED TO THE TVA APPLICATION FOR AN EARLY SITE PERMIT (ESP) AT THE CRN SITE

This appendix contains a chronological list of correspondence between the U.S. Nuclear Regulatory Commission (NRC) and Tennessee Valley Authority (TVA), and other correspondence related to the NRC staff's environmental review, under Title 10 of the *Code of Federal Regulations* Part 51, for TVA's application for an early site permit at the Clinch River Nuclear Site. All documents, with the exception of those containing proprietary information, have been placed in the Commission's Public Document Room, at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland, and are available electronically from the Public Electronic Reading Room found on the Internet at the following web address: http://www.nrc.gov/reading-rm.html. From this site, the public can gain access to the NRC's Agencywide Document Access and Management Systems (ADAMS), which provides text and image files of the NRC's public documents in the Publicly Available Records component of ADAMS. The ADAMS accession numbers for each document are included below.

October 23, 2013	NRC Memorandum: Trip Report Pre-Application Visit to Clinch River Small Modular Reactor Site, Oak Ridge, Tennessee, and Meeting with U.S. Army Corps of Engineers, Nashville District, Eastern Section, in Lenoir City, Tennessee. (Accession No. ML13296A087)
March 20, 2015	NRC Memorandum: Summary of Trip to TVA's Clinch River Site on October 7-8, 2014, for a Site Tour and a Review of the Current Status of the Environmental Report for TVA's Early Site Permit Application Submittal. (Package Accession No. ML14329A151).
April 30, 2015	Letter to NRC from J.W. Shea, Tennessee Valley Authority (TVA), Regarding Onsite Reference Portal. (Accession No. ML15124A655)
July 15, 2015	Letter from the NRC to J.W. Shea, Tennessee Valley Authority (TVA), Regarding the Clinch River Small Modular Reactor Project ESP Application Online Reference Portal. (Accession No. ML15149A397)
July 17, 2015	Letter from the NRC to Daniel Stout, TVA, Regarding the Clinch River Early Site Permit Pre-Application Readiness Assessment. (Accession No. ML15190A225)
October 26, 2015	NRC Memorandum: Observations from the Environmental Readiness Assessment Activities for a Future Early Site Permit Application for the Clinch River Nuclear Site. (Package Accession No. ML15251A697)
May 12, 2016	Letter to NRC from J.W. Shea, TVA, Submitting Application for Early Site Permit for Clinch River Nuclear Site (Rev 0). (Accession No. ML16139A752)
May 12, 2016	Early Site Permit Application (Rev 0) for Clinch River Nuclear Site at https://www.nrc.gov/reactors/new-reactors/esp/clinch-river.html#application

June 10, 2016	Letter to NRC from J.W. Shea, TVA, Regarding Submittal of Meteorological Data in Support of Early Site Permit Application for Clinch River Nuclear Site. (Accession No. ML16168A212)
June 17, 2016	Letter from NRC to J.W. Shea, TVA, Acknowledging Receipt of the Early Site Permit Application For the Clinch River Nuclear Site and Associated Federal Register Notice. (Accession No. ML16153A282)
June 23, 2016	*Federal Register* Notice - NRC Receipt of TVA Early Site Permit Application. (81 FR 40929)
June 23, 2016	Letter to NRC from J.W. Shea, TVA, Regarding Calculation Input and Output Files in Support of the Clinch River Nuclear Site Early Site Permit Application. (Accession No. ML16180A307)
July 6, 2016	Letter to NRC from J.W. Shea, TVA, Regarding Siting Study in Support of the Clinch River Nuclear Site Early Site Permit Application. (Accession No. ML16188A075)
July 28, 2016	Letter to NRC from J.W. Shea, TVA, Regarding Atmospheric Dispersion Calculation Input and Output Files in Support of the Clinch River Nuclear Site Early Site Permit Application. (Accession No. ML16216A109)
August 11, 2016	Letter to NRC from J.W. Shea, TVA, Regarding Schedule for Submittals of Supplemental Information. (Accession No. ML16224B143)
August 19, 2016	Letter from NRC to J.W. Shea, TVA, Regarding Tennessee Valley Authority Request and Schedule for Submittal of Supplemental Information in Support of Early Site Permit Application for Clinch River Nuclear Site. (Accession No. ML16225A667)
August 31, 2016	Notice of Forthcoming Public Meeting with Tennessee Valley Authority to Discuss Various Topics Related to Supplemental Information for the Early Site Permit (ESP) Application for the Clinch River Nuclear Site. (Accession No. ML16252A375)
September 15, 2016	Handouts from Public Meeting of Sep 15, 2016: Environmental Alternatives Supplemental Items. (Accession No. ML16252A182)
October 27, 2016	Letter from NRC to Daniel Stout Regarding Plan for Document Audit of Tennessee Valley Authority's Supplemental Information to Support the Early Site Permit Environmental Report. (Accession No. ML16285A388)
December 2, 2016	Letter to NRC from J.W. Shea, TVA, Regarding Information on Cumulative Radiological Health Impacts in Support of the Clinch River Nuclear Site Early Site Permit Application. (Accession No. ML16340A259)
December 2, 2016	Letter to NRC from J.W. Shea, TVA, Regarding Meteorological Information in Support of the Clinch River Nuclear Site Early Site Permit Application. (Accession No. ML16340A256)

December 8, 2016	Letter to NRC from J.W. Shea, TVA, Regarding Information on Alternate Cooling Water Systems in Support of the Clinch River Nuclear Site Early Site Permit Application. (Accession No. ML16344A061)
December 12, 2016	Letter to NRC from J.W. Shea, TVA, Regarding Submittal of Cultural Reports and Programmatic Agreement in Support of Early Site Permit Application for Clinch River Nuclear Site. (Package Accession No. ML17284A306)
December 13, 2016	Letter to NRC from J.W. Shea, TVA, Regarding Information on Terrestrial Ecology in Support of the Clinch River Nuclear Site Early Site Permit Application. (Accession No. ML16348A552)
December 15, 2016	Letter to NRC from J.W. Shea, TVA, Regarding Site Selection Information in Support of the Clinch River Nuclear Site Early Site Permit Application. (Accession No. ML16350A429)
December 16, 2016	Letter to NRC from J.W. Shea, TVA, Regarding Aquatic Ecology Information in Support of the Clinch River Nuclear Site Early Site Permit Application. (Accession No. ML16356A485)
December 27, 2016	Letter to NRC from J.W. Shea, TVA, Regarding Environmental Protection Plan Information in Support of the Clinch River Nuclear Site Early Site Permit Application. (Accession No. ML16363A378)
January 5, 2017	Letter from NRC to J.W. Shea, TVA, Regarding the Acceptance Review Results for an Early Site Permit Application for Clinch River Nuclear Site. (Package Accession No. ML16356A226)
January 9, 2017	Letter to NRC from J.W. Shea, TVA, Regarding Submittal of Cultural Resource Reports in Support of Early Site Permit Application for Clinch River Nuclear Site. (Package Accession No. ML17298A058)
January 12, 2017	*Federal Register* Notice - Early Site Permit Application; Acceptance for Docketing. (82 FR 3812)
February 11, 2017	NRC Memorandum: Summary Report for the Audit Related to the Tennessee Valley Authority's Supplemental Information to Support the Early Site Permit Environmental Report. (Accession No. ML17011A193)
February 13, 2017	Email from Allen Fetter to Ray Schiele: Clinch River ESP - Saf. Additional topics for Monday (2/13/17) public meeting. (Accession No. ML17044A265)
February 25, 2017	NRC Memorandum: Summary of Meeting Between the US. NRC and TVA to discuss topics associated with Section 2.1, 2.2 and 2.3 in Part 2 of the Site Safety Analysis Report of the Tennessee Valley Authority's Early Site Permit Application for the Clinch River Nuclear Site. (Accession No. ML17054D545)

March 1, 2017	Letter to NRC from J.W. Shea, TVA, Regarding Submittal of Calculation Input and Output Files in Support of Early Site Permit Application for Clinch River Nuclear Site. (Accession No. ML17065A269)
March 10, 2017	Letter to NRC from J.W. Shea, TVA, Regarding Submittal of Tribal Consultation Letter in Support of Early Site Permit Application. (Accession No. ML17072A224)
March 17, 2017	Letter from NRC to J.W. Shea, TVA, Regarding the Clinch River Nuclear Site Early Site Permit Application Review Schedule. (Accession No. ML17069A104)
March 30, 2017	Letter from NRC to Emily Steele, Kingston Public Library, Regarding Maintenance of Reference Materials at the Kingston Public Library Related to the Environmental Review of the Tennessee Valley Authority Early Site Permit Application at the Clinch River Nuclear Site. (Accession No. ML17061A426)
March 30, 2017	Letter from NRC to Kathy McNeilly, Oak Ridge Public Library, Regarding Maintenance of Reference Materials at the Oak Ridge Public Library Related to the Environmental Review of the Tennessee Valley Authority Early Site Permit Application at the Clinch River Nuclear Site. (Accession No. ML17061A427)
April 4, 2017	Letter from NRC to J.W. Shea, TVA, Regarding Tennessee Valley Authority - Application for an Early Site Permit for the Clinch River Nuclear Site; the Notice of Hearing, Opportunity to Petition for Leave to Intervene, and Associated Federal Register Notice. (Package Accession No. ML17061A396)
April 4, 2017	*Federal Register* Notice - Notice of Hearing and Opportunity to Petition for Leave to Intervene; Order Imposing Procedures. (82 FR 16436)
April 7, 2017	Letter from NRC to J.W. Shea, TVA, Regarding Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Related to an Early Site Permit for the Clinch River Nuclear Site. (Package Accession No. ML17068A241)
April 12, 2017	Letter from NRC to Tammy Turley, USACE Nashville District, Regarding Invitation to Participate as a Cooperating Agency in Preparation of an Environmental Impact Statement for the Tennessee Valley Authority Early Site Permit Application at the Clinch River Nuclear Site, Roane County, Tennessee. (Accession No. ML17065A237)
April 13, 2017	Federal Register Notice - Intent to Prepare Environmental Impact Statement and Conduct Scoping Process; Public Meeting and Request for Comment. (82 FR 17885)

April 17, 2017	Letter to NRC from J.W. Shea, TVA, Regarding Submittal of Supplemental Information Related to the Exclusion Area Boundary and Population Distribution Around the Clinch River Nuclear Site in Support of the Early Site Permit Application. (Accession No. ML17107A080)
April 20, 2017	Letter from NRC to Edwina Butler-Wolfe, Absentee Shawnee Tribe, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17041A081)
April 20, 2017	Letter from NRC to Ryan Morrow, Thlopthlocco Tribal Town, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17047A682)
April 20, 2017	Letter from NRC to Gary Batton, Choctaw Nation of Oklahoma, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17041A086)
April 20, 2017	Letter from NRC to Stephanie A. Bryan, Poarch Band of Creek Indians, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17047A676)
April 20, 2017	Letter from NRC to Jo Ann Battise, Alabama-Coushatta Tribe of Texas, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17041A082)
April 20, 2017	Letter from NRC to Patrick Lambert, Eastern Band of Cherokee Indians of North Carolina, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17017A123)
April 20, 2017	Letter from NRC to Bill John Baker, Cherokee Nation of Oklahoma, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17041A085)
April 20, 2017	Letter from NRC to Tarpie Yargee, Alabama-Quassarte Tribal Town, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17041A084)

April 20, 2017	Letter from NRC to B. Cheryl Smith, Jena Band of the Choctaw Indians, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee . (Accession No. ML17047A407)
April 20, 2017	Letter from NRC to Bill Anoatubby, The Chickasaw Nation, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17047A681)
April 20, 2017	Letter from NRC to John Berrey, Quapaw Tribe of Oklahoma, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17047A677)
April 20, 2017	Letter from NRC to Marcellus W. Osceola, Jr., Seminole Tribe of Florida, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17047A679)
April 20, 2017	Letter from NRC to Joe Bunch, United Keetoowah Band of Cherokee Indians, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17047A683)
April 20, 2017	Letter from NRC to Lovelin Poncho, Coushatta Tribe of Louisiana, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17047A405)
April 20, 2017	Letter from NRC to E. Patrick McIntyre, Jr., Tennessee Historical Commission, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17061A428)
April 20, 2017	Letter from NRC to Phyliss J. Anderson, Mississippi Band Of Choctaw Indians, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17047A409)
April 20, 2017	Letter from NRC to Mary Jennings, U.S. Fish and Wildlife Service, Regarding Request For Participation In The Environmental Scoping Process And A List Of Protected Species Within The Area Under Evaluation For The Proposed Clinch River Nuclear Site Early Site Permit Application. (Accession No. ML17069A249)

April 20, 2017	Letter from NRC to James Floyd, Muscogee (Creek) Nation of Oklahoma, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17047A675)
April 20, 2017	Letter from NRC to Leonard M. Harjo, Seminole Nation of Oklahoma, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee . (Accession No. ML17047A678)
April 20, 2017	Letter from NRC to Glenna J. Wallace, Eastern Shawnee Tribe of Oklahoma, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17047A406)
April 20, 2017	Letter from NRC to Ron Sparkman, Shawnee Tribe of Oklahoma, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17047A680)
April 20, 2017	Letter from NRC to Bill Pearson, U.S. Fish and Wildlife Service, Regarding Request For Participation In The Environmental Scoping Process And A List Of Protected Species Within The Area Under Evaluation For The Proposed Clinch River Early Site Permit Application Review. (Accession No. ML17088A264)
April 20, 2017	Letter from NRC to Reid Nelson, Advisory Council on Historic Preservation, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17065A239)
April 20, 2017	Letter from NRC to Jeremiah Hobia, Kialegee Tribal Town, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17047A408)
April 21, 2017	Letter to NRC from Mary Jennings, U.S. Fish and Wildlife Service, Regarding FWS#2017-CPA-0711. Notice of Intent for the Nuclear Regulatory Commission to Prepare an Environmental Impact Statement and Conduct a Scoping Process for the Clinch River Nuclear Site Located in Roane County, Tennessee. (Accession No. ML17145A505)
April 28, 2017	Notice of Public Meeting to Discuss the Environmental Scoping Process for the Clinch River Nuclear Site Early Site Permit Application. (Accession No. ML17118A330)

May 2, 2017	Letter from Tammy Turley, USACE Nashville District, to NRC, regarding Invitation to Participate as a Cooperating Agency in Preparation of an Environmental Impact Statement for the Tennessee Valley Authority Early Site Permit Application at the Clinch River Nuclear Site, Roane County, Tennessee. (Accession No. ML17205A413)
May 5, 2017	Letter to NRC from Mary Jennings, U.S. Fish and Wildlife Service, Regarding FWS# 2017-I-0473. U.S. Nuclear Regulatory Commission - Requests for Participation in the Environmental Scoping Process and List of Federally Protected Species Within the Area Under Evaluation for the Proposed Clinch River Nuclear Site Located in Oak Ridge, Roane County, Tennessee. (Accession No. ML17205A341)
May 7, 2017	Plan for Environmental Audit Related to the Clinch River Nuclear Site Early Site Permit Application. (Accession No. ML17088A728)
May 12, 2017	Letter to NRC from Elizabeth Toombs, Cherokee Nation, Regarding Clinch River Nuclear Site, Roane County, TN – Cherokee Nation Section 106. (Accession No. ML17145A580)
May 30, 2017	Letter to NRC from Larry Long, U.S. Environmental Protection Agency, Regarding Informal Pre-permit Clinch River Nuclear Site. (Accession No. ML17157B742)
June 5, 2017	Letter to NRC from Daniel Rangle, Choctaw Nation of Oklahoma, Regarding Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML17157B749)
June 7, 2017	Letter to NRC from J.W. Shea, TVA, Regarding Submittal of Supplemental Information Related to the Hydrologic Engineering in Support of the Clinch River Nuclear Site Early Site Permit Application – Groundwater. (Accession No. ML17158B342)
June 12, 2017	Letter to NRC from Kendra Abkowitz, Tennessee Department of Environment and Conservation, Regarding TDEC NEPA Review/Comments Complete. (Accession No. ML17170A310)
June 15, 2017	Letter to NRC from J.W. Shea, TVA, Regarding Submittal of Supplemental Information Regarding the Impacts of Non-Radiological Traffic Accidents in Support of the Early Site Permit Application for Clinch River Nuclear Site. (Accession No. ML17167A155)
June 28, 2017	Letter to NRC from Karen Pritchett, United Keetoowah Band of Cherokee Indians, Regarding Clinch River Nuclear Site, Roane County, Tennessee. (Accession No. ML17206A450)
June 20, 2017	NRC Memorandum: Summary of Public Scoping Meeting Related To The Early Site Permit Application Review Of The Clinch River Nuclear Site. (Package Accession No. ML17163A352)

June 26, 2017	Letter to NRC from J.W. Shea, TVA, Regarding Submittal of Supplemental Information Related to Plant Parameter Envelope Source Terms in Support of Early Site Permit Application for Clinch River Nuclear Site. (Accession No. ML17178A330)
July 7, 2017	Letter to NRC from J.W. Shea, TVA, Regarding Submittal of Supplemental Information Related to the Environmental Audit in Support of Early Site Permit Application for Clinch River Nuclear Site. (Accession No. ML17206A091)
July 18, 2017	Letter to NRC from J.W. Shea, TVA, Regarding Submittal of Supplemental Information Related to the Environmental Audit in Support of Early Site Permit Application for Clinch River Nuclear Site. (Accession No. ML17200C887)
July 20, 2017	Letter from NRC to Mary Jennings, U.S. Fish and Wildlife Service, Regarding FWS# 2017-I-0473. U.S. Nuclear Regulatory Commission (NRC) – Updated List of Federally Threatened and Endangered Species that Potentially Occur near the Proposed Clinch River Small Modular Nuclear Reactor Facility in Oak Ridge, Roane County, Tennessee. (Accession No. ML17205A342)
August 1, 2017	Letter to NRC from J.W. Shea, TVA, Regarding Submittal of Supplemental Information Related to the Environmental Audit in Support of Early Site Permit Application for Clinch River Nuclear Site. (Package Accession No. ML17234A002)
August 14, 2017	NRC Memorandum: Meeting between the U.S. Nuclear Regulatory Commission and Tennessee Valley Authority to Discuss Topics Associated With TVA's Early Site Permit Application for the Clinch River Nuclear Site [Application Figures and Graphic Information System files]. (Accession No. ML18010A258)
August 21, 2017	Email from Mike Barbour, Auburn University, to James Becker, PNNL, Regarding Map Package for AL NHP. (Package Accession No. ML18022A463).
August 21, 2017	Letter to NRC from J.W. Shea, TVA, Regarding Submittal of Supplemental Information Related to the Environmental Audit in Support of Early Site Permit Application for Clinch River Nuclear Site. (Accession No. ML17233A298)
August 25, 2017	Letter to NRC from J.W. Shea, TVA, Regarding Supplemental Information Related to Groundwater Hydrology in Support of Early Site Permit Application for Clinch River Nuclear Site. (Accession No. ML17237C084)
August 30, 2017	Meeting between the U.S. Nuclear Regulatory Commission (NRC) and Tennessee Valley Authority (TVA) to Discuss Topics Associated With TVA's Early Site Permit Application for the Clinch River Nuclear Site [Cultural Resources and Transportation]. (Accession No. ML17352A028)

September 5, 2017	Letter to NRC from J.W. Shea, TVA, Regarding Supplemental Information Related to Environmental Report Figures in Support of Early Site Permit Application for Clinch River Nuclear Site. (Accession No. ML18010A067)
September 6, 2017	Email from Pat Black, Tennessee Wildlife Resource Agency, to James Becker, PNNL, Regarding Watts Bar Reservoir Creel Survey Report. (Package Accession No. ML18022A346).
September 6, 2017	Email from Gerry Middleton, Tennessee Department of Environment and Conservation, to James Becker, PNNL, Regarding Bat Data Report 2013, 2014, and 2015. (Package Accession No. ML18019A036)
September 11, 2017	Email from Stephanie Williams, Tennessee Department of Environment and Conservation, to James Becker, PNNL, Regarding Map Package for TN NHP. (Package Accession No. ML18026A552)
September 13, 2017	Email from James Becker, PNNL, to Ian Horn, Kentucky State Nature Preserves Commission, Regarding KY NHP Review of Transmission Line Segment for Clinch River SMR ESP Project in Tennessee. (Accession No. ML18059A130)
September 15, 2017	Letter to NRC from J.W. Shea, TVA, Regarding Response to Request for Additional Information Related to the Evacuation Time Estimates in Support of Early Site Permit Application for Clinch River Nuclear Site. (Accession No. ML17261A066)
September 18, 2017	Email from Kitty McCracken, Oak Ridge National Laboratory, to James Becker, PNNL, Regarding Fish Data for Ish Creek, Oak Ridge, Tennessee. (Package Accession No. ML18016A334)
September 24, 2017	Email from Anna Yellin, Georgia Department of Natural Resources, to James Becker, PNNL, Regarding the Environmental Review. (Package Accession No. ML18012A447)
October 2, 2017	Email from Ian Horn, Kentucky State Nature Preserves Commission, to James Becker, PNNL, Regarding KY NHP Review of Transmission Line Segment for Clinch River SMR ESP Project in Tennessee. (Package Accession No. ML18012A656)
October 10, 2017	Letter to NRC, from J.W. Shea, TVA, Regarding Submittal of Supplemental Information Related to Groundwater Hydrology in Support of Early Site Permit Application for Clinch River Nuclear Site. (Accession No. ML17286A615)
October 26, 2017	Environmental Impact Statement Scoping Process Summary Report Clinch River Nuclear Site Early Site Permit Application. (Package Accession No. ML17242A061)

November 3, 2017	Email from Brian Flock, Tennessee Wildlife Resource Agency, to James Becker, PNNL, Regarding Clinch River Small Modular Reactor Project- 2 Figures. (Accession No. ML18064A895)
November 8, 2017	Email from Neil Giffen, Oak Ridge National Laboratory, to James Becker, PNNL, Regarding Questions About a Former Area of “Very High Biological Significance” on the Clinch River Site. (Package Accession No. ML18022A742)
November 13, 2017	Meeting between the U.S. Nuclear Regulatory Commission (NRC) and Tennessee Valley Authority (TVA) to Discuss Topics Associated With TVA's Early Site Permit Application for the Clinch River Nuclear Site [ER References and Site Safety Hydrology]. (Accession No. ML18010A322)
November 17, 2017	Letter to NRC from J.W. Shea, TVA, Regarding Submittal of Environmental Report References in Support of Early Site Permit Application for Clinch River Nuclear Site. (Accession No. ML17334A038)
December 7, 2017	Email from Neil Giffen, Oak Ridge National Laboratory, to James Becker, PNNL, Regarding Question About a Former Area of "Very High Biological Significance" on the Clinch River Site. (Accession No. ML18010A883).
December 15, 2017	Letter to NRC from J.W. Shea, TVA, Submitting Application for Early Site Permit for Clinch River Nuclear Site (Rev 1). (Accession No. ML18005A067)
December 15, 2017	Early Site Permit Application for Clinch River Nuclear Site at https://www.nrc.gov/reactors/new-reactors/esp/clinch-river.html#application
January 11, 2018	NRC Memorandum: Summary Report for the Full Scope Environmental Audit for the Clinch River Nuclear Site Early Site Permit Application. (Package Accession No. ML17226A020)
January 19, 2018	Email from NRC, to Theodore Isham, Seminole Nation of Oklahoma, Regarding Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Package Accession No. ML18031A950)
January 19, 2018	Email from NRC, to Samantha Robison, Alabama-Quassarte Tribal Town, Regarding Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML18046A410)
January 19, 2018	Email from NRC, to Bryant Celestine, Alabama-Coushatta Tribe of Texas, Regarding Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Package Accession No. ML18058B560)

January 20, 2018	Email from Theodore Isham, Seminole Nation of Oklahoma, to NRC, Regarding Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML18046A412)
January 22, 2018	Email from Karen Brunso, The Chickasaw Nation, to NRC, Regarding Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML18031A976)
January 22, 2018	Email from NRC, to Victoria Menchaca, Seminole Tribe of Florida, Regarding Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML18059A157)
January 22, 2018	Letter to NRC from J.W. Shea, TVA, Submitting Responses to Request for Additional Information Related to Emergency Planning Exemption Requests in Support of Early Site Permit Application for Clinch River Nuclear Site. (Accession No. ML18022A917)
January 25, 2018	Letter to NRC from J.W. Shea, TVA, Regarding Submittal of Environmental Report References in Support of Early Site Permit Application for Clinch River Nuclear Site. (Accession No. ML18036A346)
January 29, 2018	Email from NRC, to Terry Clouthier, Thlopthlocco Tribal Town, Regarding Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML18040A439)
February 9, 2018	Email from NRC, to Daniel Ragle, Choctaw Nation of Oklahoma, Regarding Clinch River Nuclear Site, Early Site Permit Application, Environmental Audit Summary Report. (Accession No. ML18044A843)
February 16, 2018	Email from NRC, to Carolyn White, Poarch Band of Creek Indians, Regarding Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML18051A746)
February 19, 2018	Letter to NRC, from Terry Clothier, Thlopthlocco Tribal Town, Regarding Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML18051A738)
March 5, 2018	Email from NRC, to Theodore Isham, Seminole Nation of Oklahoma, Regarding Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee. (Accession No. ML18064A222)

APPENDIX D
SCOPING COMMENTS AND RESPONSES

On April 13, 2017, the U.S. Nuclear Regulatory Commission (NRC) published a Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process in the *Federal Register* (82 FR 17885 2017-TN4910). The Notice of Intent notified the public of the staff's intent to prepare an environmental impact statement (EIS) and conduct scoping for an application received from Tennessee Valley Authority (TVA) for an Early Site Permit (ESP) for the Clinch River Nuclear (CRN) Site. The CRN Site is located in Roane County in eastern Tennessee.

This EIS has been prepared in accordance with provisions of the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. § 4321 *et seq*.-TN661), Council on Environmental Quality guidelines, and Title 10 of the *Code of Federal Regulations* (CFR) Parts 51 and 52 (TN250 and TN251, respectively). As outlined by NEPA, the NRC initiated the scoping process with the issuance of the *Federal Register* Notice. The NRC invited the applicant; Federal, Tribal, State, and local government agencies; local organizations; and individuals to participate in the scoping process by providing oral comments at the scheduled public meeting and/or by submitting written suggestions and comments no later than June 12, 2017.

D.1 Overview of the Scoping Process

The scoping process provides an opportunity for public participation to identify issues to be addressed in the EIS and to highlight public concerns and issues. The Notice of Intent identified the following objectives of the scoping process.

- Define the proposed action that is to be the subject of the EIS.
- Determine the scope of the EIS and identify significant issues to be analyzed in depth.
- Identify and eliminate from detailed study those issues that are peripheral or that are not significant.
- Identify any environmental assessments and other EISs that are being prepared or will be prepared that are related to, but not part of, the scope of the EIS being considered.
- Identify other environmental review and consultation requirements related to the proposed action.
- Identify parties consulting with the NRC under the National Historic Preservation Act (NHPA), as set forth in 36 CFR 800.8(c)(1)(i) (TN513).
- Indicate the relationship between the timing of the preparation of the environmental analyses and the NRC's tentative planning and decision-making schedule.
- Identify any cooperating agencies and, as appropriate, allocate assignments for preparation and schedules for completing the EIS to the NRC and any cooperating agencies.
- Describe how the EIS will be prepared and identify any contractor assistance to be used.

Two public scoping meetings were held at the Pollard Technology Conference Center Auditorium, at 210 Badger Avenue, in Oak Ridge, Tennessee, on May 15, 2017; meetings took place at 1:00 p.m. and 6:00 p.m. The NRC announced the meetings in local and regional newspapers (*The Oak Ridger, Roane County News, Knoxville Sentinel,* and *The Roane Reader*) and issued press releases locally. Each scoping meeting began with prepared statements from NRC staff members providing a brief overview of the ESP application review process and the NEPA process. After the NRC's prepared statements, the meetings were opened for public comments.

Twelve afternoon scoping meeting attendees and seven evening scoping meeting attendees provided oral comments that were recorded and transcribed by a certified court reporter. Two written statements were received during the meeting. In addition to the oral and written statements provided at the public scoping meeting, a total of 74 pieces of correspondence were received during the scoping period. The scoping period ran from April 13, 2017 to June 12, 2017.

Transcripts for both afternoon and evening scoping meetings can be found in the NRC's Agencywide Documents Access and Management System (ADAMS) under accession numbers ML17151A407 and ML17151A408, respectively. A scoping meeting summary memorandum (ML17157B585) was issued on June 20, 2017.

At the conclusion of the scoping period, the NRC staff and its contractor, Pacific Northwest National Laboratory, reviewed the scoping meeting transcripts, as well as all written material received, and identified individual comments. These comments were organized according to topic within the proposed EIS or according to the general topic if outside the scope of the EIS. After comments were grouped according to subject area, the NRC staff prepared responses to the comments, identifying which were within the scope of the EIS.

Table D-1 identifies in alphabetical order the individuals who provided comments during the scoping period, their affiliations (if given), and the ADAMS accession number that can be used to locate their correspondence. Table D-2 lists the comment categories in alphabetical order and the commenter names and numbers for comments for each category. The balance of this appendix presents the comments and NRC staff responses organized by topic category.

Table D-1. Individuals Providing Comments during the Comment Period

Commenter	Affiliation (if stated)	Comment Source and Document ID	Correspondence ID
Abkowitz, Kendra	Tennessee Department of Environment and Conservation	Email (ML17170A310)	0043
Almond, Jake		Meeting Transcript (ML17151A407)	0001-8
Anderson, KC		Email (ML17163A439)	0039
Anonymous		Letter (ML17145A549)	0035
Anonymous		Letter (ML17158B348)	0036
Anonymous		Letter (ML17180A317)	0059
Anonymous		reg.gov (ML17163A077)	0047
Anthony, Kate		reg.gov (ML17164A179)	0051
Bates, Renee		Letter (ML17157B347)	0034
Beach, Tom		Meeting Transcript (ML17151A408)	0002-1
Boles, Dustin	U.S. Fish and Wildlife Service	Email (ML17145A505)	0003
Bothwell, Cecil		Email (ML17145A542)	0008
Bryant, Harry		Email (ML17206A449)	0060
Burger, Carol		reg.gov (ML17163A081)	0050

Table D-1. (contd)

Commenter	Affiliation (if stated)	Comment Source and Document ID	Correspondence ID
Campbell, Jim	East Tennessee Economic Council	reg.gov (ML17166A207)	0053
Carter, Pat		Email (ML17157B743)	0027
Carter, Rick		Email (ML17157B745)	0028
Chinn, Jr., Rick	City of Oak Ridge	Email (ML17163A440)	0040
Chinn, Jr., Rick	City of Oak Ridge	Email (ML17180A318)	0040
Colclasure, Doug		Email (ML17163A442)	0042
Colton, Kara	Energy Communities Alliance	Email (ML17163A441)	0041
Cremer, Claudine		reg.gov (ML17163A080)	0049
Cumberland, Margaret		Meeting Transcript (ML17151A408)	0002-3
Curran, Diane	Southern Alliance for Clean Energy	Email (ML17166A206)	0052
DiMaria, Pamela		Email (ML17163A438)	0038
Ellis, Daniel		Email (ML17145A551)	0010
Emert, Steven	Anderson County Board of Commissioners	Letter (ML17177A090)	0058
Flagg, Tom		Email (ML17145A554)	0011
Frank, Terry	Anderson County Mayor	Letter (ML17151A788)	0062
Franklin, Doug	Hands On, Carpentry and Solar	reg.gov (ML17132A171)	0017
Gilmartin, Gary		Meeting Transcript (ML17151A407)	0001-2
Goins, Joe		reg.gov (ML17163A086)	0056
Goss, Sandra	Tennessee Citizens for Wilderness Planning	reg.gov (ML17166A208)	0054
Griffin, Tim	Energy, Technology and Environmental Business Association	Meeting Transcript (ML17151A407)	0001-9
Grimes, Patricia		Email (ML1715B722)	0023
Hardy, Parker	Oak Ridge Chamber of Commerce	Meeting Transcript (ML17151A407)	0001-3
Harland, Donald		reg.gov (ML17142A302)	0021
Hickman, Beth	City of Oak Ridge	Email (ML17163A440)	0040
Hickman, Beth	City of Oak Ridge	Email (ML17180A318)	0040
Holt, Cathy		Email (ML17145A565)	0014
Humphries, Leigha	Oak Ridge Chamber of Commerce	Email (ML17158C137)	0037
Hyche, Kenneth		reg.gov (ML17163A078)	0048
Jennings, Mary	U.S. Fish and Wildlife Service	Letter (ML17205A341)	0063
Johnston, Susan		reg.gov (ML17163A076)	0046

Table D-1. (contd)

Commenter	Affiliation (if stated)	Comment Source and Document ID	Correspondence ID
Jones, Sid		Email (ML17157B748)	0031
Jordan, Ben		Meeting Transcript (ML17151A407)	0001-1
Kirkman, Arden		Email (ML17157B741)	0025
Kohlhorst, Darrel		Meeting Transcript (ML17151A407)	0001-7
Krushenski, Kenneth	City of Oak Ridge	Email (ML17163A440)	0040
Krushenski, Kenneth	City of Oak Ridge	Email (ML17180A318)	0040
Kurtz, Sandy		Meeting Transcript (ML17151A408)	0002-2
LeQuire, Alan		reg.gov (ML17163A085)	0044
Lloyd, AA		Email (ML17138A296)	0020
Long, Larry	EPA Region 4	Email (ML17157B742)	0026
Lyle, Marcia		Email (ML17157B750)	0033
Martin, Rodger		Meeting Transcript (ML17151A408)	0002-6
McBride, Geoff		Email (ML17145A560)	0005
McBride, Linda		Email (ML17145A557)	0005
McClendon, Linda		Email (ML17145A507)	0004
McClendon, Linda		Email (ML17157B746)	0029
McCoy, Lawrence		Email (ML17164A178)	0038
McFadden, Nancy		Email (ML17145A539)	0007
Michlink, Doug	Container Technologies	Meeting Transcript (ML17151A407)	0001-6
Mortenson, Julia		reg.gov (ML17163A074)	0045
Naegeli, Wolf	Foundation for Global Sustainability	Meeting Transcript (ML17151A407)	0001-11
Oehler, Susan		Email (ML17145A549)	0009
Packan, Nicolas		Email (ML17057B740)	0024
Paddock, Brian		Meeting Transcript (ML17151A408)	0002-4
Pittillo, Dan		Email (ML17145A567)	0015
Powell, Michelle	Southern Alliance for Clean Energy	Meeting Transcript (ML17151A407)	0001-4
Prins, Claire		reg.gov (ML17142A304)	0022

Table D-1. (contd)

Commenter	Affiliation (if stated)	Comment Source and Document ID	Correspondence ID
Pritchett, Karen	United Keetoowah Band of Cherokee Indians	Email (ML17206A450)	0061
Pusey, Caleb		reg.gov (ML17163A073)	0044
Rangle, Daniel	Choctaw Nation of Oklahoma	Email (ML17157B749)	0032
Robertson, Grace		reg.gov (ML17136A204)	0018
Safer, Don	Tennessee Environmental Council	Meeting Transcript (ML17151A407)	0001-5
Salzman, Alicia		Letter (ML17157B750)	0057
Sauer, Robert		Email (ML17145A559)	0012
Skutnik, Steve		Meeting Transcript (ML17151A407)	0001-10
Skutnik, Steve		Meeting Transcript (ML17151A408)	0002-5
Smith, Brian		reg.gov (ML17138A295)	0019
Spencer, Martha		reg.gov (ML17163A084)	0044
Sprignoli, Damon		Email (ML17145A545)	0005
Sutlock, Dot		Email (ML17145A537)	0006
Sweeton, Beverly		Email (ML17157B747)	0030
Toombs, Elizabeth	Cherokee Nation	Email (ML17145A580)	0016
Turk, Lawrence "Butch"		Email (ML17145A535)	0005
Turk, Lawrence "Butch"		reg.gov (ML17163A082)	0044
Wallace, Beth		Email (ML17163A075)	0038
Wunderlich, Walt		Email (ML17145A564)	0013
Zeller, Lou	Blue Ridge Environmental Defense League	Meeting Transcript (ML17151A407)	0001-12
Zeller, Lou	Blue Ridge Environmental Defense League	Meeting Transcript (ML17151A408)	0002-7
Zeller, Lou	Blue Ridge Environmental Defense League	reg.gov (ML17151A409)	0055
Zeller, Lou	Blue Ridge Environmental Defense League	reg.gov (ML17166A379)	0055

Table D-2. Comment Categories with Associated Commenters and Comment IDs

Comment Category	Commenter (Comment ID)
Accidents – Severe	• Curran, Diane (0052-1) (0052-3) (0052-4) (0052-5) (0052-7) (0052-8) (0052-9) • Martin, Rodger (0002-6-5) • Safer, Don (0001-5-7)
Alternatives – Energy	• Bates, Renee (0034-1) • Curran, Diane (0052-2) (0052-6) (0052-10) (0052-13) (0052-14) (0052-15) (0052-16) (0052-17) (0052-18) • Ellis, Daniel (0010-2) • Goins, Joe (0056-2) • Harland, Donald (0021-2) • Johnston, Susan (0046-1) • Kirkman, Arden (0025-4) • McBride, Geoff (0005-2) (0005-6) • McBride, Linda (0005-2) (0005-6) • McFadden, Nancy (0007-2) (0007-4) • Mortenson, Julia (0045-1) • Naegeli, Wolf (0001-11-1) • Powell, Michelle (0001-4-5) • Safer, Don (0001-5-3) • Sprignoli, Damon (0005-2) (0005-6) • Sweeton, Beverly (0030-1) • Turk, Lawrence "Butch" (0005-2) (0005-6) • Wunderlich, Walt (0013-4) (0013-5) • Zeller, Lou (0001-12-2) (0055-1)
Alternatives – No-Action	• Curran, Diane (0052-19) • Kurtz, Sandy (0002-2-14) • Skutnik, Steve (0001-10-5) (0002-5-4)
Alternatives – Sites	• Colclasure, Doug (0042-1) • Wunderlich, Walt (0013-1) (0013-2)
Benefit – Cost Balance	• Anonymous, Anonymous (0059-4) • Anthony, Kate (0051-3) (0051-9) • Powell, Michelle (0001-4-2) • Safer, Don (0001-5-2) (0001-5-4)
Ecology – Aquatic	• Kurtz, Sandy (0002-2-3) • Naegeli, Wolf (0001-11-3) • Safer, Don (0001-5-11)
Ecology – Terrestrial	• Boles, Dustin (0003-1) (0003-2) (0003-3) (0003-4) (0003-5) (0003-6) (0003-7) • Cumberland, Margaret (0002-3-1) • Jennings, Mary (0063-1) • Kurtz, Sandy (0002-2-5) (0002-2-6) • Naegeli, Wolf (0001-11-2)
Geology	• Safer, Don (0001-5-8)
Health – Nonradiological	• Abkowitz, Kendra (0043-9) • Almond, Jake (0001-8-1)

Table D-2. (contd)

Comment Category	Commenter (Comment ID)
Health – Radiological	• Holt, Cathy (0014-3) • Kurtz, Sandy (0002-2-12) (0002-2-13) • Martin, Rodger (0002-6-1) • Paddock, Brian (0002-4-8) • Pittillo, Dan (0015-1) • Skutnik, Steve (0001-10-3)
Historic and Cultural Resources	• Abkowitz, Kendra (0043-11) • Pritchett, Karen (0061-1) • Rangle, Daniel (0032-1) • Toombs, Elizabeth (0016-1)
Hydrology – Groundwater	• Abkowitz, Kendra (0043-4) • Jones, Sid (0031-2) • Kurtz, Sandy (0002-2-2) • Paddock, Brian (0002-4-9) • Skutnik, Steve (0002-5-1)
Hydrology – Surface Water	• Abkowitz, Kendra (0043-2) (0043-3) • Anonymous, Anonymous (0059-3) • Anthony, Kate (0051-5) (0051-11) • Goss, Sandra (0054-2) • Grimes, Patricia (0023-2) • Kirkman, Arden (0025-3) • Kurtz, Sandy (0002-2-4) (0002-2-7) (0002-2-9) • Martin, Rodger (0002-6-2) • Skutnik, Steve (0001-10-2) (0002-5-2)
Land Use – Site and Vicinity	• Goss, Sandra (0054-1)
Meteorology and Air Quality	• Abkowitz, Kendra (0043-7) (0043-8) (0043-10) • Kurtz, Sandy (0002-2-8)
Need for Power	• Anthony, Kate (0051-6) (0051-12) • Powell, Michelle (0001-4-3) • Safer, Don (0001-5-6)
Nonradiological Waste	• Abkowitz, Kendra (0043-5) (0043-6)
Process – ESP	• Kohlhorst, Darrel (0001-7-1) • Safer, Don (0001-5-5) • Zeller, Lou (0055-2)
Process – NEPA	• Abkowitz, Kendra (0043-1) (0043-12) • Curran, Diane (0052-11) (0052-12) • Long, Larry (0026-1) (0026-2) (0026-4) • Paddock, Brian (0002-4-6) • Skutnik, Steve (0002-5-3)
Site Layout and Design	• Anonymous, Anonymous (0059-2) • Kurtz, Sandy (0002-2-10) • Paddock, Brian (0002-4-1) (0002-4-3) (0002-4-4) (0002-4-5) • Powell, Michelle (0001-4-4) • Wunderlich, Walt (0013-3)
Socioeconomics	• Almond, Jake (0001-8-2) • Kohlhorst, Darrel (0001-7-2) • Naegeli, Wolf (0001-11-4)
Uranium Fuel Cycle	• Harland, Donald (0021-4)

Table D-2. (contd)

Comment Category	Commenter (Comment ID)
	• Holt, Cathy (0014-2) • Hyche, Kenneth (0048-1) • Jones, Sid (0031-1) • Kirkman, Arden (0025-2) • Long, Larry (0026-3) • McBride, Geoff (0005-3) (0005-7) • McBride, Linda (0005-3) (0005-7) • McFadden, Nancy (0007-3) • Safer, Don (0001-5-10) • Sprignoli, Damon (0005-3) (0005-7) • Sutlock, Dot (0006-2) • Turk, Lawrence "Butch" (0005-3) (0005-7)

D.2 In-Scope Comments and Responses

The in-scope comment categories are listed alphabetically in Table D-3 in the order that they are presented in this EIS. In-scope comments and responses are included below the table. Parenthetical numbers shown after each comment refer to the Comment Identification (ID) number (document number-comment number) and the commenter name.

Table D-3. Comment Categories in Order as Presented in this Report

D.2.1 Comments Concerning Process – ESP
D.2.2 Comments Concerning Process – NEPA
D.2.3 Comments Concerning Site Layout and Design
D.2.4 Comments Concerning Land Use – Site and Vicinity
D.2.5 Comments Concerning Geology
D.2.6 Comments Concerning Hydrology – Surface Water
D.2.7 Comments Concerning Hydrology – Groundwater
D.2.8 Comments Concerning Ecology – Terrestrial
D.2.9 Comments Concerning Ecology – Aquatic
D.2.10 Comments Concerning Socioeconomics
D.2.11 Comments Concerning Historic and Cultural Resources
D.2.12 Comments Concerning Meteorology and Air Quality
D.2.13 Comments Concerning Health – Nonradiological
D.2.14 Comments Concerning Health – Radiological
D.2.15 Comments Concerning Nonradiological Waste
D.2.16 Comments Concerning Accidents – Severe
D.2.17 Comments Concerning the Uranium Fuel Cycle
D.2.18 Comments Concerning the Need for Power
D.2.19 Comments Concerning Alternatives – No-Action
D.2.20 Comments Concerning Alternatives – Energy
D.2.21 Comments Concerning Alternatives – Sites
D.2.22 Comments Concerning Benefit-Cost Balance

D.2.1 Comments Concerning Process – ESP

Comment: On to the scoping comments. The ESP process at this stage of the game is highly speculative without knowing what the reactor design is going to be and without even having a certified reactor design. In the ESP application they talk about four possible reactors -- designs that could be considered -- well, three of the companies have -- have removed themselves from the business. That's an indication of their judgment of the market conditions that are highly unfavorable to small modular reactors. (**0001-5-5** [Safer, Don])

Comment: I know you're doing a lessons-learned study right now, and I know the NRC has long had a lesson from the program. Looking at the EIS statements you've done in the past, I hope you will also look at the timing factor. Taking long amounts of time to get through these things does not necessarily mean a complete review. So I would hope that you would look at that because I think anything we can do to push the process forward and still make it a complete and thorough process would help the industry. (**0001-7-1** [Kohlhorst, Darrel])

Comment:

Critical Infrastructure

Executive Order 13636, "Improving Critical Infrastructure Cybersecurity," was issued February 12, 2013.[6] The order cites "cyber intrusions into critical infrastructure" which "demonstrate the need for improved cybersecurity." The order states:

Sec. 9. Identification of Critical Infrastructure at Greatest Risk. (a) Within 150 days of the date of this order, the Secretary shall use a risk-based approach to identify critical infrastructure where a cybersecurity incident could reasonably result in catastrophic regional or national effects on public health or safety, economic security, or national security.

TVA's application states that "SMR deployment will demonstrate that the technology is capable of incrementally supplying ... power that is less vulnerable to disruption to facilities owned by federal agencies."[7] The NRC cannot take lightly the prospect of another experimental nuclear reactor design's impact on electric power infrastructure in light of the evolving threats and the energy economics of the 21st Century. SMR passive cooling systems do not have active backup systems. The weaker containment of SMRs has a greater chance of damage from hydrogen explosions. Underground siting increases risk during flooding. And multiple SMRs present higher risk from reduced support staff or safety equipment. The risks from these reactors are precisely the catastrophic regional or national effects on public health or safety and economic security which EO 13636 seeks to prevent.

In conclusion, the Commission should reject TVA's proposal for modular nukes.
[footnotes:]
[6] Federal Register, Vol. 78, No. 33, February 19, 2013
[7] Clinch River Nuclear Site Early Site Permit Application, Part 3, Environmental Report, page 1-1 (**0055-2** [Zeller, Lou])

Response: *The action before the NRC is the issuance of an early site permit (ESP) to determine whether the Clinch River Nuclear (CRN) Site is suitable for placement of one or more small modular nuclear reactors with a maximum electrical output not to exceed 800 MWe. An ESP, if granted, does not authorize construction of any reactors; the applicant must obtain a construction permit (CP) or combined construction permit and operating license (combined* *license or COL) from the NRC and the CP or COL application would be the subject of an NRC review when the application for the CP or COL is submitted. An applicant is not required to specify a reactor design for an ESP; however, in the absence of a specified design, the applicant is expected to provide a plant parameter envelope (PPE), which TVA has done here. A PPE is a set of values of plant design parameters that an ESP applicant expects will bound the design characteristics of the reactor or reactors that might be constructed at a given site. The PPE values are a bounding surrogate for actual reactor design information, and should provide sufficient information about the reactor(s) and associated facilities, so that an assessment of site suitability can be made.*

The NRC is conducting its environmental review of TVA's ESP application and preparing an Environmental Impact Statement (EIS) in accordance with 10 CFR Part 51 (TN250) and 10 CFR 52.18 (TN251). The environmental review will focus on the effects of construction and operation of a nuclear power plant that is bounded by the PPE provided by the applicant. Accidents will be addressed in Section 5.11 of the EIS, but reactor safety systems and flooding risk are reviewed in the NRC's separate but parallel safety review. The outcome of the ESP safety review will be published in a Safety Evaluation Report.

D.2.2 Comments Concerning Process – NEPA

Comment: One of the things, the fundamental things, about an EIS is that it identifies what the project is and why it is needed. Because every project under an EIS has to have a no-action alternative. The law requires that.

So, the no-action alternative is we don't approve anything. And for this, obviously, it's we build these SMRs, whatever they may be at this site, but there has to be a reason. And that reason needs to be in the Environmental Impact Statement.

I know that TVA has asserted to the NRC that it doesn't need to talk about the need for power. And I know the TVA officials have said, "We're not buying any power, folks. Sorry. You know, go away. We haven't even made a contract for 3-cent-a-kilowatt-hour wind, like the west end of the State."

But, as we get closer to this, it seems to me that the EIS is going to be challenged and challengeable if it does not state the need, the projected need for power, and why that is going to be compared to the other sources that are already going and available, both from all the existing generation, particularly since TVA says it's not going to phase out its coal plants, and with things like free mining wind at the west end of the State. (**0002-4-6** [Paddock, Brian])

Comment: But, then, I think there are issues that are involved that in one place there are other issues, such as flooding and seismology risks that have not even been brought up that I think we all agree are valid.

Again, I think we should establish here the purpose of an early site permit should be to establish the viability of a site and to characterize, if a site is chosen for action, what a root cause is of potential risk factors would be. So, in other words, what is our baseline flooding risk? What is our baseline subsidence risk? What is our baseline seismological risk? These are valid.

Things I think, though, that should be not they're irrelevant to the scope and they are beyond the NRC's safety mandate include the following factors. I believe this is entirely the NRC is not an energy policy agency, nor should they be.

I believe it is valid if you want to take this to the TVA Rate Payers Board. Be my guest. You should. The same goes for electricity. These are ancillary to the site's suitability. I think the site suitability presentation should focus on the environmental suitability and environmental impacts.

A lot of talkers have brought up the absence of a specified design, which is somewhat puzzling since we're not at the construction licensing, construction/operating licensing phase.

What we question more here with this Environmental Impact Assessment is whether or not this site could suitably host a numeric nuclear facility. In this sense, then, I think discussions should be suitably restricted towards the issues which have the most pertinent influence on actual radiological safety issues of the plant. And these include the geology, hydrology, and seismology. Other issues that are more policy-oriented and such I think are not as germane. (**0002-5-3** [Skutnik, Steve])

Response: *Chapter 1 of the EIS will address the purpose of and need for the proposed action, and will present the range of alternatives considered in the EIS, including the no-action alternative. The ESP determination is primarily a siting decision; in accordance with 10 CFR 51.75 (TN250), the EIS will not include an assessment of the need for power or an evaluation of alternative energy sources because these matters were not addressed in the applicant's environmental report (ER; TVA 2016-TN4637). Site safety, seismicity, and flooding risk are reviewed in the NRC's separate but parallel safety review; the outcome of the ESP safety review will be published in a Safety Evaluation Report.*

Comment: NRC and TVA may want to consider the advantages of early consultation with federal, state and tribal agencies for the purpose of streamlining the permitting process during the NEPA analysis. One advantage of an early consultation process could be TVA obtaining their environmental permits shortly after the NEPA Record of Decision (ROD) issuance. The inclusion of NRC's systematic approach (10 CFR Part 51) along with state and federal permitting issues into the NRC's pre-permitting process can provide a streamline NEPA analysis that helps to eliminate duplications in the permitting analysis. This will help to provide a more productive analytical process overall. (**0026-1** [Long, Larry])

Comment: NRC and TVA may also want to consider incorporating the Army Corps of Engineers into the early consultation process to include Clean Water Act (CWA) 404 permitting requirements, such as avoidance and minimization, along with mitigation requirements, if any. (**0026-2** [Long, Larry])

Comment: Please provide us [EPA Region 4, NEPA, Resource Conservation & Restoration Division] with a copy (electronic, CD with two hardcopies) of future NEPA documents when they become available. (**0026-4** [Long, Larry])

Comment: The Tennessee Department of Environment and Conservation (TDEC) appreciates the opportunity to provide comments on the Nuclear Regulatory Commission (NRC) Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS) related to the Tennessee Valley Authority (TVA) early site permit (ESP) for the Clinch River Nuclear (CRN) Site near Oak Ridge, Tennessee.[1] TDEC understands that the ESP application by TVA is an initial determination process for resolving safety and environmental siting issues for a potential future Small Modular Reactor (SMR) at the CRN Site, but does not authorize construction and operation of a nuclear power plant. Additionally, as a Federal agency, TVA is required to comply with the National Environmental Policy Act (NEPA) and the National Historic Preservation Act (NHPA) independently of NRC requirements. The NRC expects to publish a

draft EIS in June 2018. The proposed CRN Site, is located in Roane County, Tennessee, along the Clinch River, approximately 25 miles west-southwest of downtown Knoxville, Tennessee. (**0043-1** [Abkowitz, Kendra])
[footnote:]
[1] For more information on the TVA CRN proposal, including the ESP Application (ML16144A086) please visit https://www.nrc.gov/reactors/new-reactors/esp/clinch-river.html. Specific information regarding the TVA CRN proposal as is discussed in TDEC's consolidated response is taken from the Part 3 – Environmental Report submitted as part of TVA's ESP to NRC. The Part 3 – Environmental Report can be found at https://www.nrc.gov/docs/ML1614/ML16144A145.html.

Comment: TDEC appreciates the opportunity to comment on this NOI from NRC to prepare an EIS for the TVA CRN Site. Please note that these comments are not indicative of approval or disapproval of the proposed action or its alternatives, nor should they be interpreted as an indication regarding future permitting decisions by TDEC. (**0043-12** [Abkowitz, Kendra])

Response: *The NRC is conducting its environmental review of TVA's ESP application and preparing an EIS in accordance with 10 CFR Part 51 (TN250) and 10 CFR 52.18 (TN251). The U.S. Army Corps of Engineers (USACE) is a cooperating agency on the environmental review and will be providing input relevant to Clean Water Act Section 404 permitting and mitigation requirements. The NRC has initiated consultation with Federal, State, and Tribal entities; a chronology of correspondence will be provided in Appendix C of the EIS, and key formal consultations (e.g., Section 7 of the Endangered Species Act) will be in Appendix F of the EIS.*

Comment:

2. Brief Summary of Basis for the Contention:

a. Requirements of NEPA

NEPA implements a "broad national commitment to protecting and promoting environmental quality." Louisiana Energy Services, L.P. (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 87 (1998) (quoting Robertson, 490 U.S. at 348 and citing 42 U.S.C. § 4331). NEPA has two key purposes: to ensure that the agency "will have available, and will carefully consider, detailed information concerning significant environmental impacts" before it makes a decision; and to guarantee that "the relevant information will be made available to the larger audience that may also play a role in the decision-making process and implementation of that decision." Robertson, 490 U.S. at 349.

In fulfilling NEPA's first purpose of evaluating the environmental impacts of its decisions, requires a federal agency to take a "hard look" at potential environmental consequences by preparing an EIS prior to any "major Federal action[] significantly affecting the quality of the human environment." Robertson, 490 U.S. at 349; 42 U.S.C. § 4332(c). The "hallmarks of a 'hard look' are thorough investigation into environmental impacts and forthright acknowledgment of potential environmental harms." National Audubon Society, 422 F.3d at 185. In addition, the agency must "rigorously explore and objectively evaluate the projected environmental impacts of all reasonable alternatives for completing the proposed action." Van Ee v. EPA, 202 F.3d 296, 309 (D.C. Cir. 2000). In considering alternatives, the agency must examine the "alternative of no action." 40 C.F .R. § 1502.14.

In fulfilling NEPA's second purpose of public participation, the agency's environmental analysis must be published for public comment "to permit the public a role in the agency's decision-making process." Robertson, 490 U.S. at 349-50; Hughes River Watershed Conservancy v. Glickman, 81F.3d437, 443 (4th Cir. 1996). NRC's Part 51 regulations also allow interested members of the public to participate in the environmental decision-making process through the NRC's hearing process. 10 C.F.R. §51.104(a). (**0052-11** [Curran, Diane])

Comment:

b. Regulatory requirements for NEPA compliance in ESP proceedings

Because an ESP approves only the banking of a site and not construction or operation of any nuclear facility, the NRC limits the scope of an EIS to issues related to the siting of the facility. As explained in the preamble to the rule, the NRC intended to focus the environmental analysis for ESP applications on issues related to site suitability, such as environmental impacts of construction and operation and alternative sites:

The environmental report and EIS for an early site permit must address the benefits associated with issuance of the early site permit (e.g., early resolution of siting issues, early resolution of issues on the environmental impacts of construction and operation of a reactor(s) that fall within the site characteristics, and ability of potential nuclear power plant licensees to "bank" sites on which nuclear power plants could be located without obtaining a full construction permit or combined license). The benefits (and impacts) of issuing an early site permit must always be addressed in the environmental report and EIS for an early site permit, regardless of whether the early site permit applicant chooses to defer consideration of the benefits associated with the construction and operation of a nuclear power plant that may be located at the early site permit site. This is because the "benefits * * * of the proposed action" for which the discussion may be deferred are the benefits associated with the construction and operation of a nuclear power plant that may be located at the early site permit site; the benefits which may be deferred are entirely separate from the benefits of issuing an early site permit. The proposed action of issuing an early site permit is not the same as the "proposed action" of constructing and operating a nuclear power plant for which the discussion of benefits (including need for power) may be deferred under § 51.50(b).

Final Rule: Licenses, Certifications, and Approvals for Nuclear Power Plants, 72 Fed. Reg. 49,352, 49,430 (Aug. 28, 2007) (emphasis added). Accordingly, NRC regulation 10 C.F.R. §51.50(b)(2) provides that an environmental report for an ESP application "need not include an assessment of the economic, technical, or other benefits (for example, need for power) and costs of the proposed action or an evaluation of alternative energy sources." As explained in the preamble, the choice is up to the applicant:

Environmental reports must focus on the environmental effects of construction and operation of a nuclear reactor, or reactors, which have characteristics that fall within the design parameters postulated in the early site permit. Environmental reports must also include an evaluation of alternative sites to determine whether there is any obviously superior alternative to the site proposed. Environmental reports submitted in an early site permit application are not required to but may include an assessment of the economic, technical, and other benefits and costs of the proposed action or an analysis of other energy alternatives.

Id. at 49,434 (emphasis added). Thus, the NRC does not consider the energy alternative issue to be material to the issuance of an ESP, unless the applicant chooses to address the issue.

In a proceeding where the applicant decides not to address energy alternatives at the ESP stage, the NRC prohibits members of the public from raising contentions regarding those issues, because the NRC does not require those issues to be addressed in its ESP licensing decisions.

See, e.g., Dominion Nuclear North Anna, L.L.C. (Early Site Permit for North Anna ESP Site), LBP-04-18, 60 NRC 253, 264 (2004) (citing Florida Power & Light Co. (Turkey Point Nuclear Generating Plant, Units 3 and 4), LBP-01-06, 53 NRC 138, 159 (2001); Pacific Gas & Electric Co. (Diablo Canyon Nuclear Power Plant, Units 1 and 2), LBP-93-01, 37 NRC 5, 29-30 (2001); Public Service Co. of New Hampshire (Seabrook Station, Units 1 and 2), LBP-82-106, 26 NRC 1649, 1656 (1982); Yankee Atomic Electric Co. (Yankee Nuclear Power Station), CLI-96-7, 43 NRC 235, 251 (1996); Arizona Public Service Co. (Palo Verde Nuclear Generating Station, Units 1, 2, and 3), LBP-91-19, 33 NRC 397, 410, aff'd in part and rev'd in part on other grounds, CLI-91-12, 34 NRC 149 (1991) (holding that a contention advocating stricter requirements than agency rules impose or that otherwise seek to litigate a generic NRC determination are inadmissible)). Accordingly, with the exception of the issue of site alternatives, NRC prohibits members of the public from seeking consideration of alternatives in an Environmental Report or EIS for an ESP, including comparisons of the proposed operational technology to other technologies for production of electricity.

In hearings on NEPA issues, the NRC also requires fairness to all parties. Hydro Resources, Inc. (P.O. Box 15910, Rio Rancho, NM 87174), CLI-01-04, 53 NRC 31, 38 (2001). As the Commission held in Hydro Resources, Inc., the NRC may not issue a license based on an EIS whose contents it has shielded from challenge in a hearing. (**0052-12** [Curran, Diane])

Response: *The commenter's scoping comments were submitted to the NRC as part of a separate hearing process. Please refer to ML17188A445 for the NRC staff's response to the comments. These comments describe the NEPA process as it relates to an ESP proceeding. The comments do not provide information relevant to the environmental effects of the proposed action and will not be evaluated in the EIS.*

D.2.3 Comments Concerning Site Layout and Design

Comment: In fact, SMRs don't even exist yet. There isn't a certified reactor design, therefore it is impossible to state now that SMRs can provide reliable energy for extended operation as TVA misleadingly stated in their ESP application. (**0001-4-4** [Powell, Michelle])

Comment: The design for the SMR is not there yet. And it seems to me that we can't really make a final determination that this site is even suitable when you don't know what you want to construct. So, I'm not quite sure why there's a scoping session ahead of even knowing about are we clear that the site would be applicable before you know that you want to build on it. (**0002-2-10** [Kurtz, Sandy])

Comment: It looks like to me that the proposal is that there's going to be 12 SMRs. It is the NuScale SMR design, which is still in discussion with the people at the NRC as well because, eventually, if it ever becomes the only approved SMR design.

I recently spent an entire afternoon listening to staff testimony to the Advisory Committee on Reactor Safeguards --and this was the other piece that the introductions mentioned --where the safety of an SMR is reviewed. It went from about one o'clock to five o'clock. It was quite extensive.

These are mostly academics and other nuclear engineers, specialists. One of the members, in fact, has been on the Advisory Committee so long that he sat on the discussion of the safety of the Clinch River breeder reactor, and he is about my age.

That Committee raised a number of questions which I think go to the point about how you decide the suitability of the site when you do not yet have an approved design. The last time the NRC approved another site approval several years ago --and this was called to our attention at a couple of earlier public meetings as this was beginning to gel. And we were told, "Go back and look at the most recent approval of the other site."

Well, I looked at it. It took about 10 years to approve the site. And that was based on the idea that they would build one of several existing designs that had already been designed and built and approved, and so forth. So, the envelope primarily for that was quite clear as to what kind of a nuclear reactor generation system might be built at a site. It seems to me that that makes the environmental assessment much, much easier. (**0002-4-1** [Paddock, Brian])

Comment: Another member of the Committee, the Advisory Committee on Reactor Safeguards, questioned, he said, "I am very uncomfortable with the assumption that, because these reactors are going to be underground, they're safe." There are a lot, tons of things we worry about with the above-ground full-scale reactors that simply can't happen. And there was not a lot of discussion about that assumption, but there was a certain amount of discomfort among several members of the Advisory Committee about the assumption that this somehow, putting small reactors underground, as is proposed here, wiped away a lot of the questions and problems that you might ordinarily think more about it. (**0002-4-3** [Paddock, Brian])

Comment: And the staff also brought up in their testimony to the Committee a very interesting question. They said, "Well, we're having quite a difficult time because there are no applicable, advanced reactor standards applicable to SMRs that are still working advanced reactors."

And by the way, there were handouts at the table there, new reactor plant designs, and referred to a 1988 Policy Statement and referred to several designs, only one of which I think, the AP1000, has seen tentative, partial construction in the United States. And this was called a "backgrounder," and it was from June 2008.

If we are still thinking, if we are still able to describe what our understanding is of advanced nuclear plant designs on a piece of paper that was put out in 2008, we obviously are not ready for new plant designs.

The same thing is true of the next-generation reactors. The factsheet talks about as of January 2004. It talks about the AP1000. And the radioactive waste sheet is dated April of 2007.

If we are where we were a decade ago on all of those issues --and I don't believe we are --in terms of both the challenges and our responses, then we're getting way ahead of ourselves.

Now, if you go back to the staff comments, one of the things they say is, "We don't have a place to go." It doesn't fit in with the advanced reactor design approval process or standards that are being worked on there. It doesn't fit in with the existing standards for full-scale reactors. These are supposed to be lightwater reactors.

But, for example, the chemical engineers have a huge, a large set of standards, very detailed standards for what goes into the kind of equipment and how it's installed, and so forth, for a full-scale reactor. And the staff said: we can't really use those. They don't apply. What we have to do with respect to every standard engineering function is to go back and figure out why that's in there. Why did we say the pipe should be this big? Why did we say it has to be done this way? And we have to figure out what that was to accomplish in terms of safety and reliability. And we have to do that with every one of the existing standards, and that is just for mechanical engineering, which was the example used, but it would clearly apply for control, instrumentation, and a number of other factors.

Likewise, at other places, they simply say, "We cannot use, without reinventing to some extent all of the existing standards for reactor safety and for reactor standards." And that brought about a very interesting conversation at the end among the members of the Advisory Committee on Reactor Safeguard because one of them said, "Why don't we go back to basics? Why don't we just look at the things where you might release radiation to affect the public and skip all the rest of this?" All this stuff that we developed over the years that says what kind of stainless steel has to be used in what kind of a situation, and what the reliability is of pumps and switches and instruments, and so forth. And that led to a fairly interesting discussion about whether we were trying to be too detailed in developing these standards. (**0002-4-4** [Paddock, Brian])

Comment: But, to tell the people that are working on the EIS that they have some kind of a grasp on what the proper envelope is --and I think that is the word that is used in the application, the proper envelope to be examined of what the possible design for our numbers, and so forth, are. Are these SMRs, and particularly the multiple system of them --it seems to me we have gotten way ahead of ourselves. (**0002-4-5** [Paddock, Brian])

Comment: If it is an experimental design of national importance the TVA rate payers should not be used as test rabbits for footing the bill if they already shoulder the risks of possible failure. Given the unreliability of renewable energy at least as long as we don't have the necessary bridging capabilities, SMRs could fill a very necessary role in stabilizing electricity supply, especially near locations where electrical supply reliability is paramount. Hopefully these reactors can be made safe enough that they can be also located near these locations, i.e., by self-contained cooling as well as by self-contained emergency systems. Until this happens TVA should direct its attention to the urgently needed revamping of the legal environment that prevents it from continuing its role as a valley-wide resource development agency, as addressed in 4. (**0013-3** [Wunderlich, Walt])

Comment: No actual approved design (**0059-2** [Anonymous, Anonymous])

Response: *Most of these comments concern the lack of an approved Small Modular Reactor (SMR) design or the timeframe for the SMR design review process. An applicant is not required to specify a reactor design for an ESP; however, in the absence of a specified design, the applicant is expected to provide a plant parameter envelope (PPE) that provides sufficient information about a surrogate reactor(s) and associated facilities so that an assessment of site suitability can be made. SMR design development and certification are outside the scope of the ESP environmental review; information about NRC's SMR design certification status can be found on the NRC's website at https://www.nrc.gov/reactors/new-reactors/smr.html.*

An ESP, if granted, does not authorize construction of any reactors. The applicant must obtain a construction permit (CP) or combined construction permit and operating license (combined license or COL) from NRC, and an application for CP or COL is required to reference a specific *reactor design. In its review of a CP or COL application referencing an ESP, the NRC would carefully consider any parameters that are outside the PPE that was evaluated for the ESP, any new and significant information that could change the impact determined for the ESP, and any information relevant to resolving any issues left unresolved for the ESP.*

D.2.4 Comments Concerning Land Use – Site and Vicinity

Comment: We recommend environmental zoning for the former Clinch River Breeder Reactor Site. We believe it is appropriate that all of the upland area on the northern half of this peninsula be designated as Zone 4 [Natural Resource Conservation]. Further, portions of the disturbed and level area at the southern end of the peninsula should be designated for Zone 5 [Industrial]. The portion of the site designated for small modular reactor installation would best be limited to the area previously disturbed by prior construction and the relatively level land immediately surrounding it to the north and away from the reservoir. Further, we ask that a strip between 75 m and 300 m wide be maintained along the edge of the Clinch River/Melton Hill Reservoir within this parcel. (**0054-1** [Goss, Sandra])

Response: *An assessment of site and regional land-use impacts from the proposed action of building and operating the CRN Site will be discussed in EIS Section 4.1 and 5.1. This assessment will address zoning issues and compatibility with nearby land uses. Cumulative land-use impacts will be addressed in Section 7.1.*

D.2.5 Comments Concerning Geology

Comment: In the geology -- that site is on karst terrain, and I was doing some reading last night on the EIS and we go into 140-something pages of geology, but the fact is, it is karst terrain. They found that when the Clinch River site was prepared. And it needs to be thoroughly considered and thoroughly vetted.

The risks of sinkholes and active sinkholes -- I mean, we've all seen the sites in Florida of huge apartment complexes ending up underground and people being buried in them. I understand there will be a lot of geology work done, but that needs to be seriously considered, especially in karst terrain. (**0001-5-8** [Safer, Don])

Response: *The geology of the site will be described in EIS Section 2.8. The effects of geologic features such as karst on the occurrence and movement of groundwater at the CRN Site will be discussed in EIS Section 2.3.1.2.*

D.2.6 Comments Concerning Hydrology – Surface Water

Comment: In particular, I've heard a number of comments at this forum which I feel are beyond the NRC's stated scope and mandate issues that are not germane to safety to -- particularly to the site suitability or safety. And I would remind the audience and the NRC that the mandate should properly be put on whether or not the site can be suitably host to a nuclear reactor design. So in this sense then I think it's perfectly appropriate to consider things like level effects on water quality (**0001-10-2** [Skutnik, Steve])

Comment: [the erosion and all the things associated with soil toxics and those kinds of things will eventually get to the river, the Clinch River. And that is not good for].... our drinking water, for that matter, as it goes downstream. (**0002-2-4** [Kurtz, Sandy])

Comment: [Then, we can talk about the climate change impacts, and I am hoping that in this scoping, do you include that and address] .....any water flow issues ... (**0002-2-7** [Kurtz, Sandy])

Comment: [When you are talking about climate change,].... You are talking temperature. And so, the temperature, water temperature is very important, especially when you're talking about nuclear plants. And so, not only the water flow, but the water quantity should be addressed if it is going to meet the needs of any nuclear plant work. (**0002-2-9** [Kurtz, Sandy])

Comment: The impacts on water quality are another valid consideration I've seen brought up that should be part of the NRC review, and we'll ultimately own that. (**0002-5-2** [Skutnik, Steve])

Comment: And there was a previous comment on water temperatures. A few years ago we had a summer where I think we hit 108 degrees. That's somewhat normal. So, severe droughts, water temperatures are a concern. I know they limited one reactor based on its operation. (**0002-6-2** [Martin, Rodger])

Comment: it [SMRs] uses too much water. we need to move in the direction of clean alternative solutions. there is so much unknown about this technology, and the clinch river is a clean river now. (**0023-2** [Grimes, Patricia])

Comment: [A reactor that produces long-lived and highly radioactive nuclear waste ....] and will most likely pollute the community's clean water supply is just not wise. (**0025-3** [Kirkman, Arden])

Comment: Given the expected activity associated with this proposed project, the following TDEC permitting requirements are likely to apply.[2] The construction of a Small Modular Reactor (SMR) at the TVA CRN Site will require a construction storm water permit based on the land disturbance at the site being more than one acre.[3] A National Pollutant Discharge Elimination Permit (NPDES) permit will be required for the discharge from the facility into the Clinch River.[4] An Aquatic Resource Alteration Permit (ARAP) will be required for the water withdrawal at the facility.[5] This facility will also be required to have a Tennessee Storm Water Multi-Sector General Permit, which will include the barge loading and offloading facility.[6]
[footnotes:]
[2] As this is a scoping document for a forthcoming EIS, there is not sufficient information to address the requirements for the permits in more detail. There have not been any public water supply intakes, wells or springs identified that would be impacted from the proposed facility, but as additional details are provided more permitting requirements may be necessary.
[3] For more information on NPDES Stormwater Construction Permitting please visit http://www.tn.gov/environment/article/permit-waternpdes-stormwater-construction-permit.
[4] For more information on NPDES Discharge Permitting please visit https://www.tn.gov/environment/article/permit-water-nationalpollutant-discharge-elimination-system-npdes-permit.
[5] For more information on the ARAP program please visit https://www.tn.gov/environment/article/permit-water-aquatic-resourcealteration-permit.
[6] For more information on the NPDES Industrial Stormwater General Permit program please visit http://www.tn.gov/environment/article/permit-water-npdes-industrial-stormwater-general-permit. (**0043-2** [Abkowitz, Kendra])

Comment: The TVA CRN Site Part 3 - Environmental Report submitted to the NRC as part of the ESP Application notes that due to the interactions of the Watts Bar Dam, Melton Hill Dam and Fort Loudon Dam, that the river flow “can be upstream, downstream or quiescent, depending on the modes of operation" within the vicinity of the site. This could mean that for short periods of time, the intake at the CRN facility would be downstream of the NPDES discharge point for the facility. It is not clear what impact if any this flow reversal would have, but TDEC recommends that the forthcoming EIS consider this variable. (**0043-3** [Abkowitz, Kendra])

Comment: SMR's are extremely water-intensive, especially when compared to clean energy choices such as wind, solar and energy efficiency and conservation. In these global warming times of drought, squandering water in this way is the last thing we should be doing. (**0051-11** [Anthony, Kate])(**0051-5** [Anthony, Kate])

Comment: Water use could be an environmental concern, but it is impossible to comment further on water consumption by the proposed reactors without more information about the cooling-system water requirements and other water intake needs. In principle, the adjacent river/reservoir could provide adequate water supply. (**0054-2** [Goss, Sandra])

Comment: More intensive water use than clean energy sources (**0059-3** [Anonymous, Anonymous])

Response: *Potential impacts on surface-water use and quality as a result of construction at the CRN Site will be discussed in EIS Sections 4.2.2.1 and 4.2.3.1. The potential impacts on surface-water use and quality as a result of plant operations at the CRN Site will be discussed in EIS Sections 5.2.2.1 and 5.2.3.1. The effects of the CRN Site discharge on water temperature in the Clinch River will be included in Section 5.2.3.1 and the resulting potential impacts on aquatic ecology will be discussed in EIS Section 5.3.2. Permits and approvals will be discussed in Chapter 1 and Appendix H of the EIS. Appendix L will discuss expected future changes in climate at the CRN Site and will evaluate the potential effects of future climate change on the assessed environmental impacts.*

D.2.7 Comments Concerning Hydrology – Groundwater

Comment: I am looking at the coarse terrain of that site, and it is right along the Clinch River, of course. So, I am hoping that the scoping will really take a look at more knowledge that we know since the breeder reactor was referred to was studied, that they will look more carefully at how this works, because this SMR will be in a hole in water.

And there are sinkholes around. I don't know who's responsible for dealing with the sinkholes, but I know in the past that those sinkholes are often treated by filling them with concrete. That doesn't seem like a good plan, in part because of the surface, and with the coarse terrain, you never quite know where the water is going to do. (**0002-2-2** [Kurtz, Sandy])

Comment: Let me say one final thing about this site. The site is, as has been mentioned, a coarse site. And TVA in its application did some extensive hydrogeological descriptive material, and as one gentleman mentioned, at a previous reactor site there was a good deal of work done.

But you have to understand in coarse [karst] that core drilling doesn't really tell you. You can drill down and you could be six inches from the edge of a gigantic cave and you will miss it, and you will not know it's there. And ground-penetrating radar only works for the first few feet. You cannot tell what's under there.

And there are two recent examples that I would offer you. One is that TVA created a new lime waste site for coal ash over at Kingston. And I don't know if you've followed that. But the darned thing blew a hole in the bottom and a sinkhole and dumped a lot of ash out into the river. And somebody came along in a boat and said, "What's all this gray stuff bubbling up in the water?" And it was coal ash.

And they spent a lot of money on re-engineering that to TVA's satisfaction because they simply could not tell. And to this day, none of the engineers who did the re-engineering can guarantee you that what they have done --you know, they cut it down and relined it, and did a lot of things --that there are not sinkholes fairly near the surface that could burst through where there is enough weight in that area. (**0002-4-9** [Paddock, Brian])

Comment: I think that with that they hydrogeology is an entirely valid concern to be brought up, no matter what reactor design should be put there. That is an entirely valid concern over siting a reactor. And this is part of every, by now, it is part of every NRC review, and it should be. (**0002-5-1** [Skutnik, Steve])

Comment: My second concern comes from participation in design of groundwater monitoring systems and groundwater tracing studies in East Tennessee over several decades. Because of the statistical nature of radioactive emissions and the counting techniques typically used for analysis of radionuclides, detection monitoring systems for releases of radioactive substances into groundwater may yield ambiguous results. The scoping document, which contains much general background information on geology and hydrogeology, indicates that the site hydrogeology will be complicated due to extensive fracturing and to dissolution (karst) processes. I have been on the site, and believe the scoping document presents a fair assessment of the geology and hydrogeology of the site. My experience has been that adequate groundwater monitoring for a release at such sites requires more sampling, both spatially and temporally, than at sites without such extensive altering of primary bedrock permeability. While TVA has reactors on karst sites, they were permitted before it was so well understood that, on these sites, it is very difficult to adequately predict either direction or velocity of groundwater flow.

At the proposed site, one monitoring well has already been contaminated with volatile organics. TVA and TDEC sampling of well 422L at the site indicated non-aqueous phase diesel range organics. This obviously adds a further complication to the question of site monitorability. Presumably, TVA would need to remediate or isolate this contamination before attempting to monitor groundwater on the site.

Finally, there are other potential sources of radioactive contamination nearby. The Clinch River has received significant discharges of radioisotopes during legacy operations at Department of Energy Oak Ridge facilities. River sediments retain significant concentrations of radionuclides, and low levels of some radioactive isotopes persist in river water. Air emissions of radioactive substances occurred near the site, possibly increasing the levels of radioactivity in soils.

My third concern about the site is related to the potential for flooding of the buried portions of the planned reactor(s) should groundwater channeling through karst conduits increase the groundwater flux into the excavation made to contain the reactor(s) due to soil piping or bedrock collapse. While there is currently little indication that such channels are well developed on the site, quarry operations and construction projects in East Tennessee frequently change groundwater hydraulics in ways that negatively impact (or even stop) operations. (**0031-2** [Jones, Sid])

Comment: Investigations by DOE and TDEC's Division of Remediation (DoR) - Oak Ridge Office have shown that there is deep ground water flow that goes under the Clinch River from the Oak Ridge National Laboratory (ORNL).[7] Migration of chlorinated solvents within the Conasauga Group formation, under the Clinch River along strike to the southwest, has resulted in contaminated private wells at Hoods Ridge. There is also suspected contamination from Oak Ridge Reservation in the Jones Island area across the Clinch River from Oak Ridge Reservation as well. TDEC recommends that any private well or spring use occurring in the area be investigated as a part of the EIS to address the unique geology and hydraulic connectivity of the site. TDEC also recommends that the extent of the existing ground water contamination, including preexisting radiological constituents and volatile organic compounds in the groundwater, at the proposed CRN Site be determined by TVA and addressed in the forthcoming draft EIS.[8]
[footnotes:]
[7] The proposed CRN Site is located in complex folded/faulted karst geology of the Valley and Ridge Province. The Copper Creek Thrust Fault cuts southwest/northeast across the "toe" of the boot-shaped site. A lesser unnamed thrust fault cuts across the northern portion of the site. Karst ground water flow does not behave as laminar flow and does not follow Darcy's Law - interstitial porosity plays a very minor role but appears to be a significant focus in TVA's investigations. The beds of the Chickamauga Group formations in the area are dipping at 30 plus degrees to the southeast. Ground water flow is going to generally be along strike of the beds to the southwest, as is evidenced from the offsite contamination from the Department of Energy (DOE) ORNL.
[8] TVA notes in its CRN Site ESP Application Part 3 - Environmental Report that monitoring well OW-422L in the center of the CRN Site has petroleum-based contamination. This location is slightly more than ½ mile west of the area of Hoods Ridge where chlorinated solvent contamination has been identified from the DOE ORNL. The existence of pre-existing site contamination is an issue of concern for both TDEC Division of Remediation and Division of Water Resources. (**0043-4** [Abkowitz, Kendra])

Response: *The occurrence and movement of groundwater at the CRN Site will be described in EIS Section 2.3.1.2, including the effects of fractures, karst, and geologic unit bedding planes. Existing groundwater quality will be described in EIS Section 2.3.3.2. Potential impacts on groundwater use and quality as a result of construction at the CRN Site will be discussed in EIS Sections 4.2.2.2 and 4.2.3.2. The potential impacts on groundwater use and quality as a result of plant operations at the CRN Site will be discussed in EIS Sections 5.2.2.2 and 5.2.3.2.*

D.2.8 Comments Concerning Ecology – Terrestrial

Comment: And to close with dignity of the Oak Ridge Reservation which is the largest contiguous protected area. There's a lot of rare and endangered species and in terms of forest and the rich and valued products -- ecological products. That's a great asset and a very valuable natural resource and -- that is also endangered by this site -- this close proximity. (**0001-11-2** [Naegeli, Wolf])

Comment: We live in a temperate rainforest. This is an especially rare kind of area. And it seems to me that we would want to preserve that, that temperate rainforest. It is one of the few in the world. And the biodiversity here of our species is very, very rare, indeed, and we need to take responsibility to protect it, another reason perhaps that this site is not suitable. (**0002-2-5** [Kurtz, Sandy])

Comment: Then, we can talk about the climate change impacts, and I am hoping that in this scoping, do you include that and address the loss of forest, soil disturbance, and ...the biodiversity, indeed, of the forest itself. (**0002-2-6** [Kurtz, Sandy])

Response: *The staff will discuss potential impacts on terrestrial resources from construction and operation of the proposed project, including forests and other natural habitats and threatened and endangered species and critical habitats, in Sections 4.3 and 5.3 of the EIS, respectively. The staff will address cumulative impacts on terrestrial resources surrounding the project area, including on the Oak Ridge Reservation, in Section 7.3 of the EIS. Appendix L of the EIS will discuss the effect of climate change on the evaluation of environmental impacts.*

Comment: So, this Clinch River Site has two advantages by being there at Oak Ridge National Laboratory because ORNL's Environmental Sciences Division has done extensive long-term research on the environment very close to this site and has just many papers and species list, and information about this area.

Also, for the past three years the National Ecological Observatory Network, or NEON, project of Battelle has been doing a lot of ecological/environmental research on many different aspects. And it is within the same area. All this environmental data is provided as a public service. So, these may be two resources that we have here. (**0002-3-1** [Cumberland, Margaret])

Response: *The staff agrees that the Oak Ridge National Laboratory and the National Ecological Observatory Network are beneficial sources of information that may be used, among others, to describe and characterize in the EIS those ecological resources that may be affected by the proposed action or alternatives.*

Comment: The [U.S. Fish and Wildlife] Service [FWS] has reviewed recent and historical endangered species collection records within the locality of the proposed project site. Records indicate that several federally listed terrestrial and aquatic species occur within the vicinity of the site identified by NRC/TVA. Due to the presence of these species within the proposed project vicinity, we request that NRC, or a designated representative thereof, work closely with the Service when addressing threatened and endangered species within the action area to ensure that the appropriate species and federally designated critical habitats are included in an assessment. While we realize that TVA has extensive records for federally listed and at-risk species in its Natural Heritage Database, we also suggest that NRC utilize the U.S. Fish and Wildlife Service Information for Planning and Conservation (IPaC) system located at: https://ecos.fws.gov/ipac/, in addition to TVA's Natural Heritage Database, to obtain the most comprehensive species information. The proposed action area can be input into IPaC and a current species list, appropriate for the proposed project, will immediately be produced. (**0003-1** [Boles, Dustin])

Comment: Furthermore, the Service [FWS] recommends the development of a Biological Assessment, as required by 50 CFR 402.12, which would analyze the potential effects of the action on listed and proposed species and designated and proposed critical habitat. The Biological Assessment will identify whether any such species or habitat are likely to be adversely affected by the action and is used in determining whether formal consultation or a conference is necessary. When evaluating potential impacts to species, both direct and indirect impacts should be considered. (**0003-2** [Boles, Dustin])

Comment: Additionally, we [FWS] recommend that NRC address and include known locations of wetlands during their analysis with determinations of potential future effects to the resource. (**0003-3** [Boles, Dustin])

Comment: We [FWS] also request that NRC coordinate frequently and early with the Service regarding the proposed action to remain in compliance with Section 7 of the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq*.). Additionally, the Service request that NRC coordinate in regards to any potential survey efforts for threatened and endangered species. (**0003-4** [Boles, Dustin])

Comment: We [FWS] further recommend that NRC address and include known locations of migratory birds, afforded certain levels of protection under the Migratory Bird Treaty Act of 1918 (16 U.S.C., Chapter 7, Subchapter II), and determine potential future effects to these resources. In addition, we request that NRC determine the potential for presence and effects to the bald eagle (*Haliaeetus leucocephalus*) in the action area. This species is currently afforded certain levels of protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c), enacted in 1940, and the MBTA. (**0003-5** [Boles, Dustin])

Comment: NRC should also identify hibernacula utilized by at-risk or federally listed bat species in the vicinity of the action area and determine if the proposed action could affect any individuals. (**0003-6** [Boles, Dustin])

Comment: As NRC proceeds with its analysis, we [FWS] will provide additional comments specific to the action. We can also provide a comprehensive list of species which we feel could be affected by the proposed action at a later date, upon request (**0003-7** [Boles, Dustin])

Comment: We have included a species list as an enclosure to this letter [see ML17205A341 for the tables], which identifies a list of species that may occur near the identified action areas. The Service recommends that you evaluate the proposed project for potential direction and indirect impacts to these listed species or their habitats in compliance with Section 7 of the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq*.). While evaluating potential impacts to these species, please also consider modification of any associated critical habitat for listed species.

While the project proponent is not required to consult on petitioned species, Section 7(a)(4) of the Endangered Species Act of 1973 does provide a mechanism for identifying and resolving potential conflicts between a proposed action and a proposed species during the early planning stages. Therefore, we take this opportunity to recommend that you consider impacts to the hellbender (*Cryptobranchus alleganiensis*), petitioned for listing in FY18. There are historic records of this species occurring near the proposed site of the CRN. Additionally, there are records of the Berry Cave salamander (*Gyrinophilus gulolineatus*), which is petitioned for listing in FY19.

The Service recommends that you coordinate with the Tennessee Wildlife Resource Agency and Tennessee Department of Environment and Conservation’s Natural Heritage Program to address concerns regarding state listed species.

Response: *The NRC staff appreciates the U.S. Fish and Wildlife Service's request to work cooperatively on the Endangered Species Act (ESA) consultation for the proposed project. The staff will coordinate with the U.S. Fish and Wildlife Service on the Endangered Species Act (ESA) consultation for the proposed project and in its development of a Biological Assessment* *to ensure that it properly addresses all potentially affected listed and proposed species (and designated critical habitat), as well as habitats used by such species (e.g., hibernacula), and will also coordinate with other state agencies as suggested. The staff will summarize relevant information from the ESA consultation and will include it in Sections 2.4, 4.3, and 5.3 of the EIS. The staff will similarly include evaluations of migratory birds, including the bald eagle, and wetlands in the EIS.*

D.2.9 Comments Concerning Ecology – Aquatic

Comment: And further on, really, the Tennessee River ecology, it's already temperature stressed by the climate change -- the more extreme southern temperatures that we've been experiencing at longer duration of them in the past two decades. So -- and even before Watts Bar 2 came online, TVA had several times instructed their nuclear power plants to refrain from really stressing the ecology of the river more. And so I think it's really a stupid idea to put more nuclear plants upstream (**0001-11-3** [Naegeli, Wolf])

Comment: The effect of the reactors on the river need -- I'm sure will be studied carefully, but I hope it's given serious consideration. The downstream water quality and the aquatic life and the effect really on the water temperature all the way down stream -- because there's been issues by the time it gets to Browns Ferry (**0001-5-11** [Safer, Don])

Comment: And so, the erosion and all the things associated with soil toxics and those kinds of things will eventually get to the river, the Clinch River. And that is not good for aquatic biodiversity .... as it goes downstream. (**0002-2-3** [Kurtz, Sandy])

Response: *Potential impacts on aquatic ecosystems from water quality effects during construction and operation will be discussed in Sections 4.3.2 and 5.3.2. Thermal impacts on aquatic organisms and habitats as a result of plant operations will be discussed in Section 5.3.2 of the EIS. Potential cumulative impacts on aquatic life will be discussed in Section 7.3.*

D.2.10 Comments Concerning Socioeconomics

Comment: Also what needs to be considered in terms of the location is population growth, at least over the next 20 years. And if local climate change goes on as it has, and has done for the last two decades at least, been always at the upper range of what the experts predicted it could be -- the change in temperatures. And so that could lead to a lot more population in this part of Tennessee because a lot of people living further south may find it unbearable and people who are north may find that extreme events which are precipitated by the climate change -- it's not so much the temperature alone that is of concern, it's really that this causes much more extreme conditions -- longer droughts, more floods, more severe storms and extended what used to be natural disasters seem to be taking longer and longer before they settle down anymore. And so that should be considered. There may be a quite populated area and a more -- that have established here in 20 years. (**0001-11-4** [Naegeli, Wolf])

Response: *Potential impacts from the proposed action on socioeconomic factors, such as the regional population, will be discussed in Section 4.4 and 5.4 of the EIS. These sections will include consideration of the demographic impacts for the proposed action. Cumulative socioeconomic impacts will be discussed in Section 7.4 of the EIS.*

Comment: Second of all, several people here have talked about the -- the workforce. I hope you will also take into consideration, Oak Ridge is very rich in nuclear workers. We understand nuclear operations. We understand the rigor and formality required with those kind of operations. We have a governor who supports education in the state. We have a drive-to-55 program. That 55-percent of our adult population certificate or -- or qualified in some field.

Locally we have the University of Tennessee involved with the operations of Oak Ridge National Lab. We have the Pellissippi Community College and Roane State Community College that all work very close with our nuclear providers and actually curtail their -- or -- or custom their -- their curriculum to make sure it matches us so that we have the workforce of the future that we need. And as you look at -- at the amount of time these reactors are going to be online and operating, that is a long time. And it is not just who we have today, it is what we want to also have in the future. (**0001-7-2** [Kohlhorst, Darrel])

***Response**: Potential impacts on socioeconomic factors from construction and operation of the proposed action will be addressed in Sections 4.4 and 5.4 of the EIS. This impact assessment will include consideration of the workforce requirements for the proposed action in conjunction with the regional labor market outlook (e.g., skill sets and availability). Cumulative socioeconomic impacts will be discussed in Section 7.4 of the EIS.*

Comment: Another thing is the -- my -- I live on Dove Ridge and if you look at the aerial photographs of the site, there is a long linear green space of trees that lead that site. And my thinking is well, two reactors. Somebody said they could put 12 in if they need more power line right away, I would think I would know where it was going -- right behind my house on the only long linear forested areas there is leading that site. So those are my concerns. My property value -- if it is built, I know it would go down. Will I be made whole? I'm concerned about that. (**0001-8-2** [Almond, Jake])

***Response:** Potential impacts from the proposed action on socioeconomic factors, such as property values, will be addressed in Sections 4.4 and 5.4 of the EIS. Cumulative socioeconomic impacts will be discussed in Section 7.4 of the EIS.*

D.2.11 Comments Concerning Historic and Cultural Resources

Comment: TDEC concurs with the plan to conduct Phase I/II site evaluation of the property proposed for the TVA CRN Site. This archaeological evaluation will determined if prehistoric and/or historic sites eligible for the National Register of Historic Places (NRHP) are located within the proposed property. If an archaeological site is determined eligible for inclusion on the NRHP, additional archaeological considerations will be necessary for the project to move forward.[13]
[footnote:]
[13] For more information on the Tennessee Division of Archeology please visit https://www.tn.gov/environment/section/arch-archaeology. If there are site specific archaeological questions please contact Jennifer Barnett at (615) 687-4780 or Jennifer.Barnett@tn.gov. (**0043-11** [Abkowitz, Kendra])

Comment: The Cherokee Nation (CN) is in receipt of your correspondence about Clinch River Nuclear Site Early Site Permit Application, and appreciates the opportunity to provide comment upon this project. The CN maintains databases and records of cultural, historic, and pre-historic resources in this area. Our Tribal Historic Preservation Office (THPO) reviewed this project, cross referenced the project's legal description against our information, and found that this Area of Potential Effect (APE) lies within our historic homelands.

In accordance with the National Historic Preservation Act (NHPA) [16 U.S.C. 470 §§ 470-470w6] 1966, undertakings subject to the review process are referred to in S101(d)(6)(A), which clarifies that historic properties may have religious and cultural significance to Indian tribes. Additionally, Section 106 of NHPA requires federal agencies to consider the effects of their action on historic properties (36 CFR Part 800) as does the National Environmental Policy Act (43 U.S.C. 4321 and 4331-35 and 40 CFR 1501.7(a) of 1969).

The CN has a vital interest in protecting its historic and cultural resources. The CN is in concurrence that an Environmental Impact Statement (EIS) in compliance with NHPA should be conducted for the Clinch River Nuclear Site, and is requesting a copy of this report. This office looks forward to receiving and reviewing the EIS. Please contact the CN with response to this request.

Additionally, we would request Department of the Interior conduct appropriate inquiries with other pertinent Tribal and Historic Preservation Offices regarding historic and prehistoric resources not included in the CN databases or records. If items of cultural significance are discovered while developing this project report, the CN asks that activities halt immediately and our offices be contacted for further consultation. (**0016-1** [Toombs, Elizabeth])

Comment: Information on Native American use in the project vicinity shows that prehistoric, ethnographic, historic, and traditional sites of value to the UKB [United Keetoowah Band] surround the project area. We recommend that a cultural resources inventory be completed prior to project implementation. (**0061-1** [Pritchett, Karen])

Response: *Potential impacts on historic and cultural resources will be discussed in Chapters 4, 5, and 7, based on the affected environment described in Chapter 2. The NRC will also fulfill its responsibilities under Section 106 of the National Historic Preservation Act (54 U.S.C. § 306108-TN4839) with regard to historic properties for the project. The results of the Section 106 review will also be presented in the EIS. Copies of the EIS will be sent to Tribal consulting parties (including Tribal Historic Preservation Officers [THPOs]), the Tennessee Historical Commission, and the Advisory Council on Historic Preservation for their review and comment in accordance with NHPA consultation requirements.*

Comment: Thank you for the correspondence regarding the above referenced project. This project lies outside of our area of historic interest. Therefore, the Choctaw Nation of Oklahoma respectfully defers to the other Tribes that have been contacted. If you have any questions, please contact me by email. (**0032-1** [Rangle, Daniel])

Response: *The NRC will remove the Choctaw Nation from the CRN ESP EIS mailing list. The NRC will continue to consult with other Tribes contacted for the proposed project under Section 106 of the National Historic Preservation Act (54 U.S.C. § 306108-TN4839).*

D.2.12 Comments Concerning Meteorology and Air Quality

Comment: When you are talking about climate change, you are talking catastrophic weather events that need to be followed up. (**0002-2-8** [Kurtz, Sandy])

Response: *Potential impacts on meteorology and air quality from construction and operation of the CNR Site will be discussed in Sections 4.7 and 5.7 of the EIS. Cumulative impacts will be discussed in Section 7.6. Climate change will be discussed in Appendix L.*

Comment: The site may have air contaminant emissions from other onsite air emission sources that are required to have an air contaminant permit from the Division of Air Pollution Control. TDEC recommends that appropriate entities involved in the project review potentially applicable air permits as well as work with the Division of Air Pollution Control to ensure all emission sources are properly identified and permitted.[12]
[footnote:]
[12] For more information on TDEC Air Pollution Control permits please visit https://www.tn.gov/environment/topic/permit-air. (**0043-10** [Abkowitz, Kendra])

Comment: Water cooling tower emissions are evaluated for permitting and have been permitted at other existing TVA nuclear plants. The water vapor itself is not a regulated emission, however the resultant particulates that arise from evaporation (minerals found in the local river water or streams) are considered to be potential emissions as are any algaecide or slime mold/fungus treatments added to the water to act as a biocide. (**0043-8** [Abkowitz, Kendra])

Response: *The EIS addresses emission from the construction and operation of the proposed facility, as well as the cumulative impacts from existing sources. These comments refer to permits the applicant should apply for prior to operation of the CRN Site. The action before the NRC is an ESP to determine whether the CRN Site is suitable for placement of one or more SMRs. An ESP, if granted, does not authorize construction, and the applicant must obtain a construction permit or a combined license from the NRC prior to building at the site. Any new and significant information regarding emissions will be addressed at that time with another NRC NEPA review. It is at that stage in the project that the applicant is likely to consider taking steps to apply for air contaminant emission permits from the state.*

Comment: Should any land clearing activities or disposal of brush or trees/tree limbs occur, TDEC prefers that wood waste be disposed of by chipping, grinding, or composting rather than open burning. However, if open burning does occur during site preparation and construction, open burning regulations should be followed. TDEC recommends that detailed clearing activities, total amount of areas where soils are to be disturbed, and associated impacts be addressed in the draft EIS.[11]
[footnote:]
[11] TDEC APC Rule 1200-3-4-.01 *et seq*., http://sos.tn.gov/effective-rules. Additional information on open burning in Tennessee is available at https://tn.gov/environment/article/apc-open-burning and http://www.burnsafetn.org/. (**0043-7** [Abkowitz, Kendra])

Response: *Environmental impacts associated with the construction of the CRN Site will be addressed in Chapter 4 of the EIS. The building-related air emissions and related impacts on air quality, as well as the emissions from any open burning of vegetation, will be addressed.*

D.2.13 Comments Concerning Health – Nonradiological

Comment: I am a neighbor to the site. I can -- from my house on my porch you can see this site. You can see the buildings that are out there already. I've always not wanted to be NIMBY about my backyard but I guess if I had to vote, I'd prefer it not be there. But my concerns are the noise. It -- how much noise this plant would make not only in the -- when it's running but in the building of it. When we moved there I had my family with me on my property, and I said can you guys hear that? And they said Dad, I don't hear anything. What are you talking about? I said that's it, I don't hear anything but the birds. So I am concerned about the noise. I'm concerned -- I -- when this thing first got announced I tried to get in touch with Lamar Alexander. He never returned my calls. But somebody finally did and I asked if there would be a cooling tower on this site, and they said yes. Talking to folks today, they don't know. But the cooling tower would be looming in my -- from my porch. And I don't think that will help the property values. (**0001-8-1** [Almond, Jake])

Comment: Cooling towers are also associated with certain other potential pathogenic airborne illnesses including Legionnaire's disease and some amoebae considered harmful. (**0043-9** Abkowitz, Kendra])

Response: *Potential impacts from nonradiological health factors, such as noise and etiological agents associated with cooling towers, due to construction and operation of the CRN Site, will be addressed in EIS Sections 4.8 and 5.8. Cumulative impacts from nonradiological health factors will be discussed in Section 7.7.*

D.2.14 Comments Concerning Health – Radiological

Comment: [I would remind the audience and the NRC that the mandate should properly be put on whether or not the site can be suitably host to a nuclear reactor design. So in this sense then I think it's perfectly appropriate to consider things like] ... radiological safety. (**0001-10-3** [Skutnik, Steve])

Comment: And there is also much associated illness, cancers and such, both in children and with workers, employees, in the nuclear site. So, that would be, I think, that people, that scoping should address. (**0002-2-12** [Kurtz, Sandy])

Comment: What impact does radiation have on the soil, the air, and the water, and noise? Those are things that should be considered, it seems to me, in scoping. (**0002-2-13** [Kurtz, Sandy])

Comment: As a public health professional, I am worried about keeping these highly toxic [radioactive] materials out of the air and water for generations to come. (**0014-3** [Holt, Cathy])

Response: *Potential impacts on human health from radiological factors due to the construction and operation of the CRN Site, such as radiological safety for workers, illness, and radiation levels, will be addressed in EIS Sections 4.7 and 5.9. Cumulative impacts on human health from radiological factors will be addressed in Section 7.8.*

Comment: Just remember the background of that is that, right now, because of the development of nuclear weapons here, you really have about a million tons of low-level radioactive waste already in this area.

And the Canadians have been given permission to bring in 10,000 more metric tons from Canada, with no permit or anything required. And they've said in their application that, while they have to have an export permit, in fact, they are not sending anything back.

So, you folks are going to be host to another 10,000 tons of low-level radioactive waste. And it is sort of a question about how much cumulative radioactive you want.

You are also storing a lot of high-level enriched uranium. Because, don't forget, when the Soviet Union collapsed, there was a deal made to bring as much of that away and keep it safely until it could be turned into fuel for reactors. So, you've already got yours. (**0002-4-8** [Paddock, Brian])

Comment: My Ph.D. research back in the mid-1960's involved radionuclide fallout in two Piedmont Georgia ecosystems, granitic outcrops and adjacent woodlands. In my study, I analyzed the radioisotope fallout from nuclear weapons testing taking place in our West and Russia. The project sampled 9 radioisotopes using scintillation counting for gamma emissions from these elements, particular Cs-127 and Mn-54. My results demonstrated the presence of these radioisotopes in all parts of three tree species, Juniperus virginiana, Pinus taeda, and Quercus georgiana. I also tested the presence of radionuclides in the soils of these trees. I found that those trees at the lower edges of rock outcrops accumulate more radionuclides than high on the outcrop and adjacent woodlands. Thus I am concerned with any potential release of radionuclides into our atmosphere and aquatic ecosystems.

This brings me to the point that development of additional sources of release or potential release will result in bioaccumulation of dangerous radionuclides. This is certainly a problem that can occur in the Clinch River watershed. It could also affect a broad area downwind of the proposed Small Modular Reactors on the Clinch. (**0015-1** [Pittillo, Dan])

Response: *A baseline preoperational radiological environmental monitoring program will be addressed in Section 2.11 of the EIS. Exposure pathways used to assess dose to construction workers is described in EIS Sections 4.9.1, 4.9.2 and 4.9.3. Exposure pathways used to assess dose to the public and biota other than humans are discussed in EIS Sections 5.9.1 and 5.9.5. Potential cumulative impacts of the radiological impacts of normal operations will be addressed in EIS Section 7.8.*

Comment: One thing, when you have that documentation in the Oak Ridge Library, you should also have I can recommend a copy of the previous settlement. There was an environmental statement I don't know how many decades ago for Clinch River. That would be useful to compare it to in terms of the subtleties that go to the safety assessment. I don't know what goes into the departmental [environmental] impact statements, but, you know, some things, if you are looking at potential radiological releases, you should look at things like weather. (**0002-6-1** [Martin, Rodger])

Response: *The staff agrees that the Final Environmental Statement related to the Construction and Operation of the Clinch River Breeder Reactor Plant, dated February1977 (NRC 1977-TN5083), may be a useful document to support this review. Radiological impacts from construction and operation of the CRN Site will be addressed in EIS Sections 4.7 and 5.9, while cumulative impacts will be discussed in Section 7.8.*

D.2.15 Comments Concerning Nonradiological Waste

Comment: According to the TVA CRN ESP Application Part 3 - Environmental Report, the CRN Site SMR is expected to be a Small Quantity Generator (SQG) of Hazardous Waste and will also construct and operate an on-site landfill[9] for construction/demolition wastes. Any nonradioactive hazardous and nonhazardous wastes associated with the construction, operation, and decommissioning of the CRN facility as well as construction of an on-site landfill must be handled in accordance the state's Solid and Hazardous Waste Rules and Regulations.[10] Furthermore, mixed wastes (e.g. containing low-level radioactive waste) with a hazardous component must be handled in accordance with the NRC requirements but also with the aforementioned Rules and Regulations. TDEC recommends that waste management considerations as specifically regulated by the Rules and Regulations of the state of Tennessee be incorporated in the forthcoming NRC EIS.
[footnotes:]

[9] If TVA wishes to construct and operate a solid waste disposal facility (i.e., construction/demolition landfill) at the CRN Site they will be required to obtain a landfill permit from the TDEC Division of Solid Waste Management. Information about the permitting process and required application materials can be found at http://www.tn.gov/environment/article/permit-waste-landfill-permit.
[10] Reference TDEC SWM Rule 0400 Chapter 11 for Solid Waste and Chapter 12 for Hazardous Waste http://sos.tn.gov/effective-rules. (**0043-5** [Abkowitz, Kendra])

Comment: Sections 3.6 and 5.5 of the Environmental Report describe the various hazardous and nonhazardous waste streams that are expected to be generated as well as their impacts and procedures for management (e.g. Spill/Discharge Response Program, TVA-approved vendors for transport and disposal, a Waste Minimization Plan). While this information is informative, TDEC recommends further discussion of specific hazardous and mixed waste management and monitoring practices, treatment methods, and storage areas for attaining compliance with the state and limiting adverse environmental impacts and irreversible environmental commitments during construction and operation of the facility and its offsite rail, barge terminal, and underground transmission line improvement projects in the forthcoming NRC EIS. (**0043-6** [Abkowitz, Kendra])

Response: *Nonradiological waste impacts due to the construction and operation of the CRN Site will be addressed in Sections 4.10 and 5.10 of the EIS. Cumulative impacts will be addressed in Section 7.9. Permits and authorizations for the CRN Site will be addressed in Appendix H.*

D.2.16 Comments Concerning Accidents – Severe

Comment: Contention 2 challenges TVA's failure to address the environmental impacts of accidents involving ignition of spent fuel in the spent fuel storage pool(s) at the proposed SMR. There is no question that the consequences of such accidents could be catastrophic, but TVA has failed to show or even assert that the likelihood of such an accident is remote and speculative. Therefore, the Environmental Report violates the National Environmental Policy Act ("NEPA") by failing to address the environmental impacts of a spent fuel storage pool fire. The NRC Staff should ensure that this deficiency is corrected in the EIS for the proposed Clinch River Site ESP. (**0052-1** [Curran, Diane])

Comment: Contention 1 raises safety issues under NRC regulations for the implementation of the Atomic Energy Act. (**0052-3** [Curran, Diane])

Comment: Contention 1 challenges TVA's application for an exemption from NRC's emergency planning requirements with respect to the establishment of ten-mile emergency planning zone ("EPZ"). As demonstrated in the contention, TVA has failed to justify its proposal to reduce the size of the EPZ to the site boundary, or in the alternative a two mile radius. (**0052-4** [Curran, Diane])

Comment: Contention 2 challenges TVA's failure to address the environmental impacts of accidents involving ignition of spent fuel in the spent fuel storage pool(s) at the proposed SMR. There is no question that the consequences of such accidents could be catastrophic, but TVA has failed to show or even assert that the likelihood of such an accident is remote and speculative. Therefore, the Environmental Report violates NEPA by failing to address the environmental impacts of a spent fuel storage pool fire. (**0052-5** [Curran, Diane])

Comment:

Contention 1: Inadequate Emergency Plan

1. Statement of the Contention: The Emergency Plan in the ESP application for the Clinch River SMR is inadequate to satisfy 10 C.F.R. §52. I 7(b)(2) because the size of the proposed plume exposure Emergency Planning Zone ("EPZ") is less than the minimum ten-mile radius required by 10 C.F.R. §50.47(c)(2) for most nuclear power reactors. While TVA claims to qualify for an exemption from 10 C.F.R. §50.47(c)(2) "due to the decreased potential consequences associated with such a facility" (ESP Application, Part 6 at 1), TVA has not demonstrated that it satisfies the NRC Staffs criterion for such an exemption with respect to the potential for a spent fuel storage pool fire. As provided in an NRC guidance document that has been consistently applied to exemption applications, the Staff will not approve an exemption to offsite emergency planning requirements unless the applicant can demonstrate that the time between uncovering of spent fuel and initiation of a zirconium fire in the spent fuel storage pool is ten hours or more. Preliminary Draft, Regulatory Improvements for Power Reactors Transitioning to Decommissioning at A-1 (RIN # 3150-AJ59, NRC Docket# NRC-2015-0070, 2015) ("Draft Guidance for Decommissioning Reactors") (NRC ADAMS Accession No. ML16309A332). [1]

Therefore, for consistency with this principle, in order for TVA to qualify for an exemption from the ten-mile EPZ, TVA should have to demonstrate for the spent fuel storage pool(s) to be located at the proposed site that in the event of a loss of cooling and adiabatic heating conditions (i.e., conditions in which a range of factors may prevent heat from leaving individual fuel assemblies or spent fuel racks), at least ten hours would elapse before a zirconium fire would be initiated. Such an analysis would depend on fuel design features, as well as operational factors that are not specified in the ESP application. If this information is not available or not sufficiently well-defined to enable a technically sound analysis that could plausibly demonstrate the condition is met with adequate margin, TVA's exemption request should be rejected without prejudice and TVA should be advised to re-submit it at the COL stage.

[footnote:]

[1] In reliance on the Draft Guidance for Decommissioning Reactors, the NRC has issued exemptions from emergency planning requirements for numerous reactors, including Kewaunee, Crystal River, San Onofre, and Vermont Yankee. See Memorandum from Stephen S. Koenick to William M. Dean re: Transition to Decommissioning Lessons Learned Report (Oct. 28, 2016) (ADAMS Accession No. ML16176A339). (**0052-7** [Curran, Diane])

Comment: 2. Brief Summary of Basis for the Contention: While detailed emergency plans are not required for ESP applications, NRC regulation 10 C.F .R. § 52.17(b)(2) provides ESP applicants with the option to submit emergency plans for approval by the NRC. As part of its ESP, TVA has submitted two alternative emergency plans -one with an EPZ that conforms to the site boundary (Part 5A of the ESP application) and the other with a two-mile EPZ (Part B of the ESP application). Part 6 of TVA's ESP application consists of a request for an exemption from the ten-mile EPZ requirement in 10 C.F.R. §§ 50.33(g), 50.47(b), and 50.47(c)(2).

As demonstrated in Draft Guidance for Decommissioning Reactors, the NRC considers pool fires to constitute contributors to the accident risk that must be protected against through the emergency planning process. Id. at A-1. In Part 6, entitled "Exemptions and Departures," TVA asserts that an EPZ extending beyond the site boundary (or, alternatively, a two-mile radius) is not necessary to achieve the purpose of NRC's emergency planning regulations because "there are no offsite consequences from any credible event in excess of the [U.S. Environmental

Protection Agency Protective Action Guidelines]." Id., Table 1-1. But TVA completely fails to discuss any SMR design features that would decrease the potential for spent fuel pool fires to result in significant off-site radiological releases.

The Draft Guidance for Decommissioning Reactors advocates the allowance of relaxation of the ten-mile EPZ requirement for decommissioning reactors on the ground that after a reactor has shut down and spent fuel has cooled for a period of years, the time between uncovering of spent fuel and ignition of spent fuel zirconium cladding (assumed to occur when the cladding temperature reaches 900°C) in a spent fuel storage pool increases to at least ten hours. Id. This guidance is based in tum on NUREG-1738, Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants (2001) (ADAMS Accession No. ML13251A342). For operating plants, the NRC has demonstrated that cladding temperatures can reach 900°C (1173 K) in less than 10 hours for certain accident scenarios. NUREG-2161, Consequence Study of a Beyond-Design-Basis Earthquake Affecting the Spent Fuel Pool for a US Mark I Boiling Water Reactor at 132-33 (2014) (ADAMS Accession No. ML13297070) ("Consequence Study").

In the case of an operating SMR or other type of reactor, recently discharged hot spent fuel is loaded periodically into the spent fuel pool. In the case of multiple modules that share one spent fuel pool, like the NuScale SMR design, this could happen as often as every two months or even more frequently, depending on the number of modules and the fuel management strategy. As a result, the time between uncovering of spent fuel and ignition could be significantly less than ten hours.

It is well established that significant radiological consequences of a pool fire could extend beyond the site boundary, and for that matter well beyond a ten-mile EPZ. Consequence Study at 169 (reporting that 4 million people could be displaced out to 500 miles). In the NRC's License Renewal Generic Environmental Impact Statement, the NRC also concluded that the environmental impacts of a pool fire are "comparable to those from the reactor accidents at full power." NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants at 1-28 (2013). The potential for reactor accidents to have significant adverse public health effects within at least a ten-mile radius --including early and latent fatalities --is discussed in NRC's emergency planning guidance documents. See NUREG-0396, Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants (1978) and NUREG-0654/FEMA-REP-I, Rev. 1, Criteria for Protective Action Recommendations for Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants (1980). Thus, before an exemption from the ten-mile EPZ requirement in NRC's emergency planning regulations may be approved, TVA should be required to demonstrate that the time between uncovering of spent fuel and ignition of spent fuel is comparable to a spent fuel pool at a decommissioning reactor, i.e., greater than ten hours.

The information provided by TVA should be sufficiently detailed to allow the NRC Staff, the parties and the Atomic Safety and Licensing Board ("ASLB") to independently verify TVA's representations. It appears doubtful that TVA will be able to supply the NRC with that information, given that (a) TVA has not yet chosen a design for the proposed SMR, (b) only one design (NuScale) has been submitted to the NRC, and (c) even the NuScale design has not been reviewed or approved by the NRC, and is still in the early stages of review. If that is the case, the NRC should reject TVA's exemption application without prejudice, and allow it to be resubmitted at the COL stage.

3. Demonstration that the Contention is Within the Scope of the Proceeding: This contention is within the scope of this ESP proceeding because it raises an issue of compliance with NRC safety regulations for issuance of an ESP.

4. Demonstration that the Contention is Material to the Findings NRC Must Make to issue an ESP for the proposed TVA SMR: The contention is material to the findings that NRC must make in order to issue an ESP for the proposed TVA SMR because it seeks to ensure that TVA fulfills NRC's emergency planning regulations with respect to the size of the EPZ. (**0052-8** [Curran, Diane])

Comment:

Contention 2: Failure to Address Consequences of Pool Fires

1. Statement of the Contention: The Environmental Report fails to satisfy NEPA because it does not address the consequences of a fire in the spent fuel storage pool, nor does it demonstrate that a pool fire is remote and speculative.

2. Brief Summary of Basis for the Contention: The consequences of spent fuel pool fires must be considered in any environmental analysis of the impacts of reactor operation, because the NRC has not ruled out their likelihood as remote and speculative. State of New York v. NRC, 681F.3d471, 483 (D.C. Cir. 2012). See also NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants at 1-28 (2013) ("License Renewal GEIS") (concluding the environmental impacts of pool fires are "comparable to those from the reactor accidents at full power."). TVA claims that the design of the spent fuel storage pool(s) for the proposed SMR has "spent fuel pool cooling without the need for active heat removal." Environmental Report at 9.3-2. But the Environmental Report does not state that the cooling system renders pool fires remote and speculative.

As discussed in Contention 1, it is well established that the radiological consequences of a pool fire are potentially catastrophic. For instance, radioactive fallout from a pool fire could displace as many as 4 million people out to 500 miles. Consequence Study at 169. The potential for reactor accidents to have significant adverse public health effects within at least a ten-mile radius --including early and latent fatalities --is also discussed in NRC's emergency planning guidance documents. See NUREG-0396, NUREG-0654. In the License Renewal GEIS, the NRC also concluded that the environmental impacts of a pool fire are "comparable to those from the reactor accidents at full power." Id. at 1-28 (2013).

Therefore, in the absence of a documented and supported assertion that the potential for a pool fire is remote and speculative, TVA must address the consequences of a pool fire in its Environmental Report.

3. Demonstration that the Contention is Within the Scope of the Proceeding: This contention is within the scope of this ESP proceeding because it seeks consideration of the consequences of a type of severe accident that NRC views as reasonably foreseeable and therefore must address in the EIS for the proposed ESP.

4. Demonstration that the Contention is Material to the Findings NRC Must Make to issue an ESP for the proposed TVA SMR: The contention is material to the findings that NRC must make in order to issue an ESP for the proposed TVA SMR because it relates to the question of whether TVA has addressed all reasonably foreseeable impacts of operating an SMR in its

Environmental Report, as required by NEPA. State of New York, 681 F.3d at 483. (**0052-9** [Curran, Diane])

Response: *The commenter's scoping comments were submitted to the NRC as part of a separate hearing process. Please refer to ML17188A445 for the NRC staff's response to the comments.*

Comment: The EIS should go in detail with beyond design basis accidents. That's major accidents where loss of coolant creates situations where massive amounts of radiation can be released. The industry is wanting to say that these -- that can never happen. That was said back in the '70s and '80s. I was there -- a critic then. And they said you could never have a major loss of coolant accident and a major release of radiation. That was before Fukushima, of course, and Fukushima proved that to be tragically wrong. And it almost happened at Three Mile Island, but that containment held for the most part. Although people that live there say -- many people have stories of -- of tragedies after Three Mile Island because of radiation exposure. So usually these environmental impact statements do not go into the details about the beyond-design basis accident because they wouldn't build them if they really went into those details. But I think it's a -- a travesty that these things aren't considered -- those types of accidents. It's my understanding that the EIS is going to go into the problems. If you have one of these reactors goes bad, well, the NuScale design, which is the only one that is on the books now as being considered, can have up to 12 50-megawatt reactors. And in the same pool with the spent fuel, all of that underground in a pool of water. If you start having one reactor go seriously bad -- and you know, the industry will say, well, these are going to have passive design where you can't have a -- a major meltdown, blah, blah, blah. Well, that was told us 30 years ago, 40 years ago when the GE Mark 1s, on the -- on the ice condenser designs. This is all theoretical and the industry try and put their best face on it, but we need -- we've learned, I hope, with nuclear energy we have to be prepared for the worst consequences because they can happen even if they are unthinkable, they are happening now. Fukushima is still happening now. So the effects of multiple cascading reactor failures and spent fuel burning due to the emptying of that pool need to be considered in the environmental impact statement. (**0001-5-7** [Safer, Don])

Comment: And I don't know what goes into a radiological release under accident conditions when they do the site assessment. That would be good to look at..... One newspaper report indicated that the Fukushima accident could never happen; that scenario could never happen. So, we need to be practical. I'm not afraid of any of this stuff. I'm a nuclear engineer. But sometimes we don't always look at things we should. (**0002-6-5** [Martin, Rodger])

Response: *EIS Chapter 5 will include an evaluation of the risks associated with potential severe accidents. The evaluation will also include estimates of health and economic risk to a distance of 50 miles from exposure to the plume and from exposure to contaminated land and water.*

D.2.17 Comments Concerning the Uranium Fuel Cycle

Comment: The spent fuel -- the impact of long-term storage needs to be considered in the EIS. The failure of the planning -- the zirconium planning is being studied right now in Oak Ridge, just now, for high burnup fuel. It's never been studied before. What's been studied is the low burnup fuel. That's not what we're dealing with in this industry anymore. The burnup of -- of -- the -- I don't know how they can know this, because they don't know the reactors of design, but in the -- the documents there was a talk of somewhere around 40 to 50 gigawatt days per metric ton.

The -- the crazy number they have for burnup, but -- measure for burnup. But the high burnup fuel and the storage of that needs to be taken into account, and the possible impacts of that fuel breaking containment through either the failure of the cladding, the failure of the pool, the failure of the canisters over time -- the canisters are just thin-walled, half-inch stainless steel. And there's been some indications recently that they are not -- they may not last as long as any of us wants to -- think that they're going to last. That needs to be put into the environmental impact statement. (**0001-5-10** [Safer, Don])

Comment: And just like existing nuclear power plants, they produce long-lived, highly radioactive nuclear waste for which no safe management and permanent storage exists. (**0005-3** [McBride, Geoff] [McBride, Linda] [Sprignoli, Damon] [Turk, Lawrence "Butch"]) (**0005-7** [McBride, Geoff] [McBride, Linda] [Sprignoli, Damon] [Turk, Lawrence "Butch"])

Comment: They are expensive. They generate high-level waste which we do not know what to do with in the US. (**0006-2** [Sutlock, Dot])

Comment: It [nuclear power] also produces highly radioactive nuclear waste. SMRs need disposal sites to contain this highly radioactive waste, but there is no safe management and no safe permanent storage for this waste. (**0007-3** [McFadden, Nancy])

Comment: I am concerned about not only the cost, but mainly the long-lived radioactive nuclear waste, which there is no known way to store safely. (**0014-2** [Holt, Cathy])

Comment: Also, I understand that this site will employ small modular reactors SMR). There are no well tested and proven designs for SMR's. SMRs produce extremely toxic, highly radioactive and long-lived nuclear waste for which no safe, long term management exists. SMRs could greatly complicate the disposal of nuclear waste. The use of SMRs would increase the number of designated locations for radioactive nuclear waste in the world, making it harder to control, track and manage. (**0021-4** [Harland, Donald])

Comment: A reactor that produces long-lived and highly radioactive nuclear waste that threatens its down-wind neighbors....is just not wise. (**0025-2** [Kirkman, Arden])

Comment: I do not live near the site or own property near the site, but I have worked intermittently on problems with radioactive waste management and groundwater monitoring in the Oak Ridge area for many years. My first concern comes both from my involvement with attempts to resolve a number of issues with on-site management of low level radioactive waste in Oak Ridge and an awareness of the difficulties encountered in attempts made to date to manage transuranic waste, high level radioactive waste, and spent nuclear fuel. There have been decades of work toward establishing an adequate disposal facility for high level radioactive waste and spent nuclear fuel in the United States, yet little progress has been made toward consensus of how and where this material can be safely disposed for the duration of the hazard. Until some significant steps toward resolution of the waste disposal issues have been made, expansion of nuclear power seems unwise. (**0031-1** [Jones, Sid])

Comment: We do not need to be using money for a risky venture into unproven nuclear power when we have no way to safely dispose of the waste which will remain dangerous for thousands of years. We do not need to pollute the plane[t] and endanger ourselves and future generations. (**0048-1** [Hyche, Kenneth])

Response: *These comments are concerned with continued storage and long-term disposal of high-level waste. While a repository for final disposal of spent nuclear fuel has yet to be constructed, the Commission has, through rulemaking, considered the environmental impacts of spent fuel disposal in light of the current national policy regarding spent fuel. As directed by 10 CFR 51.23(b) (TN250), the impacts assessed in NUREG-2157 (NRC 2014-TN4117) are deemed incorporated into this EIS in Section 6.1.6. Section 6.1.6 also explains that current national policy mandates that high-level and transuranic wastes are to be buried at deep geologic repositories and that no release to the environment is expected to be associated with deep geologic disposal.*

Comment: A major issue with nuclear facilities is the disposal of radioactive waste products. NRC may want to consider an economic feasibility comparison study for vitrification of waste products verses current storage and disposal practices as part of the EIS. (**0026-3** [Long, Larry])

Response: *An economic feasibility comparison study for vitrification of waste products versus current storage and disposal practices is outside the scope of this EIS, and this comment does not provide specific information related to the environmental effects of the proposed action.*

D.2.18 Comments Concerning the Need for Power

Comment: TVA's 2015 Integrated Resource Plan for a 20-year long term energy plan that the Southern Alliance for Clean Energy is closely working on showed that the utility did not succeed any new base load generation beyond Watts Bar 2, and possible -- and the possible extended power up rate at the three Browns Ferry Reactors. TVA did not include a need for power analysis that is typically part of the environmental report in the ESP application. We are concerned that was not included because it has been based on the outcome of the 2015 IRP, TVA would not be able to demonstrate to the NRC a need for SMRs even 20 years from now. Why spend tens of millions of dollars on a licensing process for something that is not even needed? The NRC needs to conduct a full need-for-power analysis for this draft EIS, not punt the essential review to the combined operating license stage. The NRC must not hide behind the purported need as stated in TVA's ESP application to provide secure power to the DOE facilities such as Oak Ridge National Lab. TVA repair money is being wasted on something that is not needed. (**0001-4-3** [Powell, Michelle])

Comment: The -- I second what's been said about having a need for power. That really needs to be considered now. It's -- it's -- inexcusable to push that -- to spend the $70 million of taxpayer money and TVA money when the power -- the technology -- TVA will not build the power. And with the renewables coming online, it's likely they will never need power from these SMRs. (**0001-5-6** [Safer, Don])

Comment: AND they are not needed. We are not facing any energy shortage and if we continue to make progress in conservation and clean, renewable energy, there is no reason to expect that we will be.

This is a dangerous, expensive, wasteful boondoggle, using tax payer money to profit the companies that manufacture these reactors and allowing them to test an experimental product at our expense and risk. (**0051-12** [Anthony, Kate])(**0051-6** [Anthony, Kate])

Response: *The action before NRC is the issuance of an ESP to determine whether the CRN Site is environmentally suitable for placement of one or more SMRs. The ESP determination is primarily a siting decision; in accordance with 10 CFR 51.50 (TN250), the applicant's ER need* *not include an assessment of the need for power or of alternative energy sources. In accordance with 10 CFR 51.75 (TN250), the ESP EIS will not include an assessment of the need for power or an evaluation of alternative energy sources because these matters were not addressed in the applicant's ER.*

If TVA were to apply for a construction permit or combined license at some time in the future, the environmental review of that application would include an assessment of the need for power. The review of that application would include the development of another EIS and the opportunity to participate in another hearing.

D.2.19 Comments Concerning Alternatives – No-Action

Comment: I believe that if you are going to bring in considerations of the environmental impact, the NRC should likewise consider the impacts of the alternative sources that would likely be built in the event the site is not built. I would point out that while TVA recently completed Watts Bar Unit 2, the predominant share of TVA's new electricity generation has not been renewables. It has been natural gas.

The TVA in the last 15 years has replaced hundreds of megawatts of coal capacity almost exclusively with natural gas. In that sense, then, I believe the avoided emissions from a nuclear unit should be considered a bounding part of the scope. That this is -- this would inherently result in a -- a net void emissions even with a substantial share of renewable capacity given the requirements for natural gas back up. In as much, I believe, that the early site permit should consider the countervailing environmental effects of pursuing this project. (**0001-10-5** [Skutnik, Steve])

Comment: And finally, perhaps I'm hoping that the scoping will list some alternative uses because there are many other things that that forest --and it is a forested area --could be used for. And probably the best thing would be no action at all because the climate change issues that we need to address, then the forest. But it's hard to see the forestation action that it provides free of charge would be perhaps the best use of all. (**0002-2-14** [Kurtz, Sandy])

Comment: But I want to bring up, a lot of people brought up the issue of a no-action scenario. And I think this is actually really important to go back to this. I agree that the no-action scenario should be considered. I want to present some statistics.

TVA's generating portfolio generation capacity, 2012, was about 34 percent nuclear, 32 percent coal, 9 percent hydro, 11 percent natural gas. Today it is about 37 percent nuclear, 24 percent coal, 20 percent natural gas, 9 percent hydro, 3 percent wind and solar, and 7 percent of what is termed "energy-efficiency".

There is something I want to highlight in these numbers; that while we have a moderate increase in the nuclear generation capacity from the completion of Watts Bar Unit 2, the largest and most substantial growth in TVA's electricity-generating portfolio has not been nuclear energy; it has not been renewables; it has not been hydroelectric power. It is the natural gas.

The no-action scenario inherently will mean, with the growth in electricity demand, this means displacing zero carbon-emitting sources for carbon-emitting sources. There is no way around this. So, therefore, then, a no-action scenario should consider the environmental impacts of likely alternative sources of generation that will be constructed in the absence of this source. (**0002-5-4** [Skutnik, Steve])

Comment: In considering alternatives, the agency must examine the "alternative of no action." 10 C.F.R. §51.104(a). (0052-19 [Curran, Diane])

Response: *The no-action alternative will be evaluated in Section 9.1 of the EIS with respect to the purpose and need as it is defined in Section 1.3 of the EIS. Energy alternatives are not required to be evaluated for an ESP. Because TVA has chosen not to evaluate energy alternatives in its ER, the NRC staff will not evaluate energy alternatives in its EIS. If TVA were to apply for a construction permit or combined license at some time in the future, the environmental review of that application would include an assessment of energy alternatives.*

D.2.20 Comments Concerning Alternatives – Energy

Comment: Contention 3 -Impermissible Discussion of Energy Alternatives and Technical Advantages

1. Statement of Contention: The ESP application violates the National Environmental Policy Act ("NEPA"), 42 U.S.C. § 4321-4370f, and NRC implementing regulations because it contains impermissible language comparing the proposed SMR to other energy alternatives and discussing the economic and technical advantages of the facility. The language is impermissible because TVA has explicitly invoked 10 C.F.R. §5 I.50(b)(2), which excuses it from discussing the economic, technical, or other benefits of the proposed facility such as need for power. See Environmental Report, Chapter 8 (postponing need for power discussion), Environmental Report Section 9.2 (postponing energy alternatives discussion).[2] By formally choosing to exclude consideration of alternatives from its Environmental Report, TVA has effectively precluded Petitioners from submitting contentions on those subjects.

Under the circumstances, TVA must restrict the content of the Environmental Report to the impacts of construction and operation and a limited evaluation of alternatives related solely to the selection of the site. Any language comparing the proposed SMR to other energy alternatives, or purporting to justify the need for the SMR, should be stricken from the Environmental Report.

Furthermore, such language should not be included in the NRC's Environmental Impact Statement ("EIS") for the proposed ESP. Such an EIS would end up becoming an advertisement for SMRs rather than the rigorous, unbiased and independent scientific study required by NEPA. Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 348 (1989); National Audubon Society v. Dep't of Navy, 422 F.3d 174, 185 (4th Cir. 2005); 40C.F.R.§1500. I(b).

In the alternative TVA may elect to address energy alternatives and need for power in the Environmental Report. In that case, fairness requires that Petitioners must be provided a reasonable opportunity to submit contentions on the new alternatives analysis.

Title 10 of the Code of Federal Regulations 51.50(b)(2) does not require a need for power discussion be included in an early site permit application. The need for power discussion is to be included in the combined license application.

See also Environmental Report, Section 9.2, "Energy Alternatives." The "Energy Alternatives" section is a blank page because "[t]his section is not required for an Early Site Permit Application." Id. at 9.2-1.
[footnote:]
[2] See Environmental Report at 8-1 (**0052-10** [Curran, Diane])

Comment: b. Comparison of alternatives in TVA's ESP application

In its ESP application, TVA has chosen not to address the issues of energy alternatives or need for the proposed SMR, and has instead postponed those issues to the Combined Operating Licensing ("COL") stage. See Environmental Report, Chapter 8 (postponing need for power discussion), Environmental Report Section 9.2 (postponing energy alternatives discussion).

Although the first paragraph of the "Purpose and Need" statement (Section 1.1.1) appropriately defines the purpose and need for issuance of the ESP in the limited manner prescribed by NRC regulations (i.e., "to provide for resolution of site safety and environmental issues, which provides stability in the licensing process"), Chapter 1 of the Environmental Report is brimming with claims that SMR technology is preferable to other energy technology on a host of issues, including safety, security, reliability, carbon reduction, water use, and economies of scale. And in Chapter 9, TVA's discussion of the "no action" alternative, TVA laments that all of these asserted advantages of SMRs would be lost if TVA did not receive an ESP.

For instance, TVA promotes "SMR technology" as preferable for serving federal facilities: The SMR technology is designed with inherent enhanced safety and security features. SMR deployment will demonstrate that the technology is capable of incrementally supplying clean, secure, reliable power that is less vulnerable to disruption to facilities owned by federal agencies (e.g., U.S. Department of Energy (DOE), U.S. Department of Defense (DoD), TVA, etc.). Environmental Report at 1-1. TVA asserts that building an SMR "near federal facilities" could provide "enhanced reliability and other benefits, by providing continued operation during a widespread and extended loss of the electrical power grid, meeting reliability needs with clean energy that supports carbon reduction directives." Id. at 1-2. TVA also compares SMRs favorably to coal, to "assist federal facilities with meeting carbon reduction objectives." Id. at 1-3.

To support its claims regarding the special suitability of SMRs to supply electricity to federal facilities, TVA invokes the imprimatur of DOE:

DOE expressed its support to TVA for the development and licensing of SMRs as a means to meet DOE goals of improving the environmental, economic, and energy security outlook for the United States (Reference 1-5). DOE believes that SMR deployment near federal facilities could provide enhanced reliability and other benefits, by providing continued operation during a widespread and extended loss of the electrical power grid, meeting reliability needs with clean energy that supports carbon reduction directives. DOE specifically requested TVA to assess, as a part of the deployment project planning and licensing process, the ability of SMRs to continue to supply electricity to nearby offsite customers during a disruption to offsite power supplies. This includes electricity transmission to those customers in a manner less vulnerable to intentional destructive acts and natural phenomena that could disrupt the power supply.

Environmental Report at 1-2.

TVA also asserts that SMRs have certain benefits in relation to light water reactors ("LWRs"):

SMRs provide the benefits of nuclear-generated power in situations where large nuclear units, with an approximate electrical output exceeding 1000 MWe, are not practical, because of transmission system constraints, limited space or water availability, or constraints on the availability of capital for construction and operation. Environmental Report at 1-l. See also id at 1-4 ("SMRs may provide the benefits of nuclear-generated power in situations where large nuclear units are not practical ...").

Further, TVA claims that an SMR would serve national security needs: Power generated by SMRs could be used for addressing critical energy security issues. Their use on or immediately adjacent to DoD or DOE facilities, using robust transmission (e.g., armored transformers, underground transmission), could address national security needs by providing reliable electric power in the event of a major grid disruption. A more reliable electric power supply could be accomplished by the SMR operation in "power island" mode with robust transmission to critical facilities. In addition, intentional destructive acts (e.g., terrorist attacks) and natural phenomena (e.g., tornadoes, floods, etc.) could disrupt the grid and the ability to restore most generation sources." Id. at 1-2.

In addition, TVA favorably compares the reliability SMRs to renewable energy sources, asserting that SMRS: can provide reliable energy for extended operation. Because nuclear reactors require fuel replenishment less frequently than other power generation sources (coal, gas, wind and solar), SMRs are less vulnerable to interruptions of fuel supply and delivery systems.

TVA could demonstrate this "power islanding" and secure supply concept as part of the [Clinch River] SMR project by utilizing controls, .switching, and transmission capabilities to disconnect the SMR power plant from the electrical grid while maintaining power from the SMR power plant to a specified DOE power need. Such a demonstration would show that SMR technology is capable of supplying reliable power that is less vulnerable to disruption from intentional destructive acts and natural phenomena. Id. at 1-2. Finally, TVA asserts that SMRs are preferable to other reactor designs for their safety features: SMR design features include underground containment and inherent safe-shutdown features, longer station blackout coping time without external intervention, and core and spent fuel pool cooling without the need for active heat removal. These key features advance safety by eliminating several design basis accident scenarios. Development of a security-informed design efficiently provides the same or better protection against the threats large reactors must consider. Physical security is designed into the SMR plant architecture, incorporating lessons learned from significant shifts in security posture since 2001, and the opportunity to build more inherently secure features into the initial design.

In Chapter 7, TVA also compares SMRs favorably to other reactors with respect to accident risks.

In Section 9.1, TVA once again introduces impermissible energy alternative considerations by describing the disadvantages of the "no-action alternative" as the lack of the supposed benefits described above, as well as the failure to create "new jobs" or to realize the "technological and financial benefits to the local, community Tennessee Valley, and the nation that would result from the construction of the fist-of-its-kind SMRs." Id. at 9.1-1-9.1-2. Similarly, TVA includes the same set of inappropriate energy-related alternatives in its discussion of alternative sites in Section 9.3. Id. at 9.3-2-9.3-3. (**0052-13** [Curran, Diane])

Comment: c. TVA's comparisons of SMRs with other technologies are unlawful

TVA's claims regarding the favorable comparison of SMRs with other energy alternatives must be stricken from the Environmental Report, and may not be included in the EIS for the ESP, because TVA has waived the right to make them by choosing not to address energy alternatives or the need for power in the Environmental Report. Id., Chapter 8 and page 9-2. In addition, TVA's claims regarding energy-related alternatives should be stricken in fairness to Petitioners, because Petitioners are precluded from raising issues related to energy alternatives and need for power by virtue of TVA's decision not to formally address those alternatives.

TVA's claims regarding energy alternatives are not only impermissible, but they are unsupported; some are even nonsensical. Thus, to allow them to remain, unchallenged, would reduce the Environmental Report to an advertisement for SMRs, without support or verification, and without providing the context of a comprehensive environmental analysis. For instance:

- The Environmental Report lacks a thorough comparison of SMRs with other energy technologies. TVA makes selective comparisons of SMRs with other energy technologies, but does not provide a comprehensive comparison. For instance, TVA compares SMRs with coal, gas, wind and solar on the factor of reliability. Environmental Report at 1-2. But it does not make a comprehensive analysis that addresses all relevant factors, such as carbon reduction, water use, air and water impacts, generation of waste products, and costs.

- The Environmental Report fails to acknowledge that solar and wind energy sources can meet all the other objectives listed by TVA (carbon reduction, safety, and incremental deployment), and have less deleterious environmental impacts, in particular water use. In fact, the magnitude of impact on water use is listed in Table 3.1-2 of the Environmental Report, which states that: "The expected (and maximum) rate of removal of water from a natural source to replace water losses from closed cooling water system" are "17,078 gpm (expected) [and] 25,608 gpm (maximum)." Assuming that TVA used a reactor capacity of 800 MW, that expected rate translates to 1,281 gallons/MW/hour. That rate of water withdrawal is higher than almost any other form of electricity generation. A combined cycle natural gas plant will be about a factor of four lower.[3] Solar photovoltaics (PV) and wind use negligible amounts of water; PV plants, for example, use about I gallon/MW/hour.

[footnote:]
[3] J. Macknick et al., Operational water consumption and withdrawal factors for electricity generating technologies: a review of existing literature, 7 ENVIRON. RES. LETT. 45802 (2012).
(**0052-14** [Curran, Diane])

Comment: To the extent that the Environmental Report compares SMRs with other energy sources on the factor of reliability, the comparison makes only partial sense. TVA asserts that: "Because nuclear reactors require fuel replenishment less frequently than other power generation sources (coal, gas, wind and solar), SMRs are less vulnerable to interruptions of fuel supply and delivery systems." While the statement is true for coal and gas, it is irrational in the case of wind and solar because they need no fuel replenishment. Renewable sources of power like solar and wind are, therefore, not vulnerable to fuel disruption. Although these are intermittent in nature, that concern can be addressed in a number of ways, in particular by incorporating on-site energy storage technologies.

TVA asserts that SMR technology provides "a way to supply federal mission-critical loads with reliable power from generation and transmission that is less vulnerable to supply disruption from intentional destructive acts and natural phenomenon than typical commercial power generation facilities and transmission systems." Environmental Report at 9.3-1. But TVA lumps generation and transmission together, without justification. Reliance on SMR technology has nothing to do with the security of transmission systems. In addition, TVA fails to address the United State's history of unsuccessful experimentation with small reactors, which suggests that SMRs are quite unlikely to be reliable sources of generating power in the first place. Prior experience that is particularly important to take note of is the Army's Nuclear Power Program, which was started in the 1950s, and resulted in the construction of eight small reactors. The experiences with these reactors reveal the potential for failure implicit with SMRs. The PM-3A reactor at McMurdo Sound in Antarctica, for example, "developed several malfunctions, including leaks in its primary system [and] cracks in the containment vessel that had to be welded."[5] The leaks from the plant resulted in significant contamination and nearly 14,000 tons of contaminated soil was physically removed and shipped to Port Hueneme, a naval base north of Los Angeles, for disposal. The Army eventually cancelled the program in 1976, due to poor economics as well as the realization that diesel generators were a superior option for supplying power to remote areas. The official history of the Army's Nuclear Power Program termed the development of small reactors "expensive and time consuming."[6]

[footnotes]

[4] M.V. Ramana, The Forgotten History of Small Nuclear Reactors, IEEE SPECTRUM, 2015, http://spectrum.ieee.org/energy/nuclear/the-forgotten-history-of-small-nuclear-reactors (last visited May 24, 2015); M. V. Ramana, The checkered operational history of high temperature gas cooled reactors, 72 BULLETIN OF THE ATOMIC SCIENTISTS 171-79 (2016).

[5] LAWRENCE H. Sum, THE ARMY'S NUCLEAR POWER PROGRAM: THE EVOLUTION OF ASUPPORT AGENCY 111 (1990).

[6] Suid, supra, at 93. (**0052-15** [Curran, Diane])

Comment: In both Chapter 1 and Chapter 9, the Environmental Report asserts:

SMR technology can assist federal facilities with meeting carbon reduction objectives. Energy-related carbon dioxide (C02) emissions account for more than 80 percent of greenhouse gas (OHO) emissions in the United States. Studies show that on average coal combustion generates approximately 894-975 grams of C02 per kilowatt-hour (g/kWh) of electricity generated. Natural gas generates an estimated 450-519 g/kWh. Nuclear power emission rates have been calculated to range from 6 -26 g/kWh.

Id. at 1-3, 9.3-2. TVA's unsupported assertion that nuclear power emission rates have been calculated to range from 6 to 26 grams per kilowatt hour is erroneous in two key respects. First, independent studies suggest that there is much uncertainty about the level of emissions associated with the generation of nuclear energy. A widely cited academic study shows that estimates of lifecycle emissions from nuclear power plants vary by over two orders of magnitude, from 1.4 to 288 g/kWh of C02, with a mean value of 66 g/kWh.[7] Second, and more important, SMRs require more uranium fuel for each kWh of electricity generated.[8] Because of their smaller size and higher area to volume ratio, SMRs will necessarily leak more neutrons from the core when compared to larger reactors. As a result, SMRs need more fuel for each kWh of electricity generated in comparison to the large LWRs that are most common around the world, and that are the basis for the emission estimates made so far (either the 6-26 g/kWh or the 1.4-288 g/kWh). Emissions of C02 associated with uranium mining, processing, and enrichment are the dominant contributions to the lifecycle emissions associated with nuclear power. Therefore, this increased need for fuel would result in a corresponding increase in the C02 emissions per kWh.

[footnote:]

[7] Benjamin K. Sovacool, Valuing the greenhouse gas emissions from nuclear power: A critical survey, 36 ENERGY POLICY 2950-63 (2008).

[8] Alexander Glaser, Laura Berzak Hopkins & M.V. Ramana, Resource Requirements and Proliferation Risks Associated with Small Modular Reactors, 184 NUCLEAR TECHNOLOGY 12129 (2013). (**0052-16** [Curran, Diane])

Comment: TVA claims that its SMR design improves on spent fuel pool safety by providing for "spent fuel pool cooling without the need for active heat removal." Environmental Report at 1-3, 9.3-2. But this assertion does not mention other relevant information demonstrating that SMRs may require greater spent fuel storage capacity than LWRs, because they could generate a larger quantity of spent fuel for each kWh of electricity generated -additional impacts that should be compared with the safety benefits claimed by TVA. [See, e.g., Glaser et al., cited in note 8 above. For instance, TVA's calculations appear to use a burnup value of 51 gigawatt-days per metric ton: of uranium ("GWD/tU"). This value is much higher than some of the reported burnups of the designs of the four potential SMRs under consideration by TVA. For example, the International Atomic Energy Agency lists the burnup of the Holtec SMR design as 32 GWD/tU.[9] At this relatively low burnup, the Holtec SMR will generate more spent fuel than an SMR design that has a burnup of 51 GWD/tU. In turn, this would mean that the fuel pool capacity and, possibly, dry storage capacity, will have to be increased.

This is only a partial list of deficiencies in TVA's discussion of energy alternatives, provided for purposes of illustrating the bias and lack of rigor in TVA's discussion, as further grounds for Petitioners' argument that the discussion should be stricken from the Environmental Report. If and when TVA decides to formally address the issue of energy alternatives in a revised Environmental Report, Petitioners will review it and may submit a contention that challenges its contents with a more comprehensive list of deficiencies.
[footnote:][9] IAEA, ADVANCES IN SMALL MODULAR REACTOR TECHNOLOGY DEVELOPMENTS 89 (2014). (**0052-17** [Curran, Diane])

Comment:

3. Demonstration that the Contention is Within the Scope of the Proceeding: This contention is within the scope of this ESP proceeding because it seeks compliance with NEPA and NRC regulations for the implementation of NEPA in ESP applications.

4. Demonstration that the Contention is Material to the Findings NRC Must Make to issue an ESP for the proposed TVA SMR: The contention is material to the findings that NRC must make in order to issue an ESP for the proposed TVA SMR because it relates to the question of whether TVA's Environmental Report improperly addresses issues that TVA has determined should be excluded from this ESP proceeding and therefore may not be addressed by TVA or NRC and also may not be challenged by Petitioners in contentions. (**0052-18** [Curran, Diane])

Comment: Contention 3 asserts that the Environmental Report for the proposed Clinch River Site ESP is biased and unfair, because it advocates the technical advantages of SMRs as an energy alternative, even though TVA formally elected not to address energy alternatives or the need for power in the Environmental Report for the ESP.[3] As discussed in Contention 3, when an applicant elects not to address energy alternatives, the NRC follows a policy of not addressing those issues, and does not take comments on those issues. Under the circumstances, the NRC should not repeat or expand upon the discussion of energy alternatives in the Environmental Report. To discuss energy alternatives would reduce the EIS to an advertisement for SMRs instead of the rigorous, unbiased and independent scientific study required by NEPA. (**0052-2** [Curran, Diane])
[footnote:]
[3] Contention 3 is supported by the expert declaration of Dr. M.V. Ramana, Professor and the Simons Chair in Disarmament, Global and Human Security at the Liu Institute for Global Issues, University of British Columbia, Vancouver, Canada.

Comment: Contention 3 asserts that the Environmental Report is biased and unfair, because it advocates the technical advantages of SMRs as an energy alternative, even though TVA formally elected not to address energy alternatives or the need for power in the Environmental Report for the ESP. (**0052-6** [Curran, Diane])

Response: *The commenter's scoping comments were submitted to the NRC as part of a separate hearing process. Please refer to ML17188A445 for the NRC staff's response to the comments. Energy alternatives are not required to be evaluated for an ESP. Because TVA has chosen not to evaluate energy alternatives in its ER, the NRC staff will not evaluate energy alternatives in its EIS. If TVA were to apply for a construction permit or combined license at some time in the future, the environmental review of that application would include an assessment energy alternatives.*

Comment: Regarding the fuel cost that has been mentioned earlier -- of natural gas, suppose there are quite a lot of uncertainties in there. But there's also a lot of uncertainty about nuclear fuel costs will work out in the future and -- in terms of climate and other impacts. Then the workforce requirements will -- potential workforce benefits -- economic benefits from technology -- it's certainly much less than what renewable resources for electricity could bring in the future. This is a very accelerating economic sector now, and will be for the foreseeable future. At a -- much more affect the number of jobs that will be created, and it will be all dependent on the -- mostly on the wind and solar energy, which is very productive now -- predictable in terms of the cost because, I don't know, but it can't really be easily changed.

Then regarding the safety -- safety is obviously a relative term particularly when one can predict in advance. But it's certainly safer not to use nuclear power. And the long term management of the waste -- the spent fuel -- is also not very well determined what the risks are for future generations and for the ecology of the future. That's also very unpredictable (**0001-11-1** [Naegeli, Wolf])

Comment: I will talk briefly about some of the issues we plan to bring up in our intervention on this reactor, which we plan to do in June by the deadline to intervene in the early site permit.

There is -- needs to be a basis for the plant and -- for the site permit. And that is something I have looked at and read the documents for, for example, the -- TVA's application submitted and on the record to the Commission's website. The basis -- part of the basis for the plant from TVA is Executive Order 13514, which is Federal Leadership in Energy, Environment, Economic Performance issued in 2009. It was to do this through an increased energy efficiency, reduction of greenhouse gasses, elimination of waste, new designs, construction maintenance and operating high performance, sustainable buildings in sustainable locations.

United States is the world's largest energy consumer. The Federal Government is the nation's single largest energy user. The Department of Defense is the biggest energy user in the federal system. And the leading use of -- leading in use of energy in the Defense Department is jet fuel. In other words, energy used in the most energy intensive federal agency is used principally to fly or to drive heavy equipment over long distances. A modular nuke at Clinch River would not have any impact here.

Moreover, the general trend in energy use by the Federal Government has been downward for the last four decades and is now in steep decline. According to the Federal Energy Management Program this accomplishment is directly attributed to federal employees making choices for efficiency and striving to reduce operating costs. Tools employed by federal agencies are training, technical assistance, energy performance, contracts. Not nuclear power.

A subsequent executive order, Executive Order 13693 entitled Planning for Federal Sustainability in the Next Decade was issued in 2015. It revokes 13514, but reiterated overall policy to -- to increase energy efficiency and improve environmental performance. Executive Order 13693 also sent specific targets for cleaner energy sources with interim goals and endpoints to be achieved by 2025, rebuilding electric energy and thermal energy. Two broad energy categories are defined by EO 13693, renewable and alternative. They are not the same.

According to the order -- the executive order, alternative energy includes small modular nuclear reactors. The order -- the order's definition of renewable energy does not include small modular reactors. The differences are significant when applied to the 10-year sustainability goals in section three of the executive order. Section 3b of the order specific to building electric energy, that is heating and lighting, and thermal energy which shall be provided by renewable energy and alternative energy not less than 25 percent by fiscal year 2025.

However, section 3c states that the percentage of building electric energy not thermal energy -- building electric energy -- keeping the lights on -- could be provided by renewable electric energy. Renewable electric energy, not alternative energy, which would be the small modular reactors -- is to be not less than 30 percent by fiscal year 2025. Clearly the executive order contemplates alternative energy sources to be heat sources such as nuclear and other thermal electric power plants. Renewable sources directed to be used solely for electrical generation are largely solar, wind, wave, heat pumps and hydro-electric. The order provides TVA will the bill of justification for so-called small modular reactors, particularly within the eight-year window remaining between now and 2025.

I mentioned that we [Blue Ridge Environmental Defense League] plan to intervene in this permit. We plan to do that. (**0001-12-2** [Zeller, Lou])

Comment: In terms of our water resources, SMRs are even more water-intensive than traditional nuclear reactors, which are already a water-hogging technology that strains water resources. The NRC needs to analyze the fact that SMRs use more water per unit of electricity produced in a plethora of actual clean, safe energy options. As climate change impacts such as prolonged droughts potentially becoming more frequent, we must pursue water saving not water-squandering energy choices. (**0001-4-5** [Powell, Michelle])

Comment:

Global Warming

Executive Order 13514, titled "Federal Leadership in Environmental, Energy, and Economic Performance," was issued on October 5, 2009. The public policy advanced by the President's Order was:

[I]ncrease energy efficiency; measure, report, and reduce their greenhouse gas emissions from direct and indirect activities; conserve and protect water resources through efficiency, reuse, and stormwater management; eliminate waste, recycle, and prevent pollution; leverage agency acquisitions to foster markets for sustainable technologies and environmentally preferable materials, products, and services; design, construct, maintain, and operate high performance sustainable buildings in sustainable locations; strengthen the vitality and livability of the communities in which Federal facilities are located; and inform Federal employees about and involve them in the achievement of these goals. [2]

The United States is the world's largest energy consumer; the federal government is the nation's single largest energy user; the Department of Defense is the biggest energy user in the federal government; and the leading use of energy in the Defense Department is...jet fuel. In other words, energy use in the most energy-intensive federal agency is used principally to fly or drive heavy equipment over long distances. A modular nuke at Clinch River would not have any impact here.

Moreover, the general trend in energy use by the federal government has been downward for the last four decades, and is now in steep decline. According to the Federal Energy Management Program, "this accomplishment is directly attributed federal employees making the choice for efficiency and striving to reduce operating costs." The tools employed by federal agencies are: training, technical assistance and energy performance contracts. Not nuclear power.

A subsequent executive order, EO 13693-"Planning for Federal Sustainability in the Next Decade," was issued on March 19, 2015. This order revoked EO 13514 but reiterated the overall policy: "It therefore continues to be the policy of the United States that agencies shall increase efficiency and improve their environmental performance." EO 13693 also set specific targets for cleaner energy sources with interim goals, the end points to be achieved by 2025 for building electric energy and thermal energy.

Two broad energy categories are defined in EO 13693: Renewable and alternative. They are not the same. According to the order, alternative energy includes small modular nuclear reactors. The order's definition of renewable energy does not include small modular reactors. The differences are significant when applied to the ten-year sustainability goals set by Section 3 of the order.[5] Section 3(b) of the order is specific to building electric energy and thermal energy which shall be provided by renewable electric energy and alternative energy, "not less than 25 percent by fiscal year 2025." However, Section 3(c) states that the percentage of building electric energy to be provided by renewable electric energy is to be "not less than 30 percent by fiscal year 2025."

Clearly, the Executive Order contemplates alternative energy sources to be heat sources, such as nuclear and other thermoelectric power plants. The renewable sources, directed to be used solely for electrical generation, are largely solar, wind, wave, heat pumps and hydroelectric. The order provides TVA with little justification for so-called small modular reactors, particularly within the eight-year window remaining between now and 2025;

[footnotes:]

[2] Federal Register Vol. 74, No. 194, Page 52117, October 8, 2009

[3] "'alternative energy' means energy generated from technologies and approaches that advance renewable heat sources, including biomass, solar thermal, geothermal, waste heat, and renewable combined heat and power processes; combined heat and power; small modular nuclear reactor technologies; fuel cell energy systems; and energy generation, where active capture and storage of carbon dioxide emissions associated with that energy generation is verified." EO 13693, Section 19(c)

[4] "'renewable electric energy' means energy produced by solar, wind, biomass, landfill gas, ocean (including tidal, wave, current, and thermal), geothermal, geothermal heat pumps, microturbines, municipal solid waste, or new hydroelectric generation capacity achieved from

increased efficiency or additions of new capacity at an existing hydroelectric project." EO 13693, Section I 9(v)
[5] Sec. 3. Sustainability Goals for Agencies, In implementing the policy set forth in section I of this order and to achieve the goals of section 2 of this order, the head of each agency shall, where life-cycle cost-effective, beginning in fiscal year 2016, unless otherwise specified (**0055-1** [Zeller, Lou])

Response: *The action before NRC is whether to issue an ESP and to determine whether the CRN Site is suitable under the NRC's regulations for placement of one or more SMRs. The ESP determination is primarily a siting decision; in accordance with 10 CFR 51.50 (TN250), the applicant's ER need not include an evaluation of alternative energy sources. In accordance with 10 CFR 51.75 (TN250), the EIS will not include an evaluation of alternative energy sources because these matters were not addressed in the applicant's ER (TVA 2016-TN4637). If TVA were to apply for a construction permit or combined license at some time in the future, the impacts of energy alternatives would be assessed at that time. The review of that application would include the development of another EIS and the opportunity to participate in another hearing.*

The scope of the present ESP environmental review includes water use impacts, socioeconomic impacts, and uranium fuel cycle impacts; the review team will use the plant parameter envelope values provided by the applicant to assess these impacts. In the EIS, water-related impacts will be discussed in Sections 4.2 and 5.2; socioeconomic impacts will be discussed in Sections 4.4 and 5.4, and the uranium fuel cycle will be discussed in Section 6.1. Estimated greenhouse gas emissions (GHG) emissions will be presented in Appendix K and an assessment of project impacts given predicted regional climate change will be presented in Appendix L of the EIS.

Comment: Small modular reactors are too costly, too slow to bring online, too uncertain and have a high environmental impact and risk. Current national high level radioactive waste disposal practices would leave this dangerous waste on-site for decades, or much longer, after final reactor shut down. The future belongs to renewable energy. All trends point in that direction. The global increase in renewables in 2015 was 63 gigawatts of wind, 50 gigawatts of solar, 28 of hydroelectric. Total nuclear capacity worldwide is going down, even France is moving away from nuclear power. TVA should embrace the future and aggressively add renewable generation to speed up the retirement of coal, nuclear and gas facilities. TVA should partner with the Clean Line Project to lock in two cents per kilowatt hour of electricity now. TVA should embrace all forms of solar energy and energy efficiency. The sooner TVA starts changing course to put renewables first, the smoother the transition will be. (**0001-5-3** [Safer, Don])

Comment: SMRs are significantly more water-intensive than clean energy choices such as wind, solar and energy efficiency and conservation. (**0005-2** [McBride, Geoff] [McBride, Linda] [Sprignoli, Damon] [Turk, Lawrence "Butch"]) (**0005-6** [McBride, Geoff] [McBride, Linda] [Sprignoli, Damon] [Turk, Lawrence "Butch"])

Comment: Nuclear power is more water intensive than wind, solar and energy efficiency and conservation. (**0007-2** [McFadden, Nancy])

Comment: Why choose such dangerous waste from SMRs, when wind, solar, energy efficiency and conservation measures already exist and are effective. (**0007-4** [McFadden, Nancy])

Comment: Solar based renewable energy resources will provide more jobs and a higher return on investment. In addition, the negative environmental impacts of nuclear energy (mining, disposal, etc.) far outweigh any possible short-tern benefits. Support the future, support solar (**0010-2** [Ellis, Daniel])

Comment: The TVA would do better addressing its responsibility of making the region a solar powered residential region of world class status. I recently became aware that the TVA is a hindrance, or more specifically, some obsolete law is a hindrance in completely solar powering residential needs just because it makes TVA the sole legal supplier of energy to local distributors, who are thus not allowed to buy solar power produced by residents. I think this is outrageous obsolescence in this age of distributed solar power production capability (see Knoxville Mercury, March 2017: Tale of the Two Meters). TVA was not a power company to start with. Now it is time to remember its roots and promote residential solar power instead of being a hindrance to solar energizing the Tennessee Valley Region. Many individuals in this region have installed solar and it would turn into a tsunami if the thumb screws would not be kept on people's initiative to produce their own power, but by far not enough. In countries which are much less endowed with solar energy many more people have gone solar than here, where a so-called regional development agency denies solar power to its residents just due to some obsolete law. Actually, TVA and the region should be a world leader in residential solar energy supply. How long have we still to wait for this to happen? (**0013-4** [Wunderlich, Walt])

Comment: Thinking about TVA's wind power import project and also about the solar energizing of the Tennessee Valley Region, the East Tennessee area that could be spoiled by a nuclear mishap lends itself much more for cooperating in the renewable energy system by pumped storage energy than for nuclear power experiments. We have the Cumberland rim with hundreds of meters of head for any number of such plants that have relatively high efficiency, are of proven technology and can be run totally automatic and totally pollution free. (**0013-5** [Wunderlich, Walt])

Comment: Every nuclear power plant built in the United States has been plagued by budget overruns and multiple delays. There are better alternatives for additional electrical power generation including solar and wind energy. Solar is now less expensive than fossil fuel power and vastly less expensive than nuclear power (**0021-2** [Harland, Donald])

Comment: Plus it is not needed when there are better choices that are less expensive and less highly water intensive, such as wind and solar.

The Clinch River site was previously abandoned, and should remain that way. Clean energy is the way to go, if energy is needed. (**0025-4** [Kirkman, Arden])

Comment: I am opposed to this expensive nuclear experiment. We cannot dispose of the nuclear waste we have accumulated. Why do we persist in creating more? We need to put our expertise on wind and solar, something we don't have to be concerned about polluting water, air and soil with devastating health effects. These sources of power are on the rise world wide and are much safer. They have provided many, safer jobs. Tennessee does not need to lag behind and put us in nuclear jeopardy. (**0030-1** [Sweeton, Beverly])

Comment: Thank you for your time in working for the good of our country, and its energy needs. I am writing to express my deep concern about the Clinch River Small Modular Reactor Project. These reactors are not needed and are prohibitively expensive when compared to clean, renewable solar and wind power. What's more, the Tennessee Valley Authority is seeking site approval before reactor designs have been studied, much less approved. SMRs are significantly more water-intensive than clean energy choices such as wind, solar and energy efficiency and conservation. And just like existing nuclear power plants, they produce long-lived, highly radioactive nuclear waste for which no safe management and permanent storage exists. I implore you to deny the permit. It does not make sense that we would allow them to go in this direction when good, safe alternatives exist. My hope is that you and other earnest, environmentally aware government administrators and leaders will encourage TVA to look at the long-term implications, not just their present bottom line, and seek clean and safe energy choices. (**0034-1** [Bates, Renee])

Comment: Roane County, TN, is close to major populations centers: Knoxville, Chattanooga, Nashville and Lexington, KY, as well as to many ecologically sensitive areas. Pollution of the Clinch River and Watts Bar would be increased. I lived in East Tennessee for 15 years and I know for a fact that nuclear reactors should not be built in this area.

This is an unproven, experimental technology which is not needed. We should instead be emphasizing Solar and Wind Energy, which are much kinder to our precious fresh water. Solar and Wind energy do not endanger residents and guests in the United States, unlike nuclear energy. Small modular reactors are extremely expensive. Thank you for denying TVA the ESP to build such a nuclear device. (**0045-1** [Mortenson, Julia])

Comment: Small Modular Reactors have not been proven safe, and there's no reason to try such an uncertain and expensive source of energy. I would love to see TVA take a leading role in forward-thinking, sustainable energy resources instead of wasting needed funds on this uncertain and experimental method. (**0046-1** [Johnston, Susan])

Comment: Build a solar installation. Tennessee needs renewable energies, not more pollution! (**0056-2** [Goins, Joe])

Response: *These comments express opposition to nuclear power or to building SMRs at the CRN Site, and express support for alternative sources of power generation. Because an ESP is primarily a siting decision, and analysis of energy sources is not required, energy alternatives will not be evaluated in the EIS. If TVA were to apply for a construction permit or combined license at some time in the future, the environmental impacts of energy alternatives relative to those of the proposed project would be assessed at that time. The review of that application would include the development of another EIS.*

D.2.21 Comments Concerning Alternatives – Sites

Comment: The exposure of freshwater resources to nuclear contamination is more or less critical depending on what this SMR really is. Sometimes it is presented as if it were just the size of a Truck trailer, sometimes one has the impression it is a huge structure. How much output does it provide? Is it relevant to the TVA system? Probably not, but as a small self-contained power source it could well be of national importance. Still the question remains: Do these experiments have to be conducted in a river bend of the Clinch River, in a relatively densely populated area of a very scenic part of the country,that has many other potentials. Putting nuclear weapons facilities there is bad enough, but this was a war time decision and was made at a time when the ramification of nuclear contamination were either not recognized or belittled. (**0013-2** [Wunderlich, Walt])

Response: *The EIS will include an evaluation of the construction and operation impacts of a SMR at the CRN Site in Chapters 4 and 5. The EIS will also include an evaluation of the construction and operation impacts of a SMR facility at alternative sites, such as other property within the Oak Ridge Reservation, in Chapter 9 of the EIS, and will include an evaluation of alternative sites to determine whether there is an obviously superior alternative to the proposed site.*

Comment: I find the site very precarious. It should never have been chosen for any nuclear experiments. It is surrounded on three sides by the Clinch River, a major waterway that feeds into the Tennessee river which feeds into the Mississippi River, the short stretch of Ohio River discounted. The recent experience with the Japanese Daiichi plant makes one to think about it. What if this thing explodes, what if its containment cracks? What is the geology around the site? Is it rocky, is it shaly, is it loamy? seismicity? One would assume that these elementary questions have been asked and answered satisfactorily by now. (**0013-1** [Wunderlich, Walt])

Comment: The plan to site the proposed TVA SMR at the former CRBR location in Oak Ridge, TN is in essence using a greenfield returned to its natural landscape over the intervening 35 years since the CRBR was canceled. This fully recovered natural environment is habitat to diverse and extensive numbers of wildlife species and wildlife habitat. The Federal Government is spending billions of dollars cleaning and rehabilitating legacy nuclear sites in Oak Ridge and across the US. Before another greenfield becomes a new legacy nuclear site every consideration should be given to using a recently or soon to be deactivated nuclear power plant site, closed coal fired power plant, or other nuclear era legacy site. One such nuclear era legacy brownfield site is the S-50 -- K-25 Power House site barely 3 miles from the proposed site. It has all the attributes of the proposed location, even more so -- including a railroad, barge terminal, high voltage power line infrastructure, water supply, security (water on three sides and a single entry point) no nearby public/private land owners, and it is owned by the Federal Government (DOE). In addition, using it for a nuclear reactor site would save the $100's of millions in cleanup costs faced with making it acceptable for private industrial use. https://en.wikipedia.org/wiki/S-50_(Manhattan_Project).

Are you aware of the S-50 - K-25 Power House Area and it close proximity?

Have your toured the area and been briefed on its attributes and been made aware of it as a viable location?

Why can't it be transferred to TVA from DOE in exchange for the CRBR site which can then be returned as part of the DOE Reservation Environmental Research landscape?

What are the life cycle costs savings using it as compared to a greenfield site?

These are a few of the questions that when fully and independently addressed will conclude that the SMR project located on a brownfield can go forward at a major savings in cost and environmental impact. The last thing a new nuclear project should result in is creating another nuclear liability for our Nation. Especially when so many alternatives exist, (**0042-1** [Colclasure, Doug])

Response: *Chapter 9 will describe the TVA's site selection process and the NRC staff's evaluation of that process. In Chapter 9, the NRC staff will also independently compare the alternative sites to the proposed site to determine if any of the alternative sites are environmentally preferable to the proposed site.*

D.2.22 Comments Concerning Benefit-Cost Balance

Comment: Billions of dollars could be spent on the nuclear reactor technology that is unproven, untested and significantly more expensive than other types of energy technologies that are actually available today including renewables, such as solar, wind, energy efficiency and demand site management measures.

The economics of new nuclear have only worsened since 2010 while the economics for renewables and energy efficiency have improved. The NRC must include updated economic cost analysis of the actual costs of many nuclear reactors. This can be done by looking into nearby Georgia and South Carolina where the under-construction Toshiba/Westinghouse AP 1000 reactors are years delayed and billions of dollars over budget. In fact, Westinghouse has filed for bankruptcy and is out of the construction business and parent company, Toshiba may be next in line. These projects may never be finished. The reality is that new nuclear power is losing the bet and draft environmental impact statement must consider accurate cost statement estimates as compared to other energy technologies that have only seen cost drop as new nuclear power costs sour. (**0001-4-2** [Powell, Michelle])

Comment: The economics of small modular reactors do not make sense, even with optimistic pre-construction cost projections. It is impossible to say how much actual spending would exceed these estimates, but it is almost certain to be substantial. Watts Bar 1 and 2 were originally projected to cost under $700 million. They were completed decades later at an acknowledged cost of over $13 billion. Watts Bar 2 is currently inoperable due to a structural failure in a 40-year old steam condenser. It is unknown when repairs will be completed, but not for months. The once hyped U.S. SMR business is down to one manufacturer with two possible customers, TVA and UAMPS, the Utah Associated Municipal Power Systems. In 2009, TVA made a great decision when it withdrew from plans to be the first in the US to build a Westinghouse AP1000 reactors. Construction delays from cost overruns have forced Westinghouse into bankruptcy and the VC Summer and Vogtle reactors may never be finished after billions have been spent. (**0001-5-2** [Safer, Don])

Comment: And just a footnote, the total estimated cost for TVA to develop SMRs to the point of getting this application -- early site permit -- is $72 million. Half of that will be given to TVA by the DOE. So -- so far TVA has spent around $23 million on SMR activities through fiscal year 2015, and estimates are about $5 million in the fiscal year 2016. And it will be at least five years before TVA will decide whether to build these or not. That's from Bill Johnson and Joe Hoagland, CEO and vice president at TVA. It's very uncertain whether they'll do these. (**0001-5-4** [Safer, Don])

Comment: They are not cost effective. They may cost less per reactor, but the cost per kilowatt-hour of the electricity produced by a small reactor will be higher than that of a large reactor. Perhaps eventually costs per kwh will be reduced as SMR's are mass produced, but we are decades away from that. Wind, solar and other clean renewable sources are continually reducing in price. And that is even before external costs are included. All fossil fuel energy sources are heavily subsidized in that society bears much of the actual cost of environmental destruction through mining, pollution of air and water, and impacts of global warming.(**0051-3** [Anthony, Kate])(**0051-9** [Anthony, Kate])

Comment: 4. [illegible] and most renewables are already cheaper

5. Obviously, its not about science but the money

6. Time it takes to certify SMR's will do little to help with global warming (**0059-4** [Anonymous, Anonymous])

Response: *The cost of the proposed action need not be considered in an ESP ER or in the NRC's EIS (10 CFR 51.50(b)(2) [TN250]; NUREG-1555 [NRC 2000-TN614]). If TVA were to apply for a construction permit or combined license at some time in the future, the environmental review of that application would include an assessment of the proposed project's benefit-cost balance. Therefore, this issue will not be assessed further during the ESP review or in the ESP EIS.*

D.2.23 References

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." Washington, D.C. TN250.

10 CFR Part 52. *Code of Federal Regulations*, Title 10, *Energy*, Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." Washington, D.C. TN251.

36 CFR Part 800. *Code of Federal Regulations*, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties." Washington, D.C. TN513.

82 FR 17885. April 13, 2017. "Tennessee Valley Authority; Clinch River Nuclear Site; Early Site Permit Application." *Federal Register.* U.S. Nuclear Regulatory Commission, Washington, D.C. TN4910.

42 U.S.C. § 4321 *et seq.* National Environmental Policy Act (NEPA) of 1969, as amended. TN661.

54 U.S.C. § 306108. National Historic Preservation Act Section 106, "Effect of Undertaking on Historic Property." TN4839.

NRC (U.S. Nuclear Regulatory Commission). 1977. *Final Environmental Impact Statement Related to the Construction and Operation of Clinch River Breeder Reactor Plant*. NUREG-0139, Washington, D.C. Accession No. ML082610503. TN5083.

NRC (U.S. Nuclear Regulatory Commission). 2000. *Environmental* Standard *Review* Plan—Standard *Review Plans for Environmental Reviews for Nuclear Power Plants*. NUREG–1555, Main Report and 2007 Revisions, Washington, D.C. Available at http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/toc/. TN614.

NRC (U.S. Nuclear Regulatory Commission). 2014. *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel.* Final Report, NUREG–2157, Washington, D.C. Accession No. ML14198A440. TN4117.

TVA (Tennessee Valley Authority). 2016. "Clinch River Nuclear Site Early Site Permit Application, Part 03—Environmental Report (Revision 0)." Chattanooga, Tennessee. Accession No. ML16144A145. TN4637.

APPENDIX E
DRAFT ENVIRONMENTAL IMPACT STATEMENT COMMENTS AND RESPONSES

This appendix is intentionally left blank. In the final environmental impact statement, this appendix will contain the comments on and responses to comments on the draft environmental impact statement.

APPENDIX F
KEY CONSULTATION CORRESPONDENCE

Consultation correspondence sent and received during the environmental review of the early site permit application for the Tennessee Valley Authority's (TVA's) Clinch River Nuclear (CRN) Site in Roane County, Tennessee, is identified in Table F-1. The correspondence can be found in the U.S. Nuclear Regulatory Commission's (NRC's) Agencywide Document Access and Management System (ADAMS), which is accessible from the NRC website at http://www.nrc.gov/readingrm/adams.html (the Public Electronic Reading Room) (note that the URL is case sensitive). ADAMS accession numbers also are provided in Table F-1.

A copy of the correspondence received from Native American Tribes is presented in Section F.1. Copies of correspondence received from the U.S. Army Corps of Engineers are presented in Section F.2.

Section F.3 contains copies of correspondence (excluding attachments) from Federal and State agencies regarding threatened, endangered, and sensitive species and their habitats. Appendix M is reserved for a full copy of the U.S. Fish and Wildlife (FWS) Biological Assessment upon its completion.

Table F-1. Key Early Site Permit Consultation Correspondence Regarding the CRN Site

Source	Recipient	Date and Accession Number
Correspondence with Native American Tribes (see Section F.1)		
U.S. Nuclear Regulatory Commission (NRC) (Allen Fetter)	Absentee Shawnee Tribe (Edwina Butler-Wolfe)	April 20, 2017 (ML17041A081)
NRC (Allen Fetter)	Thlopthlocco Tribal Town (Ryan Morrow)	April 20, 2017 (ML17047A682)
NRC (Allen Fetter)	Choctaw Nation of Oklahoma (Gary Batton)	April 20, 2017 (ML17041A086)
NRC (Allen Fetter)	Poarch Band of Creek Indians (Stephanie A. Bryan)	April 20, 2017 (ML17047A676)
NRC (Allen Fetter)	Alabama-Coushatta Tribe of Texas (Jo Ann Battise)	April 20, 2017 (ML17041A082)
NRC (Allen Fetter)	Eastern Band of Cherokee Indians of North Carolina (Patrick Lambert)	April 20, 2017 (ML17017A123)
NRC (Allen Fetter)	Cherokee Nation of Oklahoma Bill (John Baker)	April 20, 2017 (ML17041A085)
NRC (Allen Fetter)	Alabama-Quassarte Tribal Town (Tarpie Yargee)	April 20, 2017 (ML17041A084)
NRC (Allen Fetter)	Jena Band of the Choctaw Indians (B. Cheryl Smith)	April 20, 2017 (ML17047A407)
NRC (Allen Fetter)	The Chickasaw Nation (Bill Anoatubby)	April 20, 2017 (ML17047A681)

Table F-1. (contd)

Source	Recipient	Date and Accession Number
NRC (Allen Fetter)	Quapaw Tribe of Oklahoma (John Berrey)	April 20, 2017 (ML17047A677)
NRC (Allen Fetter)	Seminole Tribe of Florida (Marcellus W. Osceola Jr.)	April 20, 2017 (ML17047A679)
NRC (Allen Fetter)	United Keetoowah Band of Cherokee Indians (Joe Bunch)	April 20, 2017 (ML17047A683)
NRC (Allen Fetter)	Coushatta Tribe of Louisiana (Lovelin Poncho)	April 20, 2017 (ML17047A405)
NRC (Allen Fetter)	Mississippi Band of Choctaw Indians (Phyliss J. Anderson)	April 20, 2017 (ML17047A409)
NRC (Allen Fetter)	Muscogee (Creek) Nation of Oklahoma (James Floyd)	April 20, 2017 (ML17047A675)
NRC (Allen Fetter)	Seminole Nation of Oklahoma (Leonard M. Harjo)	April 20, 2017 (ML17047A678)
NRC (Allen Fetter)	Eastern Shawnee Tribe of Oklahoma (Glenna J. Wallace)	April 20, 2017 (ML17047A406)
NRC (Allen Fetter)	Shawnee Tribe of Oklahoma (Ron Sparkman)	April 20, 2017 (ML17047A680)
NRC (Allen Fetter)	Kialegee Tribal Town (Jeremiah Hobia)	April 20, 2017 (ML17047A408)
United Keetoowah Band of Cherokee Indians (Karen Pritchett)	NRC (Allen Fetter)	June 28, 2017 (ML17206A450)
Cherokee Nation (Elizabeth Toombs)	NRC (Allen Fetter)	May 12, 2017 (ML17145A580)
Choctaw Nation of Oklahoma (Daniel Rangle)	NRC (Allen Fetter)	June 5, 2017 (ML17157B749)
NRC (Jennifer Davis)	Seminole Nation of Oklahoma (Theodore Isham)	January 19, 2018 (ML18031A950)
NRC (Jennifer Davis)	Alabama-Quassarte Tribal Town (Samantha Robison)	January 19, 2018 (ML18046A410)
NRC (Jennifer Davis)	Alabama-Coushatta Tribe of Texas (Bryant Celestine)	January 19, 2018 (ML18058B560)
Seminole Nation of Oklahoma (Theodore Isham)	NRC (Jennifer Davis)	January 20, 2018 (ML18046A412)
NRC (Jennifer Davis)	Seminole Tribe of Florida (Victoria Menchaca)	January 22, 2018 (ML18059A157)
The Chickasaw Nation (Karen Brunso)	NRC (Jennifer Davis)	January 22, 2018 (ML18031A976)
NRC (Jennifer Davis)	Thlopthlocco Tribal Town (Terry Clouthier)	January 29, 2018 (ML18040A439)
NRC (Jennifer Davis)	Choctaw Nation of Oklahoma (Daniel Ragle)	February 9, 2018 (ML18044A843)

Table F-1. (contd)

Source	Recipient	Date and Accession Number
NRC (Jennifer Davis)	Poarch Band of Creek Indians (Carolyn White)	February 16, 2018 (ML18051A746)
Thlopthlocco Tribal Town (Terry Clouthier)	NRC (Jennifer Davis)	February 19, 2018 (ML18051A738)
NRC (Jennifer Davis)	Seminole Nation of Oklahoma (Theodore Isham)	March 5, 2018 (ML18064A222)
Correspondence with U.S. Army Corps of Engineers (see Section F.2)		
NRC	USACE Nashville District (Tammy Turley)	April 12, 2017 (ML17065A237)
USACE Nashville District (Tammy Turley)	NRC (Allen Fetter)	May 2, 2017 (ML17205A413)
Correspondence Regarding Historic and Cultural Resources)		
NRC (Allen Fetter)	Tennessee Historical Commission (E. Patrick McIntyre, Jr.)	April 20, 2017 (ML17061A428)
NRC (Allen Fetter)	Advisory Council on Historic Preservation (Reid Nelson)	April 20, 2017 (ML17065A239)
Correspondence Regarding Threatened, Endangered, and Sensitive Species and their Habitats (See Section F.3)		
NRC (Allen Fetter)	U.S. Fish and Wildlife Service (FWS) (Mary Jennings)	April 20, 2017 (ML17069A249)
NRC (Allen Fetter)	FWS (Bill Pearson)	April 20, 2017 (ML17088A264)
FWS (Mary Jennings)	NRC (Cindy Bladey)	April 21, 2017 (ML17145A505)
FWS (Mary Jennings)	NRC (Allen Fetter)	May 5, 2017 (ML17205A341)
U.S. Environmental Protection Agency, Region 4 (Larry Long)	NRC	May 30, 2017 (ML17157B742)
Tennessee Department of Environment and Conservation (TDEC) (Kendra Abkowitz)	NRC (Patricia Vokoun)	June 12, 2017 (ML17170A310)
FWS (Mary Jennings)	NRC (Allen Fetter)	July 20, 2017 (ML17205A342)
Tennessee Wildlife Resource Agency (Pat Black)	PNNL (James Becker)	September 6, 2017 (ML18022A346)
Tennessee Department of Environment and Conservation (Gerry Middleton)	PNNL (James Becker)	September 6, 2017 (ML18019A036)
Tennessee Department of Environment and Conservation (Stephanie Williams)	PNNL (James Becker)	September 11, 2017 (ML18026A552)

Table F-1. (contd)

Source	Recipient	Date and Accession Number
PNNL (James Becker)	Kentucky State Nature Preserve Commission (Ian Horn)	September 13, 2017 (ML18059A130)
Oak Ridge National Laboratory (Kitty McCracken)	PNNL (James Becker)	September 18, 2017 (ML18016A334)
Georgia Department of Natural Resources (Anna Yellin)	PNNL (James Becker)	September 24, 2017 (ML18012A447)
Kentucky State Nature Preserves Commission (Ian Horn)	PNNL (James Becker)	September 29, 2017 (ML18012A656)
Tennessee Wildlife Resource Agency (Brian Flock)	PNNL James Becker)	November 3, 2017 (ML18064A895)
Oak Ridge National Laboratory (Neil Giffen)	PNNL (James Becker)	November 8, 2017 (ML18022A742)
Oak Ridge National Laboratory (Neil Giffen)	PNNL (James Becker)	December 7, 2017 (ML18010A883)

F.1 Correspondence Received from Native American Tribes

ClinchRiverESPEISCEm Resource

From:	karen pritchett <kpritchett@ukb-nsn.gov>
Sent:	Wednesday, June 28, 2017 2:57 PM
To:	ClinchRiverESPEIS
Cc:	Jennifer.Barnett@tn.gov; Eric Oosahwee-Voss; karen pritchett
Subject:	[External_Sender] Clinch River Nuclear Site, Roane County, Tennessee

Dear Sir,

On behalf of Tribal Historic Preservation Officer (THPO) Eric Oosahwee-Voss, please accept this digital communication regarding the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee.

Please be advised that the proposed undertaking lies within the traditional territory of the United Keetoowah Band of Cherokee Indians in Oklahoma (UKB). This opinion is being provided by UKB THPO, pursuant to authority vested by the UKB Corporate Board and under resolution 16-UKB-34. The United Keetoowah Band is a Federally Recognized Indian Nation headquartered in Tahlequah, OK.

Information on Native American use in the project vicinity shows that prehistoric, ethnographic, historic, and traditional sites of value to the UKB surround the project area. We recommend that a cultural resources inventory be completed prior to project implementation.

Thank you for consulting with the UKB. Please note that these comments are based on information available to us at the time of the project review. We reserve the right to revise our comments as information becomes available. If you have any questions or concerns, please contact me at (918) 458-6715 or kpritchett@ukb-nsn.gov or THPO Eric Oosahwee-Voss at (918) 458-6717 or eoosahwee-voss@ukb-nsn.gov

UKB#	U17-849 17.0871

Thank you,

Karen Pritchett
TCNS Coordinator
Tribal Historic Preservation Office
United Keetoowah Band of Cherokee Indians in Oklahoma
P. O. Box 1245
Tahlequah, OK 74465
918-458-6715

ᏣᎳᎩ ᎠᏰᎵ
CHEROKEE NATION®
P.O. Box 948 • Tahlequah, OK 74465-0948 • 918-453-5000 • cherokee.org

Office of the Chief

Bill John Baker
Principal Chief
ᏫᎵ ᏣᏂ ᏧᏚᏚᎲᏍᎩ
ᎤᎬᏫᏳᎯ

S. Joe Crittenden
Deputy Principal Chief
Ꮝ. ᏦᏩ ᏧᎬᎩᏍᎩ
ᏔᎵᏁ ᎠᏓᏅᏁ ᎤᎬᏫᏳᎯ

May 12, 2017

Allen H. Fetter, Acting Branch Chief
Licensing Branch 3
Division of New Reactor Licensing, Office of New Reactors
United States Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Re: Clinch River Nuclear Site Early Site Permit Application

Mr. Allen H. Fetter:

The Cherokee Nation (CN) is in receipt of your correspondence about **Clinch River Nuclear Site Early Site Permit Application**, and appreciates the opportunity to provide comment upon this project. The CN maintains databases and records of cultural, historic, and pre-historic resources in this area. Our Tribal Historic Preservation Office (THPO) reviewed this project, cross referenced the project's legal description against our information, and found that this Area of Potential Effect (APE) lies within our historic homelands.

In accordance with the National Historic Preservation Act (NHPA) [16 U.S.C. 470 §§ 470-470w6] 1966, undertakings subject to the review process are referred to in S101(d)(6)(A), which clarifies that historic properties may have religious and cultural significance to Indian tribes. Additionally, Section 106 of NHPA requires federal agencies to consider the effects of their action on historic properties (36 CFR Part 800) as does the National Environmental Policy Act (43 U.S.C. 4321 and 4331-35 and 40 CFR 1501.7(a) of 1969).

The CN has a vital interest in protecting its historic and cultural resources. The CN is in concurrence that an Environmental Impact Statement (EIS) in compliance with NHPA should be conducted for the Clinch River Nuclear Site, and is requesting a copy of this report. This office looks forward to receiving and reviewing the EIS. Please contact the CN with response to this request.

Additionally, we would request Department of the Interior conduct appropriate inquiries with other pertinent Tribal and Historic Preservation Offices regarding historic and prehistoric resources not included in the CN databases or records. If items of cultural significance are discovered while developing this project report, the CN asks that activities halt immediately and our offices be contacted for further consultation. If you require additional information or have any questions, please contact me at your convenience.

Thank you for your time and attention to this matter.

Wado,

Elizabeth Toombs, Special Projects Officer
Cherokee Nation Tribal Historic Preservation Office
elizabeth-toombs@cherokee.org
918.453.5389

CC: Patricia Vokoun, NRC Environmental Project Manager

From: Daniel R. Ragle <dragle@choctawnation.com>
Sent: Monday, June 05, 2017 5:25 PM
To: ClinchRiverESPEIS
Subject: [External_Sender] RE: Initiation of Section 106 and Scoping Process for the Environmental Review of the Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee

Thank you for the correspondence regarding the above referenced project. This project lies outside of our area of historic interest. Therefore, the Choctaw Nation of Oklahoma respectfully defers to the other Tribes that have been contacted. If you have any questions, please contact me by email.

Daniel Ragle
Compliance Review Officer
Historic Preservation Dept.
Choctaw Nation of Oklahoma
(800) 522-6170 Ext. 2727
dragle@choctawnation.com
www.choctawnation.com
www.choctawnationculture.com

Choctaw Nation
Faith•Family•Culture

From:	Theodore Isham
To:	Davis, Jennifer
Cc:	Vokoun, Patricia
Subject:	[External_Sender] RE: Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee
Date:	Saturday, January 20, 2018 10:45:07 AM

This ***Opinion*** is being provided by Seminole Nation of Oklahoma's Cultural Advisor, pursuant to authority vested by the Seminole Nation of Oklahoma General Council. The Seminole Nation of Oklahoma is an independently Federally-Recognized Indian Nation headquartered in Wewoka, OK.

In keeping with the National Environmental Policy Act (NEPA)d, and Section 106 of the National Historic Preservation Act (NHPA), 36 CFR Part 800, this letter is to acknowledge that the Seminole Nation of Oklahoma has received notice of the proposed project at the above mentioned location.

Based on the information provided and because the potential for buried cultural resources, the proposed project has an extreme probability of affecting archaeological resources, some of which may be eligible for listing in the National Register of Historic Places (NRHP).

We recommend that an intensive literature/phaseI survey reports of the nearby archaeological sites be conducted and sent to SNO. Also, we request that a listing of all the flora in the affected area be provided.
We do request that if cultural or archeological resource materials are encountered at all activity cease and the Seminole Nation of Oklahoma and other appropriate agencies be contacted immediately.

Furthermore, due to the historic presence of our people in the project area, inadvertent discoveries of human remains and related NAGPRA items may occur, even in areas of existing or prior development. Should this occur we request all work cease and the Seminole Nation of Oklahoma and other appropriate agencies be immediately notified.

Theodore Isham
Seminole Nation of Oklahoma
Historic Preservation Officer
PO Box 1498
Seminole, Ok 74868
Phone: 405-234-5218
Cell: 918-304-9443
e-mail: isham.t@sno-nsn.gov

From: Davis, Jennifer [mailto:Jennifer.Davis@nrc.gov]
Sent: Friday, January 19, 2018 3:07 PM
To: Theodore Isham

Cc: Vokoun, Patricia
Subject: Early Site Permit Application for the Clinch River Nuclear Site in Roane County, Tennessee

Mr. Isham,

My colleague Pat Vokoun and I called your office to follow up on a letter sent by our agency (U.S. Nuclear Regulatory Commission (NRC)) from April 2017. Per request, we are re-sending this letter for your files.

The NRC is reviewing an application for an early site permit (ESP) from Tennessee Valley Authority for the proposed construction and operation of two or more Small Modular Reactors (SMRs) at the Clinch River site in Oak Ridge, Roane County, Tennessee. As part of this application process, the NRC will be completing an environmental impact statement in compliance with the National Environmental Policy Act (NEPA). NRC will also be coordinating its National Historic Preservation Act (NHPA) Section 106 review through the NEPA process in accordance with 36 CFR 800.8(c).

The ESP application and review process makes it possible to evaluate and resolve safety and environmental issues related to siting potential future SMRs at the CRN Site. An ESP does not, however, authorize construction and operation of the SMRs. Such authorization would require a separate application by TVA to the NRC, necessitating additional NEPA and NHPA review.

If you have any questions, please feel free to reach out to me or with Patricia Vokoun. Patricia is the environmental project manager for this review. Her contact information is provided in the attached letter.

Thank you,

Jennifer

Jennifer A. Davis
Senior Project Manager
Office of New Reactors
U.S. Nuclear Regulatory Commission
(301) 415-3835

From: Karen Brunso
To: Davis, Jennifer
Subject: [External_Sender] Application for the Clinch River Nuclear Site in Roane County, Tennessee
Date: Monday, January 22, 2018 3:36:41 PM
Attachments: image001.gif

Dear. Ms. Davis,
Thank you for the letter for the initiation of Section 106 and scoping process for the environmental review of the early site permit application for the Clinch River Nuclear Site in Roan County, Tennessee. The Chickasaw Nation has no additional comments on the proposed permit. Please let us know if there are any questions.

Respectfully,

Karen Brunso
Tribal Historic Preservation Officer
The Chickasaw Nation
Department of Culture & Humanities
Division of Historic Preservation
P.O. Box 1548
Ada, OK 74821-1548
Phone: 580-272-1106
Cell: 580-399-6017
Email: karen.brunso@chickasaw.net

THLOPTHLOCCO TRIBAL TOWN

Tribal Historic Preservation Office

Terry Clouthier, Tribal Historic Preservation Officer

P.O. Box 188
Okemah, OK 74859
(918) 560-6113
thpo@tttown.org

February 19, 2018

THPO File Number: 2018-67

Allen H. Fetter
Acting Branch Chief
Licensing Branch 3
Division of New Reactor Licensing
Office of New Reactors
Nuclear Regulatory Commission
Washington, D.C. 20555

RE: Early site permit application for the Clinch River Nuclear Site in Roane County, Tennessee

Dear Mr. Fetter,

Thank you for contacting the Thlopthlocco Tribal Town Tribal Historic Preservation Office (THPO) soliciting comments regarding the early site permit application for the Clinch River Nuclear Site in Roane County, Tennessee. Our office has reviewed the document provided and offers the following comment.

The THPO will refrain from commenting on this proposed undertaking until the Environmental Impact Statement is submitted for our review. Please submit an electronic copy to thpo@tttown.org once it is completed.

Please refer to THPO file number 2018-67 for all correspondence for this proposed undertaking.

Please feel free to contact the THPO at thpo@tttown.org or (918) 560-6113 if you have any questions.

Sincerely,

Terry Clouthier
Thlopthlocco Tribal Town
Tribal Historic Preservation Officer

F.2 Correspondence Received from the U.S. Army Corps of Engineers

DEPARTMENT OF THE ARMY
NASHVILLE DISTRICT, CORPS OF ENGINEERS
REGULATORY DIVISION
3701 BELL ROAD
NASHVILLE, TENNESSEE 37214

MAY 0 2 2017

SUBJECT: Invitation to Participate as a Cooperating Agency in Preparation of an Environmental Impact Statement for the Tennessee Valley Authority Early Site Permit Application at the Clinch River Nuclear Site, Roane County, Tennessee

Mr. Allen H. Fetter, Acting Branch Chief
Licensing Branch 3
Division of New Reacto Licensing
Office of New Reactors
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Mr. Fetter:

This is response to your letter dated April 12, 2017, inviting the Regulatory Division, U.S. Army Corps of Engineers, Nashville District (USACE), to participate as a cooperating agency in the development of an Environmental Impact Statement associated with the Tennessee Valley Authority (TVA) request for an early site permit for the siting and operation of one or more small modular reactors at the Clinch River Nuclear Site in Roane County, Tennessee.

The USACE has regulatory responsibilities pursuant to Section 404 of the Clean Water Act (33 U.S.C. 1344) and Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403). Under Section 10, the USACE regulates any work in, or affecting, navigable waters of the U.S. Under Section 404, the USACE regulates the discharge of dredged and/or fill material into waters of the U.S., including wetlands. A review of the information previously provided indicates the subject activity may involve work in waters/wetlands of the U.S.; therefore, a Department of the Army permit may be required.

The USACE is accepting your invitation to serve as a cooperating agency in the development of the EIS. We are looking forward to working with you as a cooperating agency. If you have any questions regarding this matter, please contact Mr. Mark M McIntosh at Mark.M.Mcintosh@usace.army.mil or by telephone (865) 986-7296, or me at Tammy.R.Turley@usace.army.mil or by telephone at (615) 369-7515.

Sincerely,

Tammy R. Turley
Chief, Regulatory Division

F.3 Correspondence Received Regarding Threatened, Endangered, and Sensitive Species and their Habitats

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Tennessee ES Office
446 Neal Street
Cookeville, Tennessee 38501

April 21, 2017

Ms. Cindy Bladey
Office of Administration
OWFN-12-H08
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Subject: Docket ID NRC-2016-0119

FWS#2017-CPA-0711. Notice of Intent for the Nuclear Regulatory Commission to Prepare an Environmental Impact Statement and Conduct a Scoping Process for the Clinch River Nuclear Site located in Roane County, Tennessee.

Dear Ms. Bladey:

U.S. Fish and Wildlife Service (Service) personnel have reviewed the Nuclear Regulatory Commission's (NRC) Notice of Intent to prepare an Environmental Impact Statement (EIS) to address the proposed Clinch River Nuclear Site (CRN), which would be situated on an approximately 1,200 acre site along the Clinch River in Roane County, Tennessee. The NOI indicates that Tennessee Valley Authority (TVA) has submitted an early site permit for the CRN. The proposed EIS would consider the environmental impacts of two (2) or more small modular reactor modules (up to 800 MWe, 2420 MWt).

Potential natural resource impacts evaluated in the EIS would include air quality, surface water, groundwater, aquatic ecology, vegetation, wildlife, threatened and endangered species, wetlands, forest resources, and natural areas and parks. In addition, NRC would evaluate socioeconomic impacts and impacts on archaeological and historic resources and aesthetics (visual, noise and odors).

The Service has reviewed recent and historical endangered species collection records within the locality of the proposed project site. Records indicate that several federally listed terrestrial and aquatic species occur within the vicinity of the site identified by NRC/TVA. Due to the presence of these species within the proposed project vicinity, we request that NRC, or a designated representative thereof, work closely with the Service when addressing threatened and endangered species within the action area to ensure that the appropriate species and federally designated critical habitats are included in an assessment. While we realize that TVA has extensive records for federally listed and at-risk species in its Natural Heritage Database, we also suggest that NRC utilize the U.S. Fish and Wildlife Service Information for Planning and Conservation (IPaC) system located at: https://ecos.fws.gov/ipac/, in addition to TVA's Natural Heritage Database, to obtain the most comprehensive species information. The proposed action area can be input into IPaC and a current species list, appropriate for the proposed project, will immediately be produced. Furthermore, the Service recommends the development of a Biological Assessment, as required by 50 CFR 402.12, which would analyze the potential effects of the action on listed and proposed species and designated and proposed critical habitat. The Biological Assessment will identify whether any such species or habitat are likely to be adversely affected by the action and is used in determining whether formal consultation or a conference is necessary. When evaluating potential impacts to species, both direct and indirect impacts should be considered.

Additionally, we recommend that NRC address and include known locations of wetlands during their analysis with determinations of potential future effects to the resource. We also request that NRC coordinate frequently and early with the Service regarding the proposed action to remain in compliance with section 7 of the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.). Additionally, the Service request that NRC coordinate in regards to any potential survey efforts for threatened and endangered species.

We further recommend that NRC address and include known locations of migratory birds, afforded certain levels of protection under the Migratory Bird Treaty Act of 1918 (16 U.S.C., Chapter 7, Subchapter II), and determine potential future effects to these resources. In addition, we request that NRC determine the potential for presence and effects to the bald eagle (*Haliaeetus leucocephalus*) in the action area. This species is currently afforded certain levels of protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c), enacted in 1940, and the MBTA. NRC should also identify hibernacula utilized by at-risk or federally listed bat species in the vicinity of the action area and determine if the proposed action could affect any individuals.

As NRC proceeds with its analysis, we will provide additional comments specific to the action. We can also provide a comprehensive list of species which we feel could be affected by the proposed action at a later date, upon request. Please anticipate that a representative of the Service will attend the Public Scoping Meeting on May 15, 2017. If you have any questions regarding our comments, please contact Dustin Boles of my staff at 931/525-4984 or by email at dustin_boles@fws.gov.

Sincerely,

Mary E. Jennings
Field Supervisor

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Tennessee ES Office
446 Neal Street
Cookeville, Tennessee 38501

May 5, 2017

Mr. Allen H. Fetter
Licensing Branch 3
Division of New Reactor Licensing
Office of New Reactors
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Subject: FWS# 2017-I-0473. U.S. Nuclear Regulatory Commission - Requests for Participation in the Environmental Scoping Process and a List of Federally Protected Species Within the Area Under Evaluation for the Proposed Clinch River Nuclear Site Located in Oak Ridge, Roane County, Tennessee.

Dear Mr. Fetter:

Thank you for your correspondence dated April 20, 2017, regarding the U.S. Nuclear Regulatory Commission's (NRC) request for participation in the environmental scoping process and request for a list of federally protected species within the area under evaluation for the proposed Clinch River Nuclear Site (CRN) located in Oak Ridge, Roane County, Tennessee. The proposed action to issue an early site permit (ESP) would grant approval of a site that could be used for the future construction and operation of two (2) or more small modular reactors (SMRs). If approved, the ESP would not authorize the applicant, Tennessee Valley Authority (TVA), to begin construction of the SMRs. U.S. Fish and Wildlife Service (Service) personnel have reviewed the information submitted, and we offer the following comments.

Correspondence indicates that the proposed CRN would be located on an approximate 935 acre site on the northern bank of the Clinch River arm of Watts Bar Reservoir. Furthermore, the proposed site is located downstream of Melton Hill Dam between Clinch River Mile 14.5 and 19. The site was evaluated in the 1970's by the TVA for a breeder reactor, which resulted in some site excavation being performed. However, the breeder reactor was not completed and the site was revegetated.

To support the CRN, it would be necessary for the TVA to construct a new 69-kV underground transmission line, approximately 5-miles long, within existing right-of-ways (ROWs) for an active 500-kV overhead transmission line to connect the CRN switchyard to 69-kV transformers at the Bethel Valley Substation on the Oak Ridge Reservation (ORR). TVA would also re-route an existing 161-kV overhead transmission line to avoid the proposed new power block location. Establishment of a barge/traffic area (BTA) on the ORR just north of the CRN site would also be necessary. The BTA would encompass an inactive barge terminal that would be refurbished and roadways would be improved in order to receive and transport SMR components to the CRN site. Additionally, segments of transmission systems well beyond the CRN site would require modifications to support the proposed facility. According to the proposal, these locations are in the following counties: Franklin, Warren, White, Van Buren, Bledsoe, Rhea, Putnam, Cumberland, Roane, Anderson, Scott, Knox, Campbell, Grainger, Hawkins, Greene, Jefferson, Hamblen, and Cocke. These modifications would include uprating, reconductoring, or rebuilding existing transmission lines. Correspondence indicates that additional ROWs would not be established, cleared, or widened to support these activities.

The proposed CRN cooling system consist of an intake system, discharge system, and an atmospheric discharge for heat. As indicated in the correspondence, a maximum of 25,608 gallons per minute (gpm) would be withdrawn from the Clinch River to make up for water lost or used via drift (8 gpm), evaporation (12,800 gpm), and blowdown (12,800 gpm). The Clinch River would receive the discharge from the blowdown.

According to the Service's IPaC database, several federally threatened and endangered species potentially occur within near proximity of the proposed CRN site, ORR (site 2 and 8), and the proposed transmission line upgrades. We have included a species list as an enclosure to this letter, which identifies a list of species that may occur near the identified action areas. The Service recommends that you evaluate the proposed project for potential direct and indirect impacts to these listed species or their habitats in compliance with section 7 of the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.). While evaluating potential impacts to these species, please also consider modification of any associated critical habitat for listed species.

While the project proponent is not required to consult on petitioned species, Section 7(a)(4) of the Endangered Species Act of 1973 does provide a mechanism for identifying and resolving potential conflicts between a proposed action and proposed species during the early planning stage. Therefore, we take this opportunity to recommend that you consider impacts to the hellbender (*Cryptobranchus alleganiensis*), petitioned for listing in FY18. There are historic records of this species occurring near the proposed site of the CRN. Additionally, there are records of the Berry Cave salamander (*Gyrinophilus gulolineatus*), which is petitioned for listing in FY19.

The Service recommends that you coordinate with the Tennessee Wildlife Resources Agency and Tennessee Department of Environment and Conservation's Natural Heritage Program to address concerns regarding state listed species. Please anticipate that a Service representative will attend the public meeting on May 15, 2017. Thank you for the opportunity to comment on the proposed action. If you have any questions regarding our comments, please contact Dustin Boles of my staff at 931/525-4984 or at dustin_boles@fws.gov.

Sincerely,

Mary E. Jennings
Field Supervisor

Enclosures as stated

Table 1. Federally listed species which may occur within near proximity of the proposed CRN and ORR sites.

Species – Common Name	Scientific Name	Federal Status	Critical Habitat Within Action Area
Alabama Lampmussel	*Lampsillis virescens*	Endangered	No
Anthony's Riversnail	*Athearnia anthonyi*	Endangered	No
Cracking Pearlymussel	*Hemistena lata*	Endangered	No
Cumberland Bean	*Villosa trabalis*	Endangered	No
Dromedary Pearlymussel	*Dromus dromas*	Endangered	No
Fanshell	*Cyprogenia stegaria*	Endangered	No
Finerayed Pigtoe	*Fusconaia cuneolus*	Endangered	No
Gray bat	*Myotis grisescens*	Endangered	No
Indiana bat	*Myotis sodalis*	Endangered	No
Northern Long-eared Bat	*Myotis septentrionalis*	Threatened	No
Orangefoot Pimpleback	*Plethobasus cooperianus*	Endangered	No
Pink Mucket	*Lampsillis abrupta*	Endangered	No
Purple Bean	*Villosa perpurpurea*	Endangered	No
Ring Pink	*Obovaria retusa*	Endangered	No
Rough Pigtoe	*Pleurobema plenum*	Endangered	No
Sheepnose Mussel	*Plethobasus cyphyus*	Endangered	No
Shiny Pigtoe	*Fusconaia cor*	Endangered	No
Snail Darter	*Percina tanasi*	Threatened	No
Spectaclecase	*Cumberlandia monodonta*	Endangered	No
Spotfin Chub	*Erimonax monachus*	Threatened	No
Turgid Blossom	*Epioblasma turgidula*	Endangered	No
Virginia Spiraea	*Spiraea virginiana*	Threatened	No
White Fringeless Orchid	*Platanthera integrilabia*	Threatened	No
White Wartyback	*Plethobasus cicatricosus*	Endangered	No

Table 2. Federally listed species which may occur within near proximity of the proposed transmission line upgrades.

Species – Common Name	Scientific Name	Federal Status	Critical Habitat Within Action Area
Anthony Riversnail	*Athearnia anthonyi*	Endangered	No
Appalachian Elktoe	*Alasmidonta raveneliana*	Endangered	No
Birdwing Pearlymussel	*Lemiox rimosus*	Endangered	No
Blackside Dace	*Chrosomus* [= *Phoxinus*] *cumberlandensis*	Threatened	No
Bluemask (Jewel) Darter	*Etheostoma akatulo*	Endangered	No
Catspaw	*Epioblasma obliquata obliquata*	Endangered	No
Chucky Madtom	*Noturus crypticus*	Endangered	Yes
Clubshell	*Pleurobema clava*	Endangered	No
Cracking Pearlymussel	*Hemistena lata*	Endangered	No
Cumberland Bean	*Vilosa trabalis*	Endangered	No
Cumberland Elktoe	*Alasmidonta atropurpurea*	Endangered	Yes
Cumberland Monkeyface	*Quadrula intermedia*	Endangered	No
Cumberland Pigtoe	*Pleurobema gibberum*	Endangered	No
Cumberland Rosemary	*Conradina verticillata*	Threatened	No
Cumberland Sandwort	*Arenaria cumberlandensis*	Endangered	No
Cumberlandian Combshell	*Epioblasma brevidens*	Endangered	Yes
Dromedary Pearlymussel	*Dromus dromas*	Endangered	No
Duskytail Darter	*Etheostoma percurum*	Endangered	No
Fanshell	*Cyprogenia stegaria*	Endangered	No
Finerayed Pigtoe	*Fusconaia cuneolus*	Endangered	No
Fluted Kidneyshell	*Ptychobranchus subtentum*	Endangered	Yes
Gray Myotis	*Myotis grisescens*	Endangered	No
Hart's-tongue Fern	*Asplenium scolopendrium var. americanum*	Threatened	No
Indiana Myotis	*Myotis sodalis*	Endangered	No
Large-flowered Skullcap	*Scuttellaria montana*	Threatened	No
Laurel Dace	*Chrosomus saylori*	Endangered	Yes
Littlewing Pearlymussel	*Pegias fabula*	Endangered	No
Morefield's Leather-flower	*Clematis morefieldii*	Endangered	No
Northern Long-eared Bat	*Myotis septentrionalis*	Threatened	No
Orangefoot Pimpleback	*Plethobasus cooperianus*	Endangered	No
Oyster Mussel	*Epioblasma capsaeformis*	Endangered	Yes
Pale Lilliput	*Toxolasma cylindrellus*	Endangered	No
Palezone Shiner	*Notropis albizonatus*	Endangered	No

Pink Mucket	*Lampsillis abrupta*	Endangered	No
Price's Potato-bean	*Apios priceana*	Threatened	No
Purple Bean	*Vilosa perpurpurea*	Endangered	Yes
Rabbitsfoot	*Quadrula cylindrica cylindrica*	Threatened	No
Rayed Bean	*Villosa fabalis*	Endangered	No
Ring Pink	*Obovaria retusa*	Endangered	No
Rough Pigtoe	*Pleurobema plenum*	Endangered	No
Rough Rabbitsfoot	*Quadrula cylindrica strigillata*	Endangered	No
Sheepnose	*Plethobasus cyphyus*	Endangered	No
Shiny Pigtoe	*Fusconaia cor*	Endangered	No
Slabside Pearlymussel	*Pleuronaia dolabelloides*	Endangered	Yes
Slender Chub	*Erimystax cahni*	Threatened	No
Small Whorled Pogonia	*Isotria medeoloides*	Threatened	No
Snail Darter	*Percina tanasi*	Threatened	No
Snuffbox	*Epioblasma triquetra*	Endangered	No
Spectaclecase	*Cumberlandia monodonta*	Endangered	No
Spotfin Chub	*Erimonax monachus*	Threatened	Yes
Tan Riffleshell	*Epioblasma florentina walkeri*	Endangered	No
Virginia Spiraea	*Spiraea virginiana*	Threatened	No
White Fringeless Orchid	*Platantherea integrilabia*	Threatened	No
White Wartyback	*Plethobasus cicatricosus*	Endangered	No
Yellowfin Madtom	*Noturus flavipinnis*	Threatened	No

From: Long, Larry <Long.Larry@epa.gov>
Sent: Tuesday, May 30, 2017 2:56 PM
To: ClinchRiverESPEIS
Cc: Vokoun, Patricia; Militscher, Chris
Subject: [External_Sender] Informal Pre-permit Clinch River Nuclear Site

I have reviewed the Nuclear Regulatory Commission's Opens House materials and the federal registry solicitation for public comments in reference to Tennessee Valley Authority's (TVA) Pre-Permit application for the Clinch River Nuclear generation station in Oak Ridge TN. Keeping with Nuclear Regulatory' s (NRC's) mission to protect public health and safety, promote common defense and security, and to protect the environment, along with EPA's mission for the protection of public health and the environment, Region 4 NEPA Program Office provides the following comments for your considerations.

NRC and TVA may want to consider the advantages of early consultation with federal, state and tribal agencies for the purpose of streamlining the permitting process during the NEPA analysis. One advantage of an early consultation process could be TVA obtaining their environmental permits shortly after the NEPA Record of Decision (ROD) issuance. The inclusion of NRC's systematic approach (10 CFR Part 51) along with state and federal permitting issues into the NRC's pre-permitting process can provide a streamline NEPA analysis that helps to eliminate duplications in the permitting analysis. This will help to provide a more productive analytical process overall.

NRC and TVA may also want to consider incorporating the Army Corps of Engineers into the early consultation process to include Clean Water Act (CWA) 404 permitting requirements, such as avoidance and minimization, along with mitigation requirements, if any.
A major issue with nuclear facilities is the disposal of radioactive waste products. NRC may want to consider an economic feasibility comparison study for vitrification of waste products verses current storage and disposal practices as part of the EIS.

Please provide us with a copy (electronic, CD with two hardcopies) of future NEPA documents when they become available.
Thank you for your time.

Larry Long
Physical Scientist/Sr. Principle Reviewer
NEPA
Resource Conservation & Restoration Division
EPA Region 4
61 Forsyth Street, SW
Atlanta, GA 30303
404-562-9460
404-562-9598(FAX)
long.larry@epa.gov

part of it. If you have received this message in error, please notify the sender immediately by email and delete all copies of the message.

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
NASHVILLE, TENNESSEE 37243-0435

ROBERT J. MARTINEAU, JR.
COMMISSIONER

BILL HASLAM
GOVERNOR

June 12, 2017

Via Electronic Mail to ClinchRiverESPEIS@nrc.gov
Attn: Patricia Vokoun, NRC Environmental Project Manager
Office of New Reactors
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Ms. Vokoun:

The Tennessee Department of Environment and Conservation (TDEC) appreciates the opportunity to provide comments on the Nuclear Regulatory Commission (NRC) Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS) related to the *Tennessee Valley Authority (TVA) early site permit (ESP) for the Clinch River Nuclear (CRN) Site* near Oak Ridge, Tennessee.[1] TDEC understands that the ESP application by TVA is an initial determination process for resolving safety and environmental siting issues for a potential future Small Modular Reactor (SMR) at the CRN Site, but does not authorize construction and operation of a nuclear power plant. Additionally, as a Federal agency, TVA is required to comply with the National Environmental Policy Act (NEPA) and the National Historic Preservation Act (NHPA) independently of NRC requirements. The NRC expects to publish a draft EIS in June 2018. The proposed CRN Site, is located in Roane County, Tennessee, along the Clinch River, approximately 25 miles west-southwest of downtown Knoxville, Tennessee.

Water Resources

- Given the expected activity associated with this proposed project, the following TDEC permitting requirements are likely to apply.[2] The construction of a Small Modular Reactor (SMR) at the TVA CRN Site will require a construction storm water permit based on the land disturbance at the site being more than one acre.[3] A National Pollutant Discharge Elimination

[1] For more information on the TVA CRN proposal, including the ESP Application (ML16144A086) please visit https://www.nrc.gov/reactors/new-reactors/esp/clinch-river.html. Specific information regarding the TVA CRN proposal as is discussed in TDEC's consolidated response is taken from the Part 3 – Environmental Report submitted as part of TVA's ESP to NRC. The Part 3 – Environmental Report can be found at https://www.nrc.gov/docs/ML1614/ML16144A145.html.
[2] As this is a scoping document for a forthcoming EIS, there is not sufficient information to address the requirements for the permits in more detail. There have not been any public water supply intakes, wells or springs identified that would be impacted from the proposed facility, but as additional details are provided more permitting requirements may be necessary.
[3] For more information on NPDES Stormwater Construction Permitting please visit http://www.tn.gov/environment/article/permit-water-npdes-stormwater-construction-permit.

Permit (NPDES) permit will be required for the discharge from the facility into the Clinch River.[4] An Aquatic Resource Alteration Permit (ARAP) will be required for the water withdrawal at the facility.[5] This facility will also be required to have a Tennessee Storm Water Multi-Sector General Permit, which will include the barge loading and offloading facility.[6]

- The TVA CRN Site Part 3 – Environmental Report submitted to the NRC as part of the ESP Application notes that due to the interactions of the Watts Bar Dam, Melton Hill Dam and Fort Loudon Dam, that the river flow "can be upstream, downstream or quiescent, depending on the modes of operation" within the vicinity of the site. This could mean that for short periods of time, the intake at the CRN facility would be downstream of the NPDES discharge point for the facility. It is not clear what impact if any this flow reversal would have, but TDEC recommends that the forthcoming EIS consider this variable.

- Investigations by DOE and TDEC's Division of Remediation (DoR) – Oak Ridge Office have shown that there is deep ground water flow that goes under the Clinch River from the Oak Ridge National Laboratory (ORNL).[7] Migration of chlorinated solvents within the Conasauga Group formation, under the Clinch River along strike to the southwest, has resulted in contaminated private wells at Hoods Ridge. There is also suspected contamination from Oak Ridge Reservation in the Jones Island area across the Clinch River from Oak Ridge Reservation as well. TDEC recommends that any private well or spring use occurring in the area be investigated as a part of the EIS to address the unique geology and hydraulic connectivity of the site. TDEC also recommends that the extent of the existing ground water contamination, including pre-existing radiological constituents and volatile organic compounds in the groundwater, at the proposed CRN Site be determined by TVA and addressed in the forthcoming draft EIS.[8]

Solid Waste Management

- According to the TVA CRN ESP Application Part 3 – Environmental Report, the CRN Site SMR is expected to be a Small Quantity Generator (SQG) of Hazardous Waste and will also construct and operate an on-site landfill[9] for construction/demolition wastes. Any nonradioactive

---

[4] For more information on NPDES Discharge Permitting please visit https://www.tn.gov/environment/article/permit-water-national-pollutant-discharge-elimination-system-npdes-permit.
[5] For more information on the ARAP program please visit https://www.tn.gov/environment/article/permit-water-aquatic-resource-alteration-permit.
[6] For more information on the NPDES Industrial Stormwater General Permit program please visit http://www.tn.gov/environment/article/permit-water-npdes-industrial-stormwater-general-permit.
[7] The proposed CRN Site is located in complex folded/faulted karst geology of the Valley and Ridge Province. The Copper Creek Thrust Fault cuts southwest/northeast across the "toe" of the boot-shaped site. A lesser unnamed thrust fault cuts across the northern portion of the site. Karst ground water flow does not behave as laminar flow and does not follow Darcy's Law – interstitial porosity plays a very minor role but appears to be a significant focus in TVA's investigations. The beds of the Chickamauga Group formations in the area are dipping at 30 plus degrees to the southeast. Ground water flow is going to generally be along strike of the beds to the southwest, as is evidenced from the offsite contamination from the Department of Energy (DOE) ORNL.
[8] TVA notes in its CRN Site ESP Application Part 3 – Environmental Report that monitoring well OW-422L in the center of the CRN Site has petroleum-based contamination. This location is slightly more than ½ mile west of the area of Hoods Ridge where chlorinated solvent contamination has been identified from the DOE ORNL. The existence of pre-existing site contamination is an issue of concern for both TDEC Division of Remediation and Division of Water Resources.
[9] If TVA wishes to construct and operate a solid waste disposal facility (i.e., construction/demolition landfill) at the CRN Site they will be required to obtain a landfill permit from the TDEC Division of Solid Waste Management. Information about the permitting process and required application materials can be found at http://www.tn.gov/environment/article/permit-waste-landfill-permit.

hazardous and nonhazardous wastes associated with the construction, operation, and decommissioning of the CRN facility as well as construction of an on-site landfill must be handled in accordance the state's Solid and Hazardous Waste Rules and Regulations.[10] Furthermore, mixed wastes (e.g. containing low-level radioactive waste) with a hazardous component must be handled in accordance with the NRC requirements but also with the aforementioned Rules and Regulations. TDEC recommends that waste management considerations as specifically regulated by the Rules and Regulations of the state of Tennessee be incorporated in the forthcoming NRC EIS.

- Sections 3.6 and 5.5 of the Environmental Report describe the various hazardous and non-hazardous waste streams that are expected to be generated as well as their impacts and procedures for management (e.g. Spill/Discharge Response Program, TVA-approved vendors for transport and disposal, a Waste Minimization Plan). While this information is informative, TDEC recommends further discussion of specific hazardous and mixed waste management and monitoring practices, treatment methods, and storage areas for attaining compliance with the state and limiting adverse environmental impacts and irreversible environmental commitments during construction and operation of the facility and its offsite rail, barge terminal, and underground transmission line improvement projects in the forthcoming NRC EIS.

Air Pollution Control

- Should any land clearing activities or disposal of brush or trees/tree limbs occur, TDEC prefers that wood waste be disposed of by chipping, grinding, or composting rather than open burning. However, if open burning does occur during site preparation and construction, open burning regulations should be followed. TDEC recommends that detailed clearing activities, total amount of areas where soils are to be disturbed, and associated impacts be addressed in the draft EIS.[11]

- Water cooling tower emissions are evaluated for permitting and have been permitted at other existing TVA nuclear plants. The water vapor itself is not a regulated emission, however the resultant particulates that arise from evaporation (minerals found in the local river water or streams) are considered to be potential emissions as are any algaecide or slime mold/fungus treatments added to the water to act as a biocide. Cooling towers are also associated with certain other potential pathogenic airborne illnesses including Legionnaire's disease and some amoebae considered harmful. The site may have air contaminant emissions from other onsite air emission sources that are required to have an air contaminant permit from the Division of Air Pollution Control. TDEC recommends that appropriate entities involved in the project review potentially applicable air permits as well as work with the Division of Air Pollution Control to ensure all emission sources are properly identified and permitted.[12]

[10] Reference TDEC SWM Rule 0400 Chapter 11 for Solid Waste and Chapter 12 for Hazardous Waste http://sos.tn.gov/effective-rules.
[11] TDEC APC Rule 1200-3-4-.01 et seq., http://sos.tn.gov/effective-rules. Additional information on open burning in Tennessee is available at https://tn.gov/environment/article/apc-open-burning and http://www.burnsafetn.org/.
[12] For more information on TDEC Air Pollution Control permits please visit https://www.tn.gov/environment/topic/permit-air.

Archaeology

- TDEC concurs with the plan to conduct Phase I/II site evaluation of the property proposed for the TVA CRN Site. This archaeological evaluation will determined if prehistoric and/or historic sites eligible for the National Register of Historic Places (NRHP) are located within the proposed property. If an archaeological site is determined eligible for inclusion on the NRHP, additional archaeological considerations will be necessary for the project to move forward.[13]

TDEC appreciates the opportunity to comment on this NOI from NRC to prepare an EIS for the TVA CRN Site. Please note that these comments are not indicative of approval or disapproval of the proposed action or its alternatives, nor should they be interpreted as an indication regarding future permitting decisions by TDEC. Please contact me should you have any questions regarding these comments.

Sincerely,

Kendra Abkowitz

Kendra Abkowitz, PhD
Director of Policy and Planning
Tennessee Department of Environment and Conservation
Kendra.Abkowitz@tn.gov
(615) 532-8689

cc: Barry Brawley, TDEC, DOR
Lacey Hardin, TDEC, APC
Lisa Hughey, TDEC, SWM
Tom Moss, TDEC, DWR
Mark Norton, TDEC, DOA

[13] For more information on the Tennessee Division of Archeology please visit https://www.tn.gov/environment/section/arch-archaeology. If there are site specific archaeological questions please contact Jennifer Barnett at (615)687-4780 or Jennifer.Barnett@tn.gov.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Tennessee ES Office
446 Neal Street
Cookeville, Tennessee 38501

July 20, 2017

Mr. Allen H. Fetter
Licensing Branch 3
Division of New Reactor Licensing
Office of New Reactors
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

John T. Baxter, Jr.
Manager
Biological Compliance
Tennessee Valley Authority
WT 11C-K
400 West Summit Hill Drive
Knoxville, Tennessee 37902

Subject: FWS# 2017-I-0473. U.S. Nuclear Regulatory Commission (NRC) – Updated List of Federally Threatened and Endangered Species that Potentially Occur near the Proposed Clinch River Small Modular Nuclear Reactor Facility in Oak Ridge, Roane County, Tennessee.

Dear Mr. Fetter and Mr. Baxter:

At the request of the Tennessee Valley Authority (TVA), the U.S. Fish and Wildlife Service (Service) attended a meeting with TVA and NRC staff on July 11, 2017, in regards to the proposed Clinch River Small Modular Reactor Nuclear Facility (CRN) in Oak Ridge, Roane County, Tennessee. The meeting included discussions and verification of the federally threatened and endangered species list provided by the Service and addressed to the NRC in a letter dated May 5, 2017.

TVA provided the Service with a CRN species list based upon the TVA database, which was addressed to the Service dated September 7, 2016. The Service did not respond to this letter, which was a request to verify the species list; however, receipt of this correspondence by the Service has not been verified. The species list provided by TVA identified only those species that could occur on or in proximity to the CRN site in Roane County, Tennessee. At the time of this TVA correspondence, transmission system work associated with development of the CRN site had not been identified.

As previously established during NRC's Environmental Impact Statement Scoping Meeting on May 17, 2017, the species lists in TVA's September 7, 2016, correspondence to the Service and the Service's May 15, 2017, correspondence to NRC were not identical. The Service attributes these differences, in part, to the lack of a completely defined action area at the time of the NRC species list request. The Service's species list was compiled using the IPaC database for Roane County, Tennessee, which represents a 326.18 square mile area, according to IPaC. The TVA has now described the action area in Roane County as the 935-acre CRN site, the Clinch River embayment of Watts Bar Reservoir, and the mainstem Tennessee River portion of Watts Bar Reservoir downstream to Watts Bar Dam. Also included in the current action area are segments of TVA's transmission system in Franklin, Warren, White, Van Buren, Bledsoe, Rhea, Putnam, Cumberland, Roane, Anderson, Scott, Knox, Campbell, Grainger, Hawkins, Greene, Jefferson, Hamblen, and Cocke counties, Tennessee. The Service considers several previously identified species extirpated from the described action area. As a result of these discussions and determinations, the TVA and Service have examined each federally protected species previously identified and have mutually agreed upon which species warrant further consideration.

The proposed CRN facility would be located on an approximate 935-acre site on the northern bank of the Clinch River arm of Watts Bar Reservoir. Furthermore, the proposed site is located downstream of Melton Hill Dam between Clinch River Mile 14.5 and 19. The site was evaluated in the 1970's by the TVA for a breeder reactor, which resulted in some site excavation being performed. However, the breeder reactor was not completed and the site was revegetated. The proposed action is to construct and operate two (2) or more small modular reactors at the CRN site.

The proposed CRN cooling system consist of an intake system, discharge system, and an atmospheric discharge for heat. As indicated in the correspondence, a maximum of 25,608 gallons per minute (gpm) would be withdrawn from the Clinch River to make up for water lost or used via drift (8 gpm), evaporation (12,800 gpm), and blowdown (12,800 gpm). The Clinch River would receive the discharge from the blowdown.

To support the CRN, it would be necessary for the TVA to construct a new 69-kV underground transmission line, approximately 5-miles long, within existing right-of-ways (ROWs) for an active 500-kV overhead transmission line to connect the CRN switchyard to 69-kV transformers at the Bethel Valley Substation on the Oak Ridge Reservation (ORR). TVA would also re-route an existing 161-kV overhead transmission line to avoid the proposed new power block location. Establishment of a barge/traffic area (BTA) on the ORR just north of the CRN site would also be necessary. The BTA would encompass an inactive barge terminal that would be refurbished and roadways would be improved in order to receive and transport SMR components to the CRN site. Additionally, segments of transmission systems well beyond the CRN site would require modifications to support the proposed facility. According to the proposal, these modification locations are all within the nineteen (19) counties listed above. These modifications could include uprating, re-conductoring, or rebuilding existing transmission lines. Correspondence indicates that additional ROWs would not be established, cleared, or widened to support these activities. The current action area, as defined by TVA and the Service, would include all affected transmission line segments within the previously identified counties, as well as the CRN site in Roane County, Tennessee.

As discussed, the Service originally identified species with potential to occur within or in near proximity of the area using the Service's IPaC database for Roane County, Tennessee. Upon further consideration, the Service has removed several federally threatened and endangered species from the CRN list. We have included this updated species list as an enclosure to this letter (Table 1.). The following species are not considered extant within the project action area and have been removed from the Service's species list: Alabama lampmussel (*Lampsillis virescens*), Anthony's riversnail (*Athearnia anthonyi*), cracking pearlymussel (*Hemistena lata*), Cumberland bean (*Villosa trabalis)*, dromedary pearlymussel (*Dromus dromas*), fanshell (*Cyprogenia stegaria*), finerayed pigtoe (*Fusconaia cuneolus*), orangefoot pimpleback (*Plethobasus cooperianus*), purple bean (*Villosa perpurpurea*), ring pink (*Obovaria retusa*), rough pigtoe (*Pleurobema plenum*), shiny pigtoe (*Fusconaia cor*), snail darter (*Percina tanasi*), spectaclecase (*Cumberlandia monodonta*), turgid blossom (*Epioblasma turgidula*), Virginia spiraea (*Spiraea virginiana*), white fringeless orchid (*Platanthera integrilabia*), and white wartyback (*Plethobasus cicatricosus*).

The entire species list for the transmission line upgrades provided by the Service in May 5, 2017, correspondence to NRC should be carried forward for further analysis; including designated critical habitat (DCH) crossed by or adjacent to the proposed transmission line upgrades. Species with DCH within or adjacent to the project action area are identified in the species list (Table 2.). The Service recommends that you evaluate the proposed project for potential direct, indirect, and cumulative impacts to these listed species or their habitats in compliance with section 7 of the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

While the project proponent is not required to consult on petitioned species, Section 7(a)(4) of the Endangered Species Act of 1973 does provide a mechanism for identifying and resolving potential conflicts between a proposed action and proposed species during the early planning stage. Therefore, we take this opportunity to recommend that you consider impacts to the hellbender (*Cryptobranchus alleganiensis*), petitioned for listing in FY18. IPaC and TVA data indicate there are historic records of this species occurring near the proposed site of the CRN.

The Service recommends that you coordinate with the Tennessee Wildlife Resources Agency and Tennessee Department of Environment and Conservation's Natural Heritage Program to address concerns regarding state listed species. If you have any questions regarding our comments, please contact Dustin Boles of my staff at 931/525-4984 or at dustin_boles@fws.gov.

Sincerely,

Mary E. Jennings

Mary E. Jennings
Field Supervisor

Enclosures as stated

Table 1. Federally listed species, occurring near the CRN site, Roane County, Tennessee.

Species – Common Name	Scientific Name	Federal Status	Critical Habitat Within Action Area
Gray bat	*Myotis grisescens*	Endangered	No
Indiana bat	*Myotis sodalis*	Endangered	No
Northern Long-eared Bat	*Myotis septentrionalis*	Threatened	No
Pink Mucket	*Lampsillis abrupta*	Endangered	No
Sheepnose Mussel	*Plethobasus cyphyus*	Endangered	No
Spotfin Chub	*Erimonax monachus*	Threatened	No

Table 2. Federally listed species, which may occur within near proximity of the proposed transmission line upgrades: Franklin, Warren, White, Van Buren, Bledsoe, Rhea, Putnam, Cumberland, Roane, Anderson, Scott, Knox, Campbell, Grainger, Hawkins, Greene, Jefferson, Hamblen, and Cocke counties, Tennessee.

Species – Common Name	Scientific Name	Federal Status	Critical Habitat Within or Adjacent to the Action Area
Anthony Riversnail	*Athearnia anthonyi*	Endangered	No
Appalachian Elktoe	*Alasmidonta raveneliana*	Endangered	No
Birdwing Pearlymussel	*Lemiox rimosus*	Endangered	No
Blackside Dace	*Chrosomus* [= *Phoxinus*] *cumberlandensis*	Threatened	No
Bluemask (Jewel) Darter	*Etheostoma akatulo*	Endangered	No
Catspaw	*Epioblasma obliquata obliquata*	Endangered	No
Chucky Madtom	*Noturus crypticus*	Endangered	Yes
Clubshell	*Pleurobema clava*	Endangered	No
Cracking Pearlymussel	*Hemistena lata*	Endangered	No
Cumberland Bean	*Vilosa trabalis*	Endangered	No
Cumberland Elktoe	*Alasmidonta atropurpurea*	Endangered	Yes
Cumberland Monkeyface	*Quadrula intermedia*	Endangered	No
Cumberland Pigtoe	*Pleurobema gibberum*	Endangered	No
Cumberland Rosemary	*Conradina verticillata*	Threatened	No
Cumberland Sandwort	*Arenaria cumberlandensis*	Endangered	No
Cumberlandian Combshell	*Epioblasma brevidens*	Endangered	Yes
Dromedary Pearlymussel	*Dromus dromas*	Endangered	No
Duskytail Darter	*Etheostoma percurum*	Endangered	No
Fanshell	*Cyprogenia stegaria*	Endangered	No

Finerayed Pigtoe	*Fusconaia cuneolus*	Endangered	No
Fluted Kidneyshell	*Ptychobranchus subtentum*	Endangered	Yes
Gray Myotis	*Myotis grisescens*	Endangered	No
Hart's-tongue Fern	*Asplenium scolopendrium var. americanum*	Threatened	No
Indiana Myotis	*Myotis sodalis*	Endangered	No
Large-flowered Skullcap	*Scuttellaria montana*	Threatened	No
Laurel Dace	*Chrosomus saylori*	Endangered	Yes
Littlewing Pearlymussel	*Pegias fabula*	Endangered	No
Morefield's Leather-flower	*Clematis morefieldii*	Endangered	No
Northern Long-eared Bat	*Myotis septentrionalis*	Threatened	No
Orangefoot Pimpleback	*Plethobasus cooperianus*	Endangered	No
Oyster Mussel	*Epioblasma capsaeformis*	Endangered	Yes
Pale Lilliput	*Toxolasma cylindrellus*	Endangered	No
Palezone Shiner	*Notropis albizonatus*	Endangered	No
Pink Mucket	*Lampsillis abrupta*	Endangered	No
Price's Potato-bean	*Apios priceana*	Threatened	No
Purple Bean	*Vilosa perpurpurea*	Endangered	Yes
Rabbitsfoot	*Quadrula cylindrica cylindrica*	Threatened	No
Rayed Bean	*Villosa fabalis*	Endangered	No
Ring Pink	*Obovaria retusa*	Endangered	No
Rough Pigtoe	*Pleurobema plenum*	Endangered	No
Rough Rabbitsfoot	*Quadrula cylindrica strigillata*	Endangered	No
Sheepnose	*Plethobasus cyphyus*	Endangered	No
Shiny Pigtoe	*Fusconaia cor*	Endangered	No
Slabside Pearlymussel	*Pleuronaia dolabelloides*	Endangered	Yes
Slender Chub	*Erimystax cahni*	Threatened	No
Small Whorled Pogonia	*Isotria medeoloides*	Threatened	No
Snail Darter	*Percina tanasi*	Threatened	No
Snuffbox	*Epioblasma triquetra*	Endangered	No
Spectaclecase	*Cumberlandia monodonta*	Endangered	No
Spotfin Chub	*Erimonax monachus*	Threatened	Yes
Tan Riffleshell	*Epioblasma florentina walkeri*	Endangered	No
Virginia Spiraea	*Spiraea virginiana*	Threatened	No
White Fringeless Orchid	*Platantherea integrilabia*	Threatened	No
White Wartyback	*Plethobasus cicatricosus*	Endangered	No
Yellowfin Madtom	*Noturus flavipinnis*	Threatened	No

From: Pat Black
To: Becker, James M
Subject: RE: thanks for the Watts Bar Reservoir creel survey report
Date: Wednesday, September 06, 2017 2:15:19 PM
Attachments: Count_WB_4_2016.xlsx
Inter_WB_4_2016.xlsx
Harv_WB_4_2017.xlsx
SurveyCodes_TWRA.pdf

Hey Jim,

I queried the three tables that make up our creel database to only include data taken from area 4 on Watts Bar from 2016. I also included a list of survey codes used to help you make sense of it.

Below is a description of the area from the Region 3 Reservoir Manager, Mike Jolley.

" Pat,

The creel area on Watts Bar that you were inquiring about is area #4. This incorporates the area that Mr. Beckor referenced. The lower boundary is the Kingston Steam Plant (Clinch River) and the upper boundary is Melton Hill Dam also located on the Clinch River. This area #4 also includes the Emory River from its mouth up to the city of Harriman. The Emory River empties into the Clinch River a mile or so above the Kingston Steam Plant. I hope this helps!

Mike Jolley
TWRA Region 3
Reservoir Fisheries Manager/Biologist "

Pat Black, TWRA
Reservoir Program Coordinator

From: Becker, James M [mailto:James.Becker@pnnl.gov]
Sent: Wednesday, September 06, 2017 12:07 PM
To: Pat Black
Subject: RE: thanks for the Watts Bar Reservoir creel survey report

Hi Pat,

How's it coming with the below? Thank you, Jim

From: Pat Black [mailto:Pat.Black@tn.gov]
Sent: Friday, August 18, 2017 1:08 PM
To: Becker, James M
Subject: RE: thanks for the Watts Bar Reservoir creel survey report

Yes,

Once I get that info from the Reg. 3 manager I'll pass it on to you.

From: Becker, James M [mailto:James.Becker@pnnl.gov]
Sent: Friday, August 18, 2017 3:06 PM
To: Pat Black
Subject: RE: thanks for the Watts Bar Reservoir creel survey report

All right. Thanks Pat. Could you also indicate where the Watts Bar zone starts and stops.

Thank you,

Jim

From: Pat Black [mailto:Pat.Black@tn.gov]
Sent: Friday, August 18, 2017 7:25 AM
To: Becker, James M
Subject: RE: thanks for the Watts Bar Reservoir creel survey report

Hey Jim,

I can give you the raw data. I've contacted our region 3 reservoir manager to get the zone delineations for Watts Bar. He said the zone will encompass a larger area than just the Clinch river portion. This will be the smallest scale available. We don't record location on individual interviews. Once I get the delineations and zone number that contains the area you are interested in, I can query our statewide database and send you the Watts Bar data. We are moving offices today so It will be next week before I will be able to finish this.

Pat Black

From: Becker, James M [mailto:James.Becker@pnnl.gov]
Sent: Thursday, August 17, 2017 7:28 PM
To: Pat Black
Subject: RE: thanks for the Watts Bar Reservoir creel survey report

Or would we be able to identify and break out 2) the surveys from Melton Hill dam down to where interstate 40 crosses the Clinch River (just below the confluence with the Emory River)?

Or if that won't work, could you send us the data for 3) Roane County (it's a longer stretch of river but at least it's not all of Watts Bar Reservoir)?

From: Becker, James M
Sent: Thursday, August 17, 2017 5:16 PM
To: 'Pat Black'
Subject: RE: thanks for the Watts Bar Reservoir creel survey report

Hi Pat,

Thanks again for the report. You mentioned that the analysis in the report pertaining to Watts Bar

Reservoir is reservoir-wide and cannot be broken down to parse out the evaluation for from Melton Hill dam down to the confluence of the Emory River. Can you give us the raw creel data for Watts Bar Reservoir? If you can, would we be able to identify and break out, in order of preference, 1) the surveys from Melton Hill dam down to the confluence of the Emory River?

Thank you,

Jim

From: Pat Black [mailto:Pat.Black@tn.gov]
Sent: Wednesday, August 16, 2017 10:21 AM
To: Becker, James M
Subject: RE: thanks for the Watts Bar Reservoir creel survey report

You're Welcome.

From: Becker, James M [mailto:James.Becker@pnnl.gov]
Sent: Wednesday, August 16, 2017 12:15 PM
To: Pat Black
Subject: thanks for the Watts Bar Reservoir creel survey report

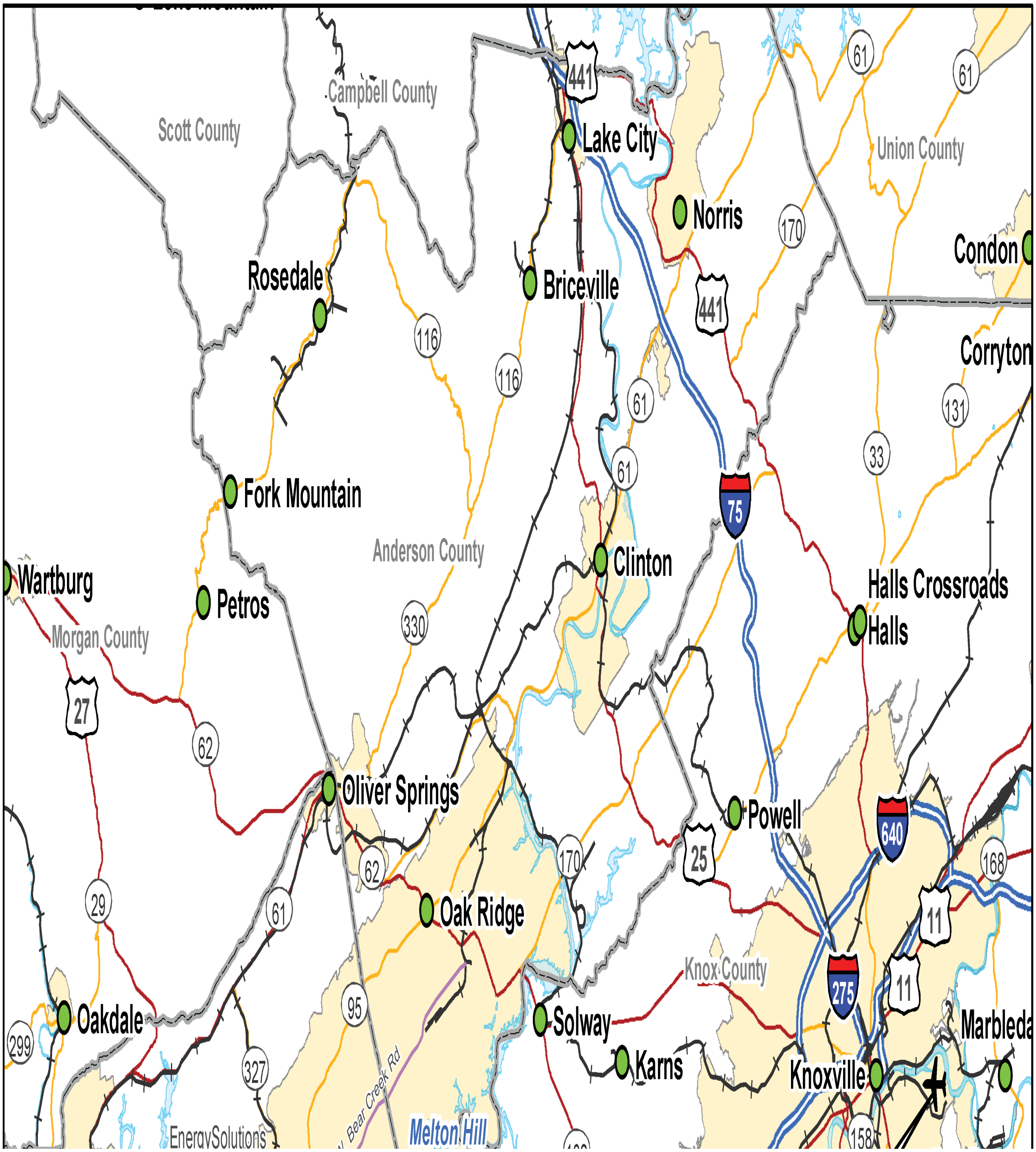
From: Gerry Middleton <Gerry.Middleton@tn.gov>
Sent: Thursday, September 07, 2017 1:46 AM
To: Becker, James M
Subject: Re: Bat data report 2013
Attachments: Acoustic Monitoring of ORR Bats 2013.docx

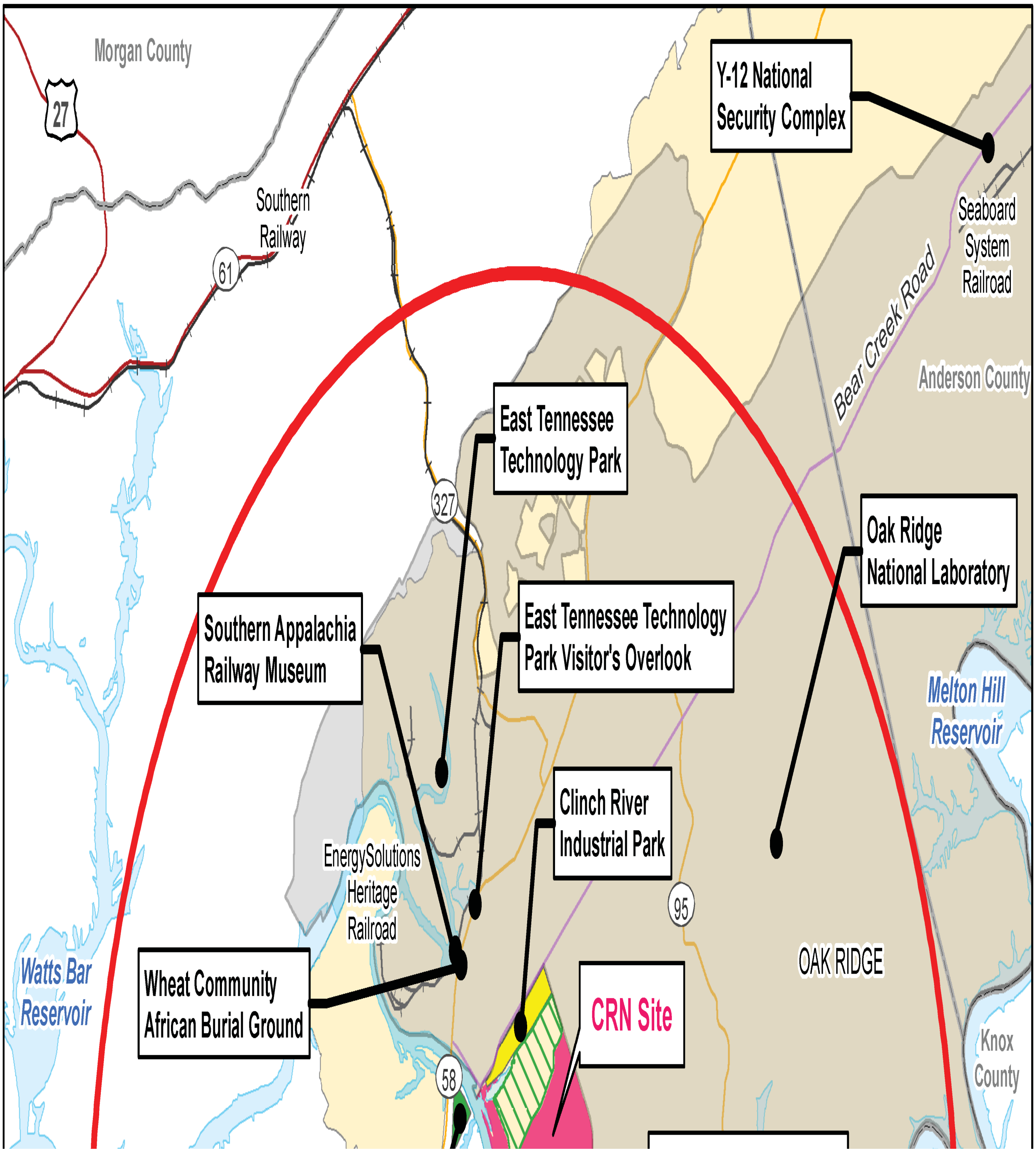
Hi James,

I'm sending 3 Oak Ridge Reservation acoustic bat survey data (2013, 2014, & 2015) via 3 emails. You may have to do a bit of "data mining" to find what you need in the reports, but hopefully these will be helpful. If you've any questions or need further information please let me know.

thanks!
Gerry

From: Becker, James M <James.Becker@pnnl.gov>
Sent: Thursday, August 17, 2017 5:06 PM
To: Gerry Middleton
Subject: RE: hi and thanks


Campbell County
Scott County
Union County
Lake City
Norris
Condon
Rosedale
Briceville
Corryton
Fork Mountain
Anderson County
Clinton
Wartburg
Petros
Morgan County
Halls Crossroads
Halls
Oliver Springs
Powell
Oak Ridge
Knox County
Oakdale
Solway
Karns
Knoxville
Marbleda
Bear Creek Rd
Melton Hill
EnergySolutions
441
61
170
116
131
33
75
27
62
330
640
25
168
11
29
95
327
275
299
158


Morgan County
27
Southern Railway
61
Y-12 National Security Complex
Seaboard System Railroad
Bear Creek Road
Anderson County
East Tennessee Technology Park
327
Oak Ridge National Laboratory
Southern Appalachia Railway Museum
East Tennessee Technology Park Visitor's Overlook
Melton Hill Reservoir
Clinch River Industrial Park
EnergySolutions Heritage Railroad
95
Watts Bar Reservoir
Wheat Community African Burial Ground
OAK RIDGE
CRN Site
Knox County
58

From: Stephanie.Ann Williams
To: Becker, James M
Subject: RE: Map package for TN NHP
Date: Monday, September 11, 2017 3:17:30 PM
Attachments: image001.png

Hi Jim-

I should have mentioned in the first email that the missing t-lines (092, 186, 624, 659, 697, and 940) are because there are no rare species observations within the buffer distance for those required lines. Sorry for any confusion.

Please let me know if you have any additional questions.
Kind regards-
Stephanie

Stephanie Williams | Data Manager
Division of Natural Areas – Natural Heritage Program
Tennessee Tower, 2nd Floor
312 Rosa L. Parks Avenue, Nashville, TN 37243 MAP
p. 615-532-4799 c. 256-337-3858
stephanie.ann.williams@tn.gov
tn.gov/environment
Natural Areas Facebook
We value your feedback! Please complete our customer satisfaction survey.

From: Becker, James M [mailto:James.Becker@pnnl.gov]
Sent: Friday, September 08, 2017 5:10 PM
To: Stephanie.Ann Williams
Subject: RE: Map package for TN NHP

Hi Stephanie,

I looked at the spreadsheets you sent and it appears data for some t-lines is missing (092, 186, 624, 659, 697, and 940).

Thank you,

Jim

From: Stephanie.Ann Williams [mailto:Stephanie.Ann.Williams@tn.gov]
Sent: Friday, September 01, 2017 12:37 PM
To: Becker, James M
Subject: RE: Map package for TN NHP

Hi Jim-

I parsed out sites 2 and 8 of the attached excel workbook.

Yes, it is OK to have our response docketed.

Have a great weekend!
Stephanie

Stephanie Williams | Data Manager
Division of Natural Areas – Natural Heritage Program
Tennessee Tower, 2nd Floor
312 Rosa L. Parks Avenue, Nashville, TN 37243 **MAP**
p. 615-532-4799 c. 256-337-3858
stephanie.ann.williams@tn.gov
tn.gov/environment
Natural Areas Facebook
We value your feedback! Please complete our customer satisfaction survey.

From: Becker, James M [mailto:James.Becker@pnnl.gov]
Sent: Wednesday, August 30, 2017 4:47 PM
To: Stephanie.Ann Williams
Subject: RE: Map package for TN NHP

Hi Stephanie,

Thank you very much for your response to our data request.

We routinely acknowledge the source of NHP data we use in producing documents on behalf of the Nuclear Regulatory Commission (NRC), and will do so with the TN NHP data.

The NRC must docket the NHP data referenced in its documents to make the data available to the general public (beyond those organizations you indicated in #1 in your below email). Per the data request, it appears you did not provide location-specific information (e.g., coordinates) in your response, so is it OK to have your response docketed? Please confirm or let me know what modifications you would need to make to your data package in order to make it acceptable to TN NHP for NRC docketing.

In the data package, the data for alternative sites 2 and 8 are grouped together. Would it be possible for you to put the data for each alternative site in its own spreadsheet and re-send?

Thank you,

Jim

From: Stephanie.Ann Williams [mailto:Stephanie.Ann.Williams@tn.gov]
Sent: Wednesday, August 30, 2017 1:12 PM
To: Becker, James M
Cc: Montgomery, Sadie A
Subject: RE: Map package for TN NHP

Mr. Becker-

Please find attached the Tennessee Natural Heritage Program's (TNHP) rare species data and invoice. The excel workbook contains sheets for each of the requested buffer areas.

Reminder about our data:

1. The information provided to you by TNHP is intended for distribution or use only within your department, agency, organization, or business. Should individuals or entities outside your organization/project team ask you for data that we are providing, please refer them to TNHP.

2. As a professional courtesy, we ask that you acknowledge TNHP as a source of your information whenever you use TNHP data in your reports, papers, or publications that incorporate TNHP data. However, site-specific locational information should not be provided to third parties, published, or otherwise distributed in any way without written permission by TNHP.

Please contact me should you have any questions.
Kind regards-
Stephanie

Stephanie Williams | Data Manager
Division of Natural Areas – Natural Heritage Program
Tennessee Tower, 2nd Floor
312 Rosa L. Parks Avenue, Nashville, TN 37243 **MAP**
p. 615-532-4799 c. 256-337-3858
stephanie.ann.williams@tn.gov
tn.gov/environment
Natural Areas Facebook
We value your feedback! Please complete our customer satisfaction survey.

From: Becker, James M [mailto:James.Becker@pnnl.gov]
Sent: Friday, August 18, 2017 2:23 PM
To: Stephanie.Ann Williams; David Withers
Cc: Montgomery, Sadie A
Subject: Map package for TN NHP

***** This is an EXTERNAL email. Please exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email - STS-Security. *****

Hi Stephanie and Dave,

I enjoyed our conversations earlier this week. We have **two requests**.

The **first request** concerns the attached map package (mpk) containing the following files, with the buffers within which we would like TN NHP to identify species and habitat (terrestrial and aquatic) (of concern to both the State and Federal governments) occurrences in parentheses:

CRN Site Boundary (within 2 miles of the site boundary on all sides)
Barge Area (within 2 miles of the site boundary on all sides)
Potential Candidate (aka Alternative) Sites 2 & 8 (within 2 miles of the boundary on all sides of each site)
Transmission Line Segments requiring upgrades (within 1/8 [0.125] mile on either side of each line [identified as "LXXXX"])
CRN Site Vicinity Transmission Line (extending east of CRN Site boundary to the Bethel Valley substation) (within 1/8 [0.125] mile on either side)

I am copying Sadie Montgomery on this email, as she is the one who put the attached mpk file together and can answer any questions you might have regarding extracting the files, etc.

The **second request** concerns aquatic species and habitat occurrences only, in the Clinch River between Melton Hill dam and the confluence of the Emory River (located just east of where Interstate 40 crosses the Clinch River). Note that there is no line feature (in a shape file) we can send you that defines this reach of the Clinch River. I hope you can identify it from the above description.

If you could report findings for the 5 attached files and the Clinch River in a sortable spreadsheet (or each in its own individual Excel spreadsheet), that would be much appreciated. Note that we do not need coordinates for species/habitat locations rather just a list of the species/habitats with occurrences within the specified buffers.

Thank you very much for helping us with this. If you have any other questions, besides regarding extracting the mpk files, please call me at 509-371-7186.

Thank you,

Jim Becker

From:	McCracken, Kitty
To:	Becker, James M
Subject:	Fish data for Ish Creek, Oak Ridge, TN
Date:	Monday, September 18, 2017 4:29:08 PM
Attachments:	IshCk_fishdata.xlsx

Hi Jim.

Attached is fish population data from Fall 2016 and Spring 2017 for Ish Creek on the Oak Ridge Reservation.

Let me know if you need any other data.

Thanks,

Kitty McCracken

From: Jett, Robert T.
Sent: Monday, September 18, 2017 4:02 PM
To: McCracken, Kitty <mccrackenmk@ornl.gov>
Subject: RE: Ish Creek data

Here's data from the last year. Numbers w/o parentheses are density values numbers in parentheses are biomass values.
Trent

From: McCracken, Kitty
Sent: Monday, September 18, 2017 8:23 AM
To: Jett, Robert T. <jettrt@ornl.gov>
Subject: Ish Creek data

Hi Trent,

Would you send me the latest Ish Creek data you have for fish?

Thanks.

Kitty

From: Nongame Review
To: Becker, James M
Subject: Environmental Review
Date: Sunday, September 24, 2017 9:09:34 AM
Attachments: ir-17418-asy-2017-09-24-10-53-49.pdf

Hi James-

Please see attached Environmental Review for the Georgia portion of the proposed transmission line (SMR ESP) project. If I can be of additional assistance, do not hesitate to contact me-

Thanks!
Anna

Anna Yellin
Environmental Review Coordinator, Nongame Conservation

Wildlife Resources Division
(706) 557-3283 | M: (678) 459-8393

Facebook • Twitter • Instagram
Buy a hunting or fishing license today!

A division of the
GEORGIA DEPARTMENT OF NATURAL RESOURCES

September 29, 2017

James Becker
Pacific Northwest National Laboratory
902 Batelle Blvd
Richland, WA 99354

Data Request 18-020

Dear Mr. Becker,

This letter is in response to your data request of September 27, 2017 for the Clinch River Small Modular Reactor in Bell and Whitley Counties, Kentucky. We have reviewed our Natural Heritage Program Database to determine if any of the endangered, threatened, or special concern plants and animals or exemplary natural communities monitored by the Kentucky State Nature Preserves Commission occur near the project area on Eagan, Frakes, Kayjay, and Artemus USGS Quadrangles as indicated in the file provided to us. Please see the attached Excel file and geodatabase for more information.

Element Occurrence Records
1-mile for all records – 42 records
5-mile for aquatic records – 81 records
5-mile for federally listed species – 55 records
10-mile for mammals and birds – 38 records

This project intersects four different managed areas and three conservations sites including a Kentucky Division of Water Outstanding Resource Water. Please use the attached geodatabase with corresponding feature classes (managed areas and conservation sites) to determine proximity and impact. KSNPC is not regulatory but recommends contacting the proper authorities (KDOW, KY DEP, KDFWR, USFWS, etc.) about impacts to the managed lands and conservation lands.

Certain taxa are considered sensitive by KSNPC because either they exist in limited geographic areas, or they have certain characteristics or habitat requirements that make them especially vulnerable to specific pressures such as collection, human disturbance, etc. Measures should be taken to avoid the disturbance of possible habitat for these species. For this reason, the exact location of some species has not been included in the enclosed data report. Please contact

KSNPC for more information.

This project as planned goes through one or more large forest blocks. KSNPC is now monitoring large forest blocks, which are defined as 900 or more acres of contiguous forest. Large forest blocks were determined using the best available data at this time. Forest fragmentation is one of the primary impacts to plants and animals that require large tracts of forest for all parts of their life cycles. Fragmenting or impacting large forest blocks should be avoided.

I would like to take this opportunity to remind you of the terms of the data request license, which you agreed upon in order to submit your request. The license agreement states "Data and data products received from the Kentucky State Nature Preserves Commission, including any portion thereof, may not be reproduced in any form or by any means without the express written authorization of the Kentucky State Nature Preserves Commission." The exact location of plants, animals, and natural communities, if released by the Kentucky State Nature Preserves Commission, may not be released in any document or correspondence. These products are provided on a temporary basis for the express project (described above) of the requester, and may not be redistributed, resold or copied without the written permission of the Kentucky State Nature Preserves Commission's Heritage Branch (801 Teton Trail, Frankfort, KY, 40601. Phone: (502) 573-2886).

Please note that the quantity and quality of data collected by the Kentucky Natural Heritage Program are dependent on the research and observations of many individuals and organizations. In most cases, this information is not the result of comprehensive or site-specific field surveys; many natural areas in Kentucky have never been thoroughly surveyed and new plants and animals are still being discovered. For these reasons, the Kentucky Natural Heritage Program cannot provide a definitive statement on the presence, absence, or condition of biological elements in any part of Kentucky. Heritage reports summarize the existing information known to the Kentucky Natural Heritage Program at the time of the request regarding the biological elements or locations in question. They should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. We would greatly appreciate receiving any pertinent information obtained as a result of on-site surveys.

If you have any questions or if I can be of further assistance, please do not hesitate to contact me.

Sincerely,

Ian Horn
Geoprocessing Specialist

Enclosures: Data Report and Interpretation Key

From: Brian Flock
To: Becker, James M
Subject: RE: Climch River small modular nuclear reactor project- 2 figures this time
Date: Friday, November 03, 2017 12:10:29 PM

Unfortunately the way the data is aggregated it is difficult to really give you good answers on some of this. I know that all the data is based on bats in hand because it was from scientific permits and we don't have any way with our system to track acoustics. For the roost data I know that in those two areas I have clusters of bats data and my familiarity with the projects that were done there I know that in those clusters were at least 1 maternity roost.

Closest known IBat Hibernacula are Grassy Cove Saltpeter (Cumberland County) and White Oak Blowhole (Blount County, Smoky National Park) both 30+ miles
Closest known NLEB is Marble Bluff Cave (Roane County) 8 miles It also has summer record of Gray Bats (TVA data)
Hibernacula data with cave name and county can be found here
http://www.tnbwg.org/TNBWG_WNS.html

Brian Flock, Ph. D.

From: Becker, James M [mailto:James.Becker@pnnl.gov]
Sent: Friday, November 3, 2017 12:44 PM
To: Brian Flock
Subject: RE: Climch River small modular nuclear reactor project- 2 figures this time

Thank you for helping. I have some further questions. Hope you don't mind.

To what do the distances refer, mist net captures or acoustic recordings of the species within those distances from the peninsula? Or is it something else?

When you say the closest roost, does that mean maternity roost or non-maternity (satellite male/non-reproductive female) roost?

Anything on gray bat roosts or hibernacula? Anything on NLEB or IB hibernacula?

Are you at liberty to release data or reports related to the above?

Thanks again,

Jim

From: Brian Flock [mailto:Brian.Flock@tn.gov]
Sent: Friday, November 03, 2017 8:18 AM

To: Becker, James M
Subject: RE: Climch River small modular nuclear reactor project- 2 figures this time

Sorry, It took me longer than expected. I lost access to ArcGIS for about 3 weeks, which put me behind. I used the peninsula to estimate distances.

Here is what I can give you.

0 to 4 miles Gray bat
8 to 12 miles Gray bat and Northern Myotis
16 to 20 miles Gray bat

Closest Indiana bat roost we have data on is Blount County, Cherokee Forest
Closest Northern Myotis roost we have data on is Morgan County, Catoosa WMA

Hope this helps for your review.

Brian Flock, Ph. D.
Wildlife Action Plan Coordinator
Tennessee Wildlife Resources Agency
PO Box 40747
Nashville, TN 37204
Ph: 615-781-6569

From: Becker, James M [mailto:James.Becker@pnnl.gov]
Sent: Thursday, August 17, 2017 1:40 PM
To: Brian Flock
Subject: FW: Climch River small modular nuclear reactor project- 2 figures this time

***** This is an EXTERNAL email. Please exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email - STS-Security. *****

Trying again…

From: Becker, James M
Sent: Thursday, August 17, 2017 11:09 AM
To: 'brian.flock@tn.gov'
Subject: FW: Climch River small modular nuclear reactor project

---

From: Becker, James M

Sent: Wednesday, August 16, 2017 9:06 AM
To: 'Chris Simpson'
Subject: RE: Climch River small modular nuclear reactor project

Thought I did but didn't. Here they are. Thanks, Jim

From: Chris Simpson [mailto:Chris.Simpson@tn.gov]
Sent: Wednesday, August 16, 2017 6:52 AM
To: Becker, James M
Subject: RE: Climch River small modular nuclear reactor project

Thank you, did you send any attachments? Thanks, Chris.

From: Becker, James M [mailto:James.Becker@pnnl.gov]
Sent: Tuesday, August 15, 2017 7:01 PM
To: Chris Simpson
Subject: Climch River small modular nuclear reactor project

Hi Chris,

I have attached several figures to help you find and orient yourself to the above project. As we discussed on the phone, TVA proposes to construct and operate a small modular nuclear reactor on what I will call the Clinch River peninsula in the Clinch River arm of Watts Bar Reservoir. The Clinch River Site (CRN Site) is labeled in pink in the first figure. The CRN Site and the adjacent Grassy Creek Habitat Protection Area (HPA) is shown in the 2nd figure. In addition to these, the Barge Traffic Area (BTA) is found in the 3rd figure. The BTA would also be developed and road improvements made for the unloading of large components transported upriver.

Note that TVA's environmental report (part of its application to the Nuclear Regulatory Commission for this project) states that there are no known caves or mines on the Clinch River Site, the 935 acre project area. There are also no known caves in the Grassy Creek HPA. Liz Hamrick's bat survey report for the project states the following about nearby caves,

"Exposed rock features reflect that underground karst features are present in some areas, which may provide habitat for small mammals, green salamanders, and roosting bats. Two previously documented caves (Gage 2011), Rennies Cave and 2-Batteries Cave, are located within Grassy Creek HPA. Three additional caves/karst openings near Grassy Creek were encountered by botanical staff during surveys of the HPA....Roosting bats were observed in Rennies Cave by archaeological surveyors in April, 2011. Photos of 2 individual bats were taken by surveyors and later reviewed by terrestrial zoology staff. One bat was identified as a tricolored bat (*Perimyotis subflavus*); the other bat individual could not be identified based on the photo."

Hope this helps. There may well be more caves in the nearby area, but these are the only ones noted in TVA's references. If you have any questions, call at 509-371-7186.

Thank you,

Jim

From:	Giffen, Neil R.
To:	Becker, James M
Subject:	RE: Question about a former area of "very high biological significance" on the Clinch River Site
Date:	Wednesday, November 08, 2017 8:01:11 AM
Attachments:	Nature Conservancy BSR Table.pdf Nature Conservancy BSR Map.pdf Nature Conservancy BSR Descriptions.pdf

Jim,

This area was originally identified to be of significance in a 1995 Nature Conservancy report that studied biodiversity on the Oak Ridge Reservation (ORR). You are correct when you say that the area was not noted in the 2009 Baranski report because is not part of the reservation. However, there is still a portion of that area that is on the reservation (shown as RA22 in the 2009 Baranski Report). The current description of that area in the ORR natural areas database is the following:

RA22 GRASSY CREEK SECURITY SITE

Location: Northwest-facing slope of Chestnut Ridge in the Grassy Creek watershed. Grid E5; section 2E.

Size: 43.1 acres (17.4 ha)

General description: This area contains limestone outcrops on the slope. Two of the species found here, Wild Ginger (*Asarum canadense*) and Jacob's Ladder (*Polemonium reptans*), are uncommon on the ORR.

Status species present:

Rare communities present:

Wetlands:

Other factors: The area probably consisted of intact forest in 1935.

Disturbances and external effects: Gas line on northeastern edge. Adjacent to private land. Disturbance impacts = Low to Intermediate.

Previous recognitions: Part of BSR2-5.

The Nature Conservancy assigned biodiversity significance ranks (BSRs) to areas based on the resources found in the particular area. I have attached the table from the 1995 document that describes those ranks. The full 100 acre area noted in the 2006 Parr report was known as BSR2-5 in the 1995 Natural Conservancy report. I have attached the map and relevant text from that report that describes the site. The description is similar to how we describe the current RA22. Please also note BSR2-6, is another area of significance in that area. The reference for the 1995 Nature Conservancy report is the following:

TNC (The Nature Conservancy). 1995. "Oak Ridge Reservation, Biodiversity, and the Common Ground Process: Preliminary Biodiversity Report on the Oak Ridge Reservation." Unpublished report. TNC, Arlington, Virginia.

I hope this helps. If you have any questions or need anything further, let me know.

Neil

Neil R. Giffen
Natural Resources Manager
office phone: 865-241-9421
cell phone: 865-963-9974
email: giffennr1@ornl.gov

From: Becker, James M [mailto:James.Becker@pnnl.gov]
Sent: Friday, November 03, 2017 8:00 PM
To: Giffen, Neil R.
Subject: Question about a former area of "very high biological significance" on the Clinch River Site

Hi Neil. I was wondering if you can help me with the following.

Parr and Hughes (2006, see Figures 12 and 13) identified an area of about 100 ac in the eastern portion of the CRN Site that extended from just east of the CRBR footprint to the Clinch River as having "very high biological significance" due to confirmed and potential habitat for (unidentified species of) rare plants and wildlife. It is likely this area contained the (unidentified) rare plant species that were located just beyond the Clinch River Breeder Reactor (CRBR) footprint and which were protected from disturbance during redress (DOE 1984, DOE et al. 1984). However, Parr and Hughes (2006) was superseded by Baranski (2009) which does not indicate any important habitats occurring on the Clinch River Site (see Figure 1 in Baranski 2009), including this approximate 100-ac area. Baranski (2009) did not indicate why this area identified by Parr and Hughes (2006-TN5058) was excluded.

My question is why this 100-ac area was excluded by Baranski (2009). Was it because the species found there (which are not identified) were no longer considered rare or of concern (would be odd given the area probably supported the rare plant species noted by DOE in 1984 and that the area was again referenced for rare plants by Parr and Hughes in 2006 after 20 years)? Was it because suddenly it was decided that since the Clinch River Site was not part of the Oak Ridge Reservation (ORR) that the area wasn't included (note that the Clinch River Site has not been part of the ORR since before the Clinch River Breeder Reactor and yet the 100-ac area was included in the Parr and Hughes [2006] document)?

If you could answer this for me, I would greatly appreciate it.

Thank you,

Jim

References

Baranski, M.J. 2009. *Natural Area Analysis and Evaluation, Oak Ridge Reservation*. ORNL/TM-2009-201, Oak Ridge National Laboratory, Oak Ridge, Tennessee. Accession No. ?? TN 5133.

Parr, P.D. and J.F. Hughes. 2006. *Oak Ridge Reservation Physical Characteristics and Natural Resources*. ORNL-2006-G01046/lmh, Oak Ridge National Laboratory, Oak Ridge,

Tennessee. Accession No. ?? TN5058.

From: Giffen, Neil R.
To: Becker, James M
Subject: RE: Question about a former area of "very high biological significance" on the Clinch River Site
Date: Thursday, December 07, 2017 10:02:32 AM

Jim,

Yes, BSR2-6 is not included in the Baranski report because it is no longer part of the Oak Ridge Reservation. The site was recognized by The Nature Conservancy back in 1995 for the areas' significant river bluffs. I believe you have that referenced in the previous information I sent to you. If you can't find it, please let me know. There is also a record for Appalachian bugbane (*Cimicifuga rubifolia*) for that area. This is a species that was previously listed by the state of Tennessee, but is no longer. It is considered as a G3 on the global scale. We still consider it of conservation concern for the reservation because of its rarity.

I hope this helps. If you need anything further, please let me know.

Neil

Neil R. Giffen
Natural Resources Manager
office phone: 865-241-9421
cell phone: 865-963-9974
email: giffennr1@ornl.gov

From: Becker, James M [mailto:James.Becker@pnnl.gov]
Sent: Wednesday, December 06, 2017 8:45 PM
To: Giffen, Neil R.
Subject: RE: Question about a former area of "very high biological significance" on the Clinch River Site

Hi Neil. I just realized we had confusion over the 100-ac area I had questions on in my original email to you from Nov 3 below at the beginning of the string. The 100-ac area I was referring to is BSR2-6 (not BSR2-5 for which I believe your answer applies). My question is the same, namely:

Why this 100-ac area was excluded by Baranski (2009). Was it because the species found there (which are not identified) were no longer considered rare or of concern (would be odd given the area probably supported the rare plant species noted by DOE in 1984 and that the area was again referenced for rare plants by Parr and Hughes in 2006 after 20 years)? Was it because suddenly it was decided that since the Clinch River Site was not part of the Oak Ridge Reservation (ORR) that the area wasn't included (note that the Clinch River Site has not been part of the ORR since before the Clinch River Breeder Reactor and yet the 100-ac area was included in the Parr and Hughes [2006] document)?

Thank you,

Jim

From: Giffen, Neil R. [mailto:giffennr1@ornl.gov]
Sent: Friday, November 10, 2017 4:41 AM
To: Becker, James M
Subject: RE: Question about a former area of "very high biological significance" on the Clinch River Site

You're very welcome. If you need anything else, let me know. Best of luck with the writing!

Neil R. Giffen
Natural Resources Manager
office phone: 865-241-9421
cell phone: 865-963-9974
email: giffennr1@ornl.gov

From: Becker, James M [mailto:James.Becker@pnnl.gov]
Sent: Thursday, November 09, 2017 4:27 PM
To: Giffen, Neil R.
Subject: RE: Question about a former area of "very high biological significance" on the Clinch River Site

Thank you very much Neil!

APPENDIX G
SUPPORTING INFORMATION FOR RADIOLOGICAL DOSE ASSESSMENTS OF ROUTINE OPERATIONS (G.1) AND POSTULATED SEVERE ACCIDENTS (G.2)

G.1 Supporting Documentation for Radiological Dose Assessment from Normal Effluent Releases

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed and performed an independent dose assessment of the radiological impacts resulting from normal operation of small modular reactors (SMRs) at the Clinch River Nuclear (CRN) Site The results of these assessments are presented in this appendix and are compared to the results from the Tennessee Valley Authority's (TVA) assessment of routine operations found in Section 5.9 of this EIS, Radiological Impacts of Normal Operations.

Section G.1 is divided into four subsections that address estimates of dose to the public from liquid effluents (G.1.1), estimates of dose to the public from gaseous effluents (G.1.2), estimates of cumulative and population doses (G.1.3), and estimates of dose to nonhuman biota from liquid and gaseous effluents (G.1.4).

G.1.1 Estimates of Dose to the Public from Normal Liquid Effluents

The NRC staff used the dose assessment approach specified in Regulatory Guide 1.109 (NRC 1977-TN90) and the LADTAP II computer code (Strenge et al. 1986-TN82) to estimate doses to the maximally exposed individual (MEI) and population from the liquid effluent pathway of SMRs at the CRN Site.

G.1.1.1 Scope

Doses from SMRs on the CRN Site to the MEI were calculated and compared to regulatory criteria for the following:

- Total Body dose was the total for all pathways (i.e., ingestion of aquatic organisms as food and recreational activity on and near the Clinch River), and the highest value for either the adult, teen, child, or infant was compared to the 3-mrem/yr per reactor design objective in Title 10 of the *Code of Federal Regulations* (CFR) Part 50, Appendix I (10 CFR Part 50-TN249).
- Organ dose was the total for each organ for all pathways (i.e., ingestion of aquatic organisms as food and recreational activity on and near the Clinch River), and the highest value for the adult, teen, child, or infant was compared to the 10-mrem/yr per reactor design objective specified in 10 CFR Part 50, Appendix I (TN249).

The NRC staff reviewed the assumed exposure pathways and the input parameters and values used by TVA (2017-TN4921|). The NRC staff concluded that TVA accurately described the exposure pathways. Except where noted in Table G-1, the input parameters and values provided by TVA were found to be appropriate for the analyses. Where NRC staff took exception, alternative values were taken from either Regulatory Guide 1.109 (NRC 1977-TN90) or from other sources, as documented.

Table G-1. Parameters Used in Calculating Dose to the Public from Liquid Effluent Releases

Parameter	NRC Staff Value			Comments
	Nuclide	Per Unit[a]	Per Site[b]	
New unit liquid effluent source term (Ci/yr)	H-3	$2.21 \times 10^{+2}$	$8.85 \times 10^{+2}$	Values from Environmental Report (ER) Tables 3.5-1 and 3.5-2 (TVA 2017-TN4921).
	Na-24	2.80×10^{-3}	8.40×10^{-3}	
	Cr-51	1.07×10^{-2}	1.28×10^{-1}	
	Mn-54	5.44×10^{-3}	6.53×10^{-2}	
	Fe-55	4.06×10^{-3}	4.87×10^{-2}	
	Mn-56	2.72×10^{-4}	1.09×10^{-3}	
	Fe-59	9.92×10^{-4}	1.19×10^{-2}	
	Co-58	5.20×10^{-3}	5.51×10^{-2}	
	Co-60	2.05×10^{-3}	8.21×10^{-3}	
	Zn-65	1.76×10^{-3}	2.11×10^{-2}	
	W-187	2.10×10^{-4}	6.30×10^{-4}	
	Np-239	2.49×10^{-3}	2.99×10^{-2}	
	C-14	8.19×10^{-4}	9.83×10^{-3}	
	P-32	7.57×10^{-5}	3.03×10^{-4}	
	Ni-63	1.53×10^{-2}	1.84×10^{-1}	
	Cu-64	1.68×10^{-3}	6.72×10^{-3}	
	Br-82	1.87×10^{-6}	7.48×10^{-6}	
	Br-83	3.52×10^{-6}	1.41×10^{-5}	
	Br-84	8.38×10^{-5}	1.01×10^{-3}	
	Br-85	2.42×10^{-9}	9.68×10^{-9}	
	Rb-86	1.87×10^{-5}	7.48×10^{-5}	
	Rb-88	3.73×10^{-3}	1.49×10^{-2}	
	Rb-89	5.15×10^{-5}	6.18×10^{-4}	
	Sr-89	4.19×10^{-5}	1.67×10^{-4}	
	Sr-90	3.57×10^{-6}	1.43×10^{-5}	
	Y-90	1.55×10^{-7}	1.86×10^{-6}	
	Sr-91	1.67×10^{-4}	6.67×10^{-4}	
	Y-91	3.13×10^{-5}	1.25×10^{-4}	
	Y-91m	6.67×10^{-6}	2.67×10^{-5}	
	Sr-92	5.91×10^{-5}	2.36×10^{-4}	
	Y-92	2.25×10^{-4}	9.01×10^{-4}	
	Y-93	1.81×10^{-4}	7.25×10^{-4}	
	Zr-95	1.83×10^{-4}	2.20×10^{-3}	
	Nb-95	2.67×10^{-4}	1.07×10^{-3}	
	Zr-97	1.10×10^{-7}	4.40×10^{-7}	
	Mo-99	3.77×10^{-3}	4.52×10^{-2}	
	Tc-99	4.40×10^{-9}	1.76×10^{-8}	
	Tc-99m	1.89×10^{-3}	2.27×10^{-2}	
	Ru-103	6.57×10^{-4}	2.63×10^{-3}	
	Rh-103m	3.64×10^{-7}	4.37×10^{-6}	
	Ru-105	1.76×10^{-8}	7.04×10^{-8}	
	Rh-105	1.07×10^{-7}	4.27×10^{-7}	
	Ru-106	9.80×10^{-3}	3.92×10^{-2}	
	Rh-106	9.35×10^{-8}	3.74×10^{-7}	
	Ag-110	8.69×10^{-9}	3.48×10^{-8}	
	Ag-110m	2.22×10^{-3}	2.66×10^{-2}	
	Sb-124	5.73×10^{-5}	2.29×10^{-4}	
	Sb-125	1.98×10^{-9}	7.92×10^{-9}	
	Sb-127	1.10×10^{-8}	4.40×10^{-8}	
	Te-127	3.19×10^{-6}	1.28×10^{-5}	
	Te-127m	1.43×10^{-6}	5.72×10^{-6}	
	Sb-129	4.40×10^{-9}	1.76×10^{-8}	
	Te-129	4.13×10^{-5}	1.65×10^{-4}	
	I-129	4.20×10^{-10}	5.04×10^{-9}	
	Te-129m	2.30×10^{-2}	6.90×10^{-2}	
	I-130	4.62×10^{-6}	1.85×10^{-5}	

Table G-1. (contd)

Parameter	NRC Staff Value			Comments
	Te-131	1.01×10^{-5}	4.05×10^{-5}	
	I-131	1.38×10^{-2}	1.66×10^{-1}	
	Te-131m	6.60×10^{-4}	1.98×10^{-3}	
	Te-132	4.40×10^{-2}	1.32×10^{-1}	
	I-132	4.40×10^{-2}	1.32×10^{-1}	
	I-133	2.30×10^{-2}	2.76×10^{-1}	
	Te-134	2.64×10^{-7}	1.06×10^{-6}	
	I-134	3.26×10^{-3}	3.91×10^{-2}	
	Cs-134	2.87×10^{-3}	3.44×10^{-2}	
	I-135	1.37×10^{-2}	1.64×10^{-1}	
	Cs-136	2.93×10^{-3}	1.17×10^{-2}	
	Cs-137	3.53×10^{-3}	4.24×10^{-2}	
	Ba-137m	5.17×10^{-4}	2.07×10^{-3}	
	Cs-138	1.18×10^{-3}	1.42×10^{-2}	
	Ba-139	1.54×10^{-8}	6.16×10^{-8}	
	Ba-140	1.60×10^{-2}	4.80×10^{-2}	
	La-140	1.07×10^{-3}	4.27×10^{-3}	
	La-141	2.20×10^{-8}	8.80×10^{-8}	
	Ce-141	3.96×10^{-5}	1.58×10^{-4}	
	La-142	2.97×10^{-9}	1.19×10^{-8}	
	Ce-143	8.13×10^{-5}	3.25×10^{-4}	
	Pr-143	1.73×10^{-5}	6.93×10^{-5}	
	Ce-144	7.47×10^{-4}	2.99×10^{-3}	
	Pr-144	4.21×10^{-4}	1.69×10^{-3}	
	Nd-147	2.67×10^{-7}	1.07×10^{-6}	
	Pu-238	6.60×10^{-10}	2.64×10^{-9}	
	Pu-239	8.47×10^{-11}	3.39×10^{-10}	
	Pu-240	1.07×10^{-10}	4.27×10^{-10}	
	Pu-241	3.19×10^{-8}	1.28×10^{-7}	
	Am-241	4.62×10^{-11}	1.85×10^{-10}	
	Cm-242	9.46×10^{-9}	3.78×10^{-8}	
	Cm-244	4.40×10^{-10}	1.76×10^{-9}	
Discharge rate	4,670 ft^3/s			Value from ER Section 5.4.1.1 based on mean flow rate past Melton Hill Dam from 2004–2013 (TVA 2017-TN4921). TVA used 4,000 ft^3/s in its analysis.
Source term multiplier	1			Calculation on a per unit basis. Same value used by TVA in its analysis.
Site type	Fresh water			Discharge to Clinch River arm of Watts Bar Reservoir. Same assumption used by TVA in its analysis.
Impoundment reconcentration model	None			No impoundment. Same assumption used by TVA in its analysis.
Dilution factors for aquatic food and boating, shoreline, and swimming.	1			Value used by TVA in its analysis (conservative).
Transit time to receptor (hr)	0 hr			Value used by TVA in its analysis (conservative).

Table G-1. (contd)

Parameter	NRC Staff Value	Comments
Consumption and usage factors for adults, teens, children, and infants	Fish consumption (kg/yr) 21 (adult) 16 (teen) 6.9 (child) 0 (infant)	LADTAP II code default values used (NRC 1977-TN90; Strenge et al. 1986-TN82), except where noted.
	Crustacean consumption (kg/yr) 0 (adult) 0 (teen) 0 (child) 0 (infant)	Note: TVA used 5, 3.8, 1.7, and 0 kg/yr for crustacean consumption rates that correspond to LADTAP default values for saltwater sites.
	Aquatic plant consumption (kg/yr) 0 (adult) 0 (teen) 0 (child) 0 (infant)	
	Drinking water (l/yr) 730 (adult) 510 (teen) 510 (child) 330 (infant)	
	Shoreline usage (hr/yr) 12 (adult) 67 (teen) 14 (child) 0 (infant)	
	Swimming (hr/yr) 0 (adult) 0 (teen) 0 (child) 0 (infant)	Note: TVA used default shoreline usage values for swimming (i.e., 12, 67, 14, and 0 hr/yr).
	Boating (hr/yr) 0 (adult) 0 (teen) 0 (child) 0 (infant)	Note: TVA used default shoreline usage values for boating (i.e., 12, 67, 14, and 0 hr/yr).
50-mi population	2,643,269	Value from ER Section 2.5.1.4 estimated for year 2067. TVA used 2,658,157 in its analysis.
50-mi sport fishing[(c)]	1.87×10^6	Value used by TVA in its analysis.
50-mi commercial fishing[(c)]	5.93×10^6	Value used by TVA in its analysis.
50-mi sport invertebrate ingestion[(c)]	0	Minimal invertebrate harvest.
50-mi commercial invertebrate[(c)]	0	Minimal invertebrate harvest.
50-mi drinking water[(d)]	5.80×10^4	TVA used a value of 2.49×10^5 for the population within 50 mi served by Clinch or Tennessee Rivers for its source of drinking water.

Table G-1. (contd)

Parameter	NRC Staff Value	Comments
50-mi shoreline usage[c]	3.38×10^7 person-hr/yr	Time spent by the average individual on shoreline activities was taken from NRC RG 1.109 Table E-4 (NRC 1977-TN90). Person-hours per year were determined by multiplying the average rate of 12.8 hr/yr by the projected 2067 population of 2,643,269.
50-mi swimming usage[c]	3.38×10^7 person-hr/yr	Time spent by the average individual on shoreline activities was taken from NRC RG 1.109 Table E-4 (NRC 1977-TN90). The time spent swimming is assumed to be identical to that spent on shoreline activities. Person-hours/year were determined by multiplying the average rate of 12.8 hr/yr by the projected 2067 population of 2,643,269.
50-mi boating usage[c]	3.38×10^7 person-hr/yr	Time spent by the average individual on shoreline activities was taken from NRC RG 1.109 Table E-4 (NRC 1977-TN90). The time spent boating is assumed to be identical to that spent on shoreline activities. Person-hours/year were determined by multiplying the average rate of 12.8 hr/yr by the projected 2067 population of 2,643,269.
Milk production using Clinch River for irrigation	30,800 kg/yr	TVA value. Production within 50 mi was determined by multiplying the projected 2067 milk production within 50 mi by the percentage of irrigated state land within 50 mi (2.41 percent) and by the percentage of irrigation occurring with water from the Clinch River arm of Watts Bar Reservoir within 50 mi (0.67 percent).

Table G-1. (contd)

Parameter	NRC Staff Value	Comments
Meat production using Clinch River for irrigation	26,200 kg/yr	TVA value. Production within 50 mi was determined by multiplying the projected 2067 meat production within 50 mi by the percentage of irrigated state land within 50 mi (2.41 percent) and by the percentage of irrigation occurring with water from the Clinch River arm of Watts Bar Reservoir within 50 mi (0.67 percent).
Produce production using Clinch River for irrigation	113,000 kg/yr	TVA value. Production within 50 mi was determined by multiplying the projected 2067 produce production within 50 mi by the percentage of irrigated state land within 50 mi (2.41 percent) and by the percentage of irrigation occurring with water from the Clinch River arm of Watts Bar Reservoir within 50 mi (0.67 percent).

(a) Per unit is the plant parameter envelope (PPE) bounding value for a single SMR unit taken from ER Table 3.5-2 (TVA 2017-TN4921) and is used throughout this section.
(b) Per site is the PPE bounding value for the CRN Site taken from ER Table 3.5-1 (TVA 2017-TN4921) and is included for multi-unit (site-wide) analysis throughout this section.
(c) Parameter is based on the LADTAP II default value.
(d) Based on a review of data available at the U.S. Environmental Protection Agency's (EPA's) Safe Drinking Water Information System (SDWIS), the number of persons within 50 river miles downstream of the CRN Site liquid effluent discharge point (CRM 15.5) whose source of drinking water was the Clinch or Tennessee Rivers (directly or influenced by) was 40,534 in 2017. Using the annual population growth rate of 0.72 percent reported in Section 2.5.1.4 of TVA's ER (TVA 2017-TN4921), a population of 40,534 in 2017 would grow to 58,024 by 2067. EPA's SDWIS was accessed April 26, 2017 at: https://www.epa.gov/ground-water-and-drinking-water/safe-drinking-water-information-system-sdwis-federal-reporting.

To calculate doses to the public from liquid effluents, the NRC staff used a personal computer version of the LADTAP II code titled NRCDOSE, Version 2.3.13 (CNS 2006-TN102), obtained through the Oak Ridge Radiation Safety Information Computational Center (RSICC), and updates to the user interface obtained directly from Chesapeake Nuclear Services.

G.1.1.2 Input Parameters

Table G-1 provides a list of the major parameters used in calculating dose to the public from liquid effluent releases during normal operation.

G.1.1.3 Comparison of Results

The results documented in the TVA Environmental Report (ER) (TVA 2017-TN4921) for doses from liquid effluent releases are compared in Table G-2 with the results calculated by the NRC staff. The doses calculated by the NRC staff are considerably lower than the doses calculated by TVA, with one exception. Differences between the TVA and NRC staff parameter values are described in Table G-1 and includes differences in the 50-mi population, average river flow rate, some population-averaged activity and consumption rates, and the population obtaining drinking water from potentially contaminated sources. For calculating the population dose from liquid effluents, TVA used the population distribution for the year 2067. However, Section 5.4.1 of the NRC's Environmental Standard Review Plan (ESRP) (NRC 2000-TN614) uses a "projected population for 5 years from the time of the licensing action under consideration." Because the population is assumed to increase, the use of the year 2067 is conservative (i.e., yielding a higher calculated population dose). The NRC staff evaluated TVA's projected 2067 population distribution and determined they were reasonable. The single exception where the TVA estimate is less than the staff estimate is the liquid pathway population dose from the CRN Site with more than one SMR. The TVA estimate, described in a footnote to ER Table 5.4-17, is a multiple of 4 times the single-unit value. The staff's analysis and estimate are based on the PPE source term from ER Table 3.5-1, so the estimate is slightly larger.

Based on TVA's conservative approach, the NRC staff are confident that the liquid effluent doses from normal operations are bounding (i.e., actual doses are expected to be no higher than those presented by TVA).

Table G-2. Comparison of Doses to the Public from Liquid Effluent Releases for a New Nuclear Power Plant (Per Unit and Per Site)

Type of Dose	Value from TVA ER[(a)(b)]	NRC Staff Calculation	Percent Difference
Per Single Unit			
Total body (mrem/yr)	0.020 (adult)	0.015	-25
Organ dose (mrem/yr)	0.097 (adult GI-LLI)	0.044	-55
Thyroid (mrem/yr)	0.064 (child)	0.053	-17
Total body population dose from liquid pathway (person-rem/yr)	2.43	1.37	-44
Per Site			
Total body (mrem/yr)	0.17 (adult)	0.12	-29
Organ dose (mrem/yr)	0.66 (child kidney)	0.44	-33
Thyroid (mrem/yr)	0.66 (child)	0.56	-15
Total body population dose from liquid pathway (person-rem/yr)	9.6	14.6	+52

GI-LLI = gastrointestinal lining of lower intestine.
(a) Results per unit were taken from TVA ER Tables 5.4-8 and 5.4-12 (TVA 2017-TN4921).
(b) Results per site were taken from TVA ER Tables 5.4-9 and 5.4-17 (TVA 2017-TN4921).

G.1.2 Estimates of Dose to the Public from Normal Gaseous Effluents

The NRC staff used the dose assessment approach specified in Regulatory Guide 1.109 (NRC 1977-TN90) and the XOQDOQ and GASPAR II computer codes (Sagendorf et al. 1982-TN280; Strenge et al. 1987-TN83) to estimate doses to the MEI and to the population within a 50-mi radius of the CRN Site from the gaseous effluent pathway. The NRC staff used the projected per unit and per site radioactive gaseous effluents release values from the TVA ER and ER supplemental information (TVA 2017-TN4921).

G.1.2.1 Scope

The NRC staff reviewed the input parameters and values used by TVA for appropriateness. The MEI is assumed to be at 0.66 mi WNW of the CRN Site. The pathways considered included plume, ground, inhalation, and ingestion of locally grown meat, milk, and vegetables. Default values from Regulatory Guide 1.109 (NRC 1977-TN90) were used when site-specific input parameters were not available. Based on its review of available documents and understanding gained during the site audit, the NRC staff concluded that the assumed exposure pathways and input parameters were appropriate. These pathways and parameters were used by the NRC staff in its independent calculations using GASPAR II.

Joint frequency distribution data of wind speed and wind direction by atmospheric stability class for the CRN Site provided in ER Tables 2.7.5-2 to 2.7.5-8 (TVA 2017-TN4921) were used as input to the XOQDOQ code (Sagendorf et al. 1982-TN280) to calculate the average atmospheric dispersion factor (χ/Q, the annual average normalized air concentration value[s]) and deposition factor (D/Q, the annual normalized total surface concentration rate[s]) values for routine releases. The NRC staff reviewed the XOQDOQ output files provided by TVA and concluded they are appropriate for use in dose calculations for the gaseous effluents.

Population doses were calculated for all types of releases (i.e., noble gases, particulates, iodines, H-3, and C-14) using the GASPAR II code for the following: plume immersion; direct radiation from radionuclides deposited on the ground; inhalation; and ingestion of vegetables, milk, and meat.

G.1.2.2 Resources Used

To calculate doses to the public from gaseous effluents, the NRC staff used a personal computer version of the XOQDOQ and GASPAR II codes titled NRCDose Version 2.3.13 (CNS 2006-TN102) obtained through the Oak Ridge RSICC and updates to the user interface obtained directly from Chesapeake Nuclear Services.

G.1.2.3 Input Parameters

Table G-3 provides a list of the major parameters used in calculating dose to the public from gaseous effluent releases during normal operation.

Table G-3. Parameters Used in Calculating Dose to the Public from Gaseous Effluent Releases

Parameter	NRC Staff Value			Comments
	Nuclide	Per Unit[a]	Per Site[b]	
New unit gaseous effluent source term (Ci/yr)[a]	Ar-41	$4.00 \times 10^{+1}$	$5.44 \times 10^{+2}$	Values from Environmental Report (ER) Tables 3.5-3 and 3.5-4 (TVA 2017-TN4921).
	Kr-83m	1.07×10^{-3}	1.28×10^{-2}	
	Kr-85	$1.21 \times 10^{+2}$	$7.20 \times 10^{+2}$	
	Kr-85m	$8.47 \times 10^{+1}$	$3.39 \times 10^{+2}$	
	Kr-87	8.18×10^{0}	$3.27 \times 10^{+1}$	
	Kr-88	$3.63 \times 10^{+1}$	$1.45 \times 10^{+2}$	
	Kr-89	1.25×10^{-7}	5.00×10^{-7}	
	Xe-131m	$2.75 \times 10^{+2}$	$1.67 \times 10^{+3}$	
	Xe-133	$5.61 \times 10^{+2}$	$2.24 \times 10^{+3}$	
	Xe-133m	$2.63 \times 10^{+1}$	$1.05 \times 10^{+2}$	
	Xe-135	$7.04 \times 10^{+1}$	$2.82 \times 10^{+2}$	
	Xe-135m	3.19×10^{0}	$1.28 \times 10^{+1}$	
	Xe-137	7.50×10^{-1}	3.00×10^{0}	
	Xe-138	2.86×10^{0}	$1.14 \times 10^{+1}$	
	I-129	6.68×10^{-12}	8.02×10^{-11}	
	I-131	7.70×10^{-2}	2.31×10^{-1}	
	I-132	3.38×10^{-1}	1.35×10^{0}	
	I-133	2.63×10^{-1}	1.05×10^{0}	

Table G-3. (contd)

Parameter	NRC Staff Value			Comments
	Nuclide	Per Unit[(a)]	Per Site[(b)]	
	I-134	5.84×10^{-1}	2.33×10^{0}	
	I-135	3.72×10^{-1}	1.49×10^{0}	
	H-3	$3.10 \times 10^{+2}$	$1.01 \times 10^{+3}$	
	C-14	7.30×10^{0}	$1.00 \times 10^{+1}$	
	Na-24	6.25×10^{-4}	2.50×10^{-3}	
	P-32	1.24×10^{-4}	5.68×10^{-4}	
	Cr-51	5.42×10^{-3}	2.17×10^{-2}	
	Mn-54	8.35×10^{-4}	5.22×10^{-3}	
	Fe-55	1.00×10^{-3}	4.01×10^{-3}	
	Mn-56	5.24×10^{-4}	2.17×10^{-3}	
	Co-57	2.75×10^{-5}	1.10×10^{-4}	
	Co-58	2.30×10^{-2}	6.90×10^{-2}	
	Fe-59	1.25×10^{-4}	9.55×10^{-4}	
	Co-60	8.80×10^{-3}	2.64×10^{-2}	
	Ni-63	1.22×10^{-3}	1.46×10^{-2}	
	Cu-64	1.54×10^{-3}	6.18×10^{-3}	
	Zn-65	1.71×10^{-3}	6.86×10^{-3}	
	Br-84	1.07×10^{-6}	1.28×10^{-5}	
	Rb-88	8.17×10^{-7}	9.80×10^{-6}	
	Rb-89	6.67×10^{-6}	2.67×10^{-5}	
	Sr-89	3.00×10^{-3}	9.00×10^{-3}	
	Sr-90	1.20×10^{-3}	3.60×10^{-3}	
	Y-90	7.09×10^{-6}	2.84×10^{-5}	
	Sr-91	1.54×10^{-4}	6.18×10^{-4}	
	Y-91	3.72×10^{-5}	1.49×10^{-4}	
	Sr-92	1.21×10^{-4}	4.84×10^{-4}	
	Y-92	9.60×10^{-5}	3.84×10^{-4}	
	Y-93	1.71×10^{-4}	6.86×10^{-4}	
	Zr-95	1.00×10^{-3}	3.00×10^{-3}	
	Nb-95	2.50×10^{-3}	7.50×10^{-3}	
	Mo-99	9.19×10^{-3}	3.68×10^{-2}	
	Tc-99m	4.59×10^{-5}	1.83×10^{-4}	
	Ru-103	5.42×10^{-4}	2.17×10^{-3}	
	Rh-103m	1.23×10^{-9}	1.48×10^{-8}	
	Ru-106	7.80×10^{-5}	2.34×10^{-4}	
	Rh-106	3.81×10^{-12}	4.57×10^{-11}	
	Ag-110m	1.78×10^{-4}	2.14×10^{-3}	
	Sb-124	2.79×10^{-5}	1.12×10^{-4}	
	Sb-125	9.42×10^{-6}	3.77×10^{-5}	
	Te-129m	3.38×10^{-5}	1.35×10^{-4}	
	Te-131m	1.17×10^{-5}	4.68×10^{-5}	
	Te-132	5.94×10^{-6}	7.13×10^{-5}	
	Cs-134	2.30×10^{-3}	6.90×10^{-3}	
	Cs-136	9.19×10^{-5}	3.68×10^{-4}	
	Cs-137	8.14×10^{-3}	3.26×10^{-2}	
	Cs-138	2.63×10^{-5}	1.05×10^{-4}	
	Ba-140	4.17×10^{-3}	1.67×10^{-2}	
	La-140	2.79×10^{-4}	1.12×10^{-3}	
	Ce-141	1.42×10^{-3}	5.68×10^{-3}	
	Ce-143	9.63×10^{-9}	1.16×10^{-7}	
	Ce-144	2.92×10^{-6}	1.17×10^{-5}	
	Pr-144	2.92×10^{-6}	1.17×10^{-5}	
	W-187	2.92×10^{-5}	1.17×10^{-4}	
	Np-239	1.84×10^{-3}	7.35×10^{-3}	

Table G-3. (contd)

Parameter	NRC Staff Value	Comments
Population distribution	From ER Table 5.4-5 (TVA 2017-TN4921)	Site-specific population distribution within 50 miles of CRN Site projected to 2067
Maximum dispersion direction	WNW from ER Table 5.4-4 (TVA 2017-TN4921)	Site-specific meteorological data from June 1, 2011 through May 31, 2013 were used in the determination of maximum dispersion distance
Atmospheric dispersion factors (sec/m^3)	TVA ER Table 2.7.6-10 (TVA 2017-TN4921)	Based on site-specific meteorological data from June 1, 2011 through May 31, 2013
Ground deposition factors (m^{-2})	TVA ER Section 2.7 per Table 5.4-4 (TVA 2017-TN4921)	Site-specific data provided by TVA in ER Table 2.7.6-10
Annual milk production within the 50-mi radius of the site	1.91×10^8 kg/yr	From TVA ER Table 5.4-4 where TVA provided a projected kg/yr value to the year 2067.
Annual meat production within the 50-mi radius of the site	1.63×10^8 kg/yr	Site-specific data from ER Table 5.4-4 where TVA provided a projected value to the year 2067 (TVA 2017-TN4921)
Consumption factors for milk, meat, leafy vegetables, and vegetables		Default values in GASPAR (Strenge et al. 1987-TN83)

	Vegetables (kg/yr)	Leafy Vegetables (kg/yr)	Milk (L/yr)	Meat (kg/yr)
Average Adult	190	30	110	95
Average Teen	240	20	200	59
Average Child	200	10	170	37
Maximum Adult	520	64	310	110
Maximum Teen	630	42	400	65
Maximum Child	520	26	330	41
Maximum Infant	0	0	330	0

Parameter	NRC Staff Value	Comments
Receptor locations and dispersion coefficients	Site boundary: 0.21 mi WNW Nearest residence: 0.66 mi WNW Nearest vegetable garden: 1.15 mi WNW Nearest meat animal: 0.70 mi WNW	Site-specific values from ER Table 5.4-10 (TVA 2017-TN4921)

MEI Location	Atmospheric Dispersion Coefficient χ/Q (s m^{-3}) No Decay/ Undepleted	2.26-Day Half-Life/ Undepleted	8-day Half-Life/ Depleted	D/Q (m^{-2})
Nearest Site Boundary, 0.21 mi WNW	2.0×10^{-4}	2.0×10^{-4}	1.0×10^{-4}	5.2×10^{-8}
MEI, 0.66 mi WNW	2.5×10^{-5}	2.5×10^{-5}	2.3×10^{-5}	8.5×10^{-9}

Table G-3. (contd)

MEI Location	Atmospheric Dispersion Coefficient χ/Q (s m^{-3}) No Decay/ Undepleted	2.26-Day Half-Life/ Undepleted	8-day Half-Life/ Depleted	D/Q (m^{-2})
Nearest Vegetable Garden, 1.15 mi WNW	1.0×10^{-5}	9.9×10^{-6}	8.7×10^{-6}	3.3×10^{-9}
Nearest Meat Animal, 0.7 mi WNW	2.3×10^{-5}	2.3×10^{-5}	2.1×10^{-5}	7.8×10^{-9}

Parameter	NRC Staff Value	Comments
Fraction of year leafy vegetables are grown	1.0	Bounding value that maximizes the estimate of consequences
Fraction of year milk cows are on pasture	1.0	Bounding value that maximizes the estimate of consequences
Fraction of MEI's vegetable intake from own garden	0.76	Conservative value
Fraction of year beef cattle on pasture	1.0	Bounding value that maximizes the estimate of consequences

(a) Per unit is the plant parameter envelope (PPE) bounding value for a single SMR unit taken from ER Table 3.5-4 (TVA 2017-TN4921) and is used throughout this section.
(b) Per site is the PPE bounding value for the CRN Site taken from ER Table 3.5-3 (TVA 2017-TN4921) and is included for multi-unit (site-wide) analysis throughout this section.

The NRC staff compared the estimated population dose documented in the TVA ER (TVA 2017-TN4921) from normal gaseous effluents with the results calculated by the NRC staff. The doses calculated by the NRC staff confirmed the doses calculated by TVA.

TVA calculated the MEI dose by summing the nearest residence (0.66 mi WNW) inhalation dose and the dose from eating vegetables from the nearest garden and eating meat from the nearest animal, even though the three locations are not geographically at the same place. This approach maximized the estimated dose. The NRC staff compared its estimates of doses to the MEI with the results documented by TVA (TVA 2017-TN4921). The doses calculated by the NRC staff confirmed the doses calculated by TVA.

Table G-4 and Table G-5 provide doses to the MEI calculated by the NRC staff. Doses to the MEI were calculated at the nearest residence, nearest garden, and the nearest meat animal. The doses estimated by TVA and those calculated by the NRC staff were comparable to the TVA estimates, but were slightly more conservative (i.e., larger).

Table G-4. Doses to the MEI from Normal Gaseous Effluent Releases for an SMR Unit

Location	Pathway	Total Body Dose (mrem/yr)[a]	Skin Dose (mrem/yr)[a]	Max Organ Dose (mrem/yr)[a]
Nearest owner-controlled area boundary, 0.21 mi WNW	Plume	$6.20 \times 10^{+0}$	$1.40 \times 10^{+1}$	$6.31 \times 10^{+0}$ (Lung)
Nearest residence, 0.66 mi WNW	Ground	9.17×10^{-2}	1.08×10^{-1}	1.08×10^{-1} (Skin)
	Inhalation			
	Adult	1.84×10^{-1}	1.76×10^{-1}	$1.48 \times 10^{+0}$ (Thyroid)
	Teen	1.86×10^{-1}	1.78×10^{-1}	$1.85 \times 10^{+0}$ (Thyroid)
	Child	1.64×10^{-1}	1.57×10^{-1}	$2.18 \times 10^{+0}$ (Thyroid)
	Infant	9.51×10^{-2}	9.05×10^{-2}	$1.93 \times 10^{+0}$ (Thyroid)
Nearest garden, 1.15 mi WNW	Vegetable			
	Adult	5.58×10^{-1}	5.47×10^{-1}	$2.21 \times 10^{+0}$ (Bone)
	Teen	8.36×10^{-1}	8.25×10^{-1}	$3.56 \times 10^{+0}$ (Bone)
	Child	$1.87 \times 10^{+0}$	$1.86 \times 10^{+0}$	$8.52 \times 10^{+0}$ (Bone)
Nearest meat animal. 0.70 mi WNW	Meat			
	Adult	4.03×10^{-1}	4.00×10^{-1}	$1.80 \times 10^{+0}$ (Bone)
	Teen	3.29×10^{-1}	3.27×10^{-1}	$1.51 \times 10^{+0}$ (Bone)
	Child	6.01×10^{-1}	5.99×10^{-1}	$2.58 \times 10^{+0}$ (Bone)

(a) NRC staff confirmatory calculation results.

Table G-5. Doses to the MEI from Normal Gaseous Effluent Releases for the Site

Location	Pathway	Total Body Dose (mrem/yr)[a]	Skin Dose (mrem/yr)[a]	Max Organ Dose (mrem/yr)[a]
Nearest owner-controlled area boundary, 0.21 mi WNW	Plume	$4.01 \times 10^{+1}$	$8.43 \times 10^{+1}$	$4.06 \times 10^{+1}$ (Lung)
Nearest residence, 0.66 mi WNW	Ground	3.07×10^{-1}	3.60×10^{-1}	3.60×10^{-1} (Skin)
	Inhalation			
	Adult	6.04×10^{-1}	5.75×10^{-1}	$5.07 \times 10^{+0}$ (Thyroid)
	Teen	6.10×10^{-1}	5.80×10^{-1}	$6.41 \times 10^{+0}$ (Thyroid)
	Child	5.39×10^{-1}	5.12×10^{-1}	$7.62 \times 10^{+0}$ (Thyroid)
	Infant	3.12×10^{-1}	2.95×10^{-1}	$6.79 \times 10^{+0}$ (Thyroid)
Nearest garden, 1.15 mi WNW	Vegetable			
	Adult	1.03×10^{-0}	9.91×10^{-1}	$3.24 \times 10^{+0}$ (Bone)
	Teen	1.45×10^{-0}	$1.41 \times 10^{+0}$	$5.15 \times 10^{+0}$ (Bone)
	Child	$3.03 \times 10^{+0}$	$2.98 \times 10^{+0}$	$1.23 \times 10^{+1}$ (Bone)
Nearest meat animal. 0.70 mi WNW	Meat			
	Adult	6.38×10^{-1}	8.58×10^{-1}	$2.48 \times 10^{+0}$ (Bone)
	Teen	5.01×10^{-1}	$1.41 \times 10^{+0}$	$2.09 \times 10^{+0}$ (Bone)
	Child	8.92×10^{-1}	8.78×10^{-1}	$3.92 \times 10^{+0}$ (Bone)

(a) NRC staff confirmatory calculation results.

Table G-6 and Table G-7 compare the TVA population dose estimates taken from Tables 5.4-13 (per SMR unit) and 5.4-17 (per CRN Site) of the ER (TVA 2017-TN4921) with the NRC staff estimates. The NRC staff's independent calculation for population doses yielded results that are comparable to the TVA estimates on a per unit basis, but are considerably lower (by about 50 percent) on a per site basis.

Table G-6. Comparison of Population Total Body Doses from Gaseous Effluent Releases for an SMR Unit

Pathway	*TVA ER* (person-rem/yr)[(a)]	NRC Staff Estimated Population (person-rem/yr)
Plume	8.0×10^{-1}	8.04×10^{-1}
Ground plane	5.7×10^{-1}	5.71×10^{-1}
Inhalation	$1.4 \times 10^{+0}$	$1.44 \times 10^{+0}$
Vegetable ingestion	$7.7 \times 10^{+0}$	$7.67 \times 10^{+0}$
Milk ingestion	$1.8 \times 10^{+0}$	$1.80 \times 10^{+0}$
Meat ingestion	$2.6 \times 10^{+0}$	$2.61 \times 10^{+0}$
Total	$1.5 \times 10^{+1}$	$1.49 \times 10^{+1}$

Table G-7. Comparison of Population Total Body Doses from Gaseous Effluent Releases for the Site

Pathway	TVA ER (person-rem/yr)[(a)]	NRC Staff Estimated Population (person-rem/yr)
Plume		$3.63 \times 10^{+0}$
Ground plane		$1.91 \times 10^{+0}$
Inhalation		$4.73 \times 10^{+0}$
Vegetable ingestion		$1.32 \times 10^{+1}$
Milk ingestion		$3.03 \times 10^{+0}$
Meat ingestion		$4.05 \times 10^{+0}$
Total	$6.0 \times 10^{+1}$	$3.06 \times 10^{+1}$

G.1.3 Cumulative and Population Dose Estimates

Based on parameters shown for the liquid and gaseous pathways, Table G-1 and Table G-3, respectively, the NRC staff compared the results documented in the ER (TVA 2017-TN4921) for all pathway dose estimates to the MEI with those calculated by the NRC staff. Cumulative dose estimates include doses from all pathways (i.e., direct exposure, liquid effluents, and gaseous effluents) for SMRs at the CRN Site, as well as the existing and reasonably foreseeable radiological projects and facilities described in Section 7.8 of this EIS. Based on its conservative approach to liquid effluent calculations and its further assumption of summing the MEI doses for each of these individual facilities, TVA demonstrated the cumulative MEI dose would not exceed the 100 mrem/yr dose limit in 10 CFR 20.1301 (TN283).

Based on TVA's conservative approach, the NRC staff are confident that the all-pathways dose from normal operations at the CRN Site are bounding (i.e., actual doses are expected to be no higher than those presented by TVA). Separately, a cumulative dose was estimated for radioactive materials introduced into the general environment as the result of operations that are part of a nuclear fuel cycle for comparison to the dose standards of 40 CFR Part 190 (TN739). For this estimation, the NRC staff considered contributions from Oak Ridge National Laboratory-related facilities (2.4 mrem [Section 7.8 of this EIS]), Watts Bar Nuclear Power Plant (2.6 mrem/yr [TVA 2017-TN4921]), and the CRN Site (11 mrem/yr [TVA 2017-TN4921]) for a total of 16 mrem/yr, which does not exceed the 25-mrem/yr annual whole body dose equivalent standard in 40 CFR Part 190 (TN739).

G.1.4 Estimates of Dose to Nonhuman Biota from Liquid and Gaseous Effluents

The NRC staff performed confirmatory calculations of the doses to nonhuman biota from liquid and gaseous effluents using the LADTAP II (Strenge et al. 1986-TN82) and GASPAR II (Strenge et al. 1987-TN83) codes. The NRC staff used a personal computer version of the LADTAP II code and GASPAR II code titled NRCDose Version 2.3.13 (CNS 2006-TN102) obtained through the Oak Ridge RSICC.

G.1.4.1 Liquid Effluent Pathways

The NRC estimated doses to nonhuman biota from liquid effluents using fish, invertebrates, and algae as surrogate aquatic biota species. Muskrats, raccoons, herons, and ducks are used as surrogate terrestrial biota species. The NRC staff recognizes the LADTAP II computer program (Strenge et al. 1986-TN82) as an appropriate method for calculating dose to the aquatic biota and for calculating the liquid pathway contribution to terrestrial biota. Most of the LADTAP II input parameters are specified in Section G.1.1.3. The NRC staff's dose analysis confirmed that the liquid pathway doses to biota estimated by TVA were bounding.

G.1.4.2 Gaseous Effluent Pathways

The NRC staff assessed doses to terrestrial nonhuman biota from the gaseous effluent pathway based on the results of the GASPAR II calculations for human doses discussed in Section G.1.2. Again, muskrats, raccoons, herons, and ducks were used as surrogate terrestrial biota species. The NRC staff assessed the doses at the site boundary (0.21 mi WNW) to achieve a reasonable estimate of the doses to terrestrial biota that might live on the CRN Site. It was assumed that doses for raccoons and ducks were equivalent to adult human doses for inhalation, vegetation ingestion, and the plume. The dose from ground exposure was doubled for terrestrial biota. The doubling of doses from ground deposition reflects the closer proximity of these organisms to the ground. Muskrats and herons do not consume terrestrial vegetation, so that pathway was not included for those organisms. The NRC staff's dose assessment results were slightly less than the gaseous pathway doses to biota estimated by TVA as shown in Table 5-11 of this EIS, confirming the bounding nature of the TVA analysis.

G.2 Supporting Documentation for Radiological Dose Assessments of Postulated Severe Accidents

The NRC staff reviewed the severe accident Melcor Accident Consequence Code System (MACCS) input parameters and values applied by TVA. This included the MACCS ATMOS, EARLY and CHRONIC files for the severe accident releases considered by TVA (TVA 2017-TN5093). The NRC staff also reviewed the site and meteorological input files provided by TVA. The NRC staff varied MACCS input parameter values when appropriate.

In conducting their independent evaluations with the MACCS computer code, the NRC staff evaluated impacts based on the three plume exposure pathway emergency planning zone (EPZ) assumptions: 1) site boundary EPZ (at 0.21 mi) considered in Part 5A of the TVA ESP application (TVA 2017-TN5443); 2) the 2-mi EPZ considered in Part 5B of the TVA ESP application (TVA 2017-TN5442); and 3) a 10-mi EPZ, which is consistent with those assumed for large light water reactors. Evaluations were performed for these three EPZ assumptions pending a final determination of the EPZ exemption request included in Part 6 of the TVA ESP application (TVA 2017-TN5444).

The NRC staff and the TVA results were directly compared for the 2-mi EPZ distance evaluation and were found to be consistent with each other. The NRC staff computed a total population dose of 6.03×10^{-3} person-rem/reactor-year compared to the TVA result of 7.71×10^{-3} person-rem/reactor-year. The NRC staff's economic cost estimate is $19.40/reactor-year, and the TVA estimate is $29.30/reactor-year. Both of these estimates indicate a low economic risk.

The NRC staff and TVA total population dose and economic cost estimates for all three of the EPZ distances do not differ significantly, as shown in Table G-8.

Table G-8. NRC Confirmatory Calculations

EPZ Distances (mi)	NRC Calculation Total Population Dose (person-rem/ reactor-year)	TVA Calculation Total Population Dose (person-rem/ reactor-year)[a]	NRC Calculation Economic Cost ($/reactor-year)	TVA Calculation Economic Cost ($/reactor-year)[a]
0.21	6.19×10^{-3}	NA	19.5	NA
2.0	6.03×10^{-3}	7.71×10^{-3}	19.4	29.3
10	5.97×10^{-3}	NA	23.0	NA

(a) TVA calculated population doses and economic costs for a 2-mi EPZ only.

The NRC staff conducted a sensitivity analysis by varying the evacuation speeds and relocation times for the 10-mi EPZ assumption. The sensitivity analysis values were obtained from NUREG-0498 (NRC 1978-TN5095) and NUREG/CR-7110 (Bixler et al. 2013-TN4592). The results of the 10-mi EPZ baseline and sensitivity cases are presented in Table G-9. The results reveal a negligible difference between the two cases.

Table G-9. Results of the NRC Staff's Sensitivity Analysis for 10-Mi EPZ Base and Sensitivity Cases

Case	Total Population Dose (person-rem/reactor-year)	Economic Cost ($/reactor-year)
Baseline	5.97×10^{-3}	23.0
Sensitivity	6.04×10^{-3}	23.0

Based on the Commission's ruling in CLI-16-07 regarding two MACCS decontamination input parameter values (NRC 2016-TN4631), the staff determined that a sensitivity study would be appropriate for the CRN Site's economic risk. For the sensitivity study, the NRC staff only varied the decontamination costs for both decontamination levels set in the MACCS calculations. The decontamination costs for low-level decontamination was set to $24,000 and to $100,000 for the high-level decontamination. The baseline analysis already set the timeframe to conduct the decontamination activities to the value specified in CLI-16-07, namely one year. The results of the sensitivity study as compared to the NRC staff's 2-mi EPZ baseline case are presented in Table G-10 where total population dose risk values are provided for additional context between the two cases. The results of this sensitivity study also demonstrates no significant difference between the two cases. As shown in Table G-8, there is no significant difference for the total economic costs between the three EPZ distance assessments. Therefore, the same small increase in economic cost as seen in this sensitivity analysis is expected for the site boundary and 10-mi EPZ distance assessments.

Table G-10. Results of the NRC Staff's Decontamination Cost Sensitivity Analysis for 2-Mi EPZ Base and Sensitivity Cases

Case	Total Population Dose (person-rem/reactor-year)	Economic Cost ($/reactor-year)
Baseline	6.03×10^{-3}	19.4
Sensitivity	6.09×10^{-3}	23.9

G.3 References

10 CFR Part 20. *Code of Federal Regulations*, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation." Washington, D.C. TN283.

10 CFR Part 50. *Code of Federal Regulations*, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities." Washington, D.C. TN249.

40 CFR Part 190. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations." Washington, D.C. TN739.

Bixler, N., R. Gauntt, J. Jones, and M. Leonard. 2013. *State-of-the-Art Reactor Consequence Analyses Project Volume 1: Peach Bottom Integrated Analysis.* NUREG/CR–7110, Volume 1, Revision 1, Sandia National Laboratories, Albuquerque, New Mexico. Accession No. ML13150A053. TN4592.

CNS (Chesapeake Nuclear Services, Inc.). 2006. *NRCDose for Windows, Suite of NRC's Dose Modeling Codes for Reactor Radioactive Effluents.* Annapolis, Maryland. Available at http://www.chesnuc.com/docs/NRCDose%20Datasheet.pdf. TN102.

NRC (U.S. Nuclear Regulatory Commission). 1977. *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I*. Regulatory Guide 1.109, Revision 1, Washington, D.C. Accession No. ML003740384. TN90.

NRC (U.S. Nuclear Regulatory Agency). 1978. *Final Environmental Impact Statement Related to the Operation of Watts Bar Nuclear Plant Units Nos. 1 and 2*. NUREG-0498, Washington, D.C. Accessed October 18, 2017, at http://152.87.4.98/environment/reports/wattsbar2/related/dec_1978.pdf. TN5095

NRC (U.S. Nuclear Regulatory Commission). 2000. *Environmental* Standard *Review* Plan—Standard *Review Plans for Environmental Reviews for Nuclear Power Plants*. NUREG–1555, Main Report and 2007 Revisions, Washington, D.C. Available at http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/toc/. TN614.

NRC (U.S. Nuclear Regulatory Commission). 2000. *Environmental* Standard *Review* Plan—Standard *Review Plans for Environmental Reviews for Nuclear Power Plants*. NUREG–1555, Main Report and 2007 Revisions, Washington, D.C. Available at http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/toc/. TN614.

NRC (U.S. Nuclear Regulatory Commission). 2016. *Memorandum and Order in the Matter of Entergy Nuclear Operations, Inc. (Indian Point Nuclear Generating Units 2 and 3).* CLI-16-07. Washington, D.C. Accession No. ML16125A150. TN4631.

Sagendorf, J.F., J.T. Goll, and W.F. Sandusky. 1982. *XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations.* NUREG/CR–2919, Pacific Northwest Laboratory, Richland, Washington. Accession No. ML081360412. TN280.

Strenge, D.L., R.A. Peloquin, and G. Whelan. 1986. *LADTAP II—Technical Reference and User Guide*. NUREG/CR–4013, Pacific Northwest Laboratory, Richland, Washington. Accession No. ML14098A069. TN82.

Strenge, D.L., T.J. Bander, and J.K. Soldat. 1987. *GASPAR II—Technical Reference and User Guide*. NUREG/CR–4653, Pacific Northwest Laboratory, Richland, Washington. Accession No. ML14098A066. TN83.

TVA (Tennessee Valley Authority). 2017. "Clinch River Nuclear Site Early Site Permit Application, Part 03—Environmental Report (Revision 1)." Chattanooga, Tennessee. Accession No. ML18003A471. TN4921.

TVA (Tennessee Valley Authority). 2017. "Clinch River Nuclear Site Early Site Permit Application, Part 5A—Emergency Plan (Site Boundary EPZ) (Revision 1)." Chattanooga, Tennessee. Accession No. ML18003A475. TN5443.

TVA (Tennessee Valley Authority). 2017. "Clinch River Nuclear Site Early Site Permit Application, Part 5B—Emergency Plan (2-Mile EPZ) (Revision 1)." Chattanooga, Tennessee. Accession No. ML18003A480. TN5442.

TVA (Tennessee Valley Authority). 2017. "Clinch River Nuclear Site Early Site Permit Application, Part 06—Exemptions and Departures (Revision 1)." Chattanooga, Tennessee. Accession No. ML18003A487. TN5444.

TVA (Tennessee Valley Authority). 2017. Letter from J.W. Shea to NRC, dated March 1, 2017, regarding "Submittal of Calculation Input and Output Files in Support of Early Site Permit Application for Clinch River Nuclear Site." CNL-17-032, Chattanooga, Tennessee. Accession No. ML17065A269. TN5093.

APPENDIX H
LIST OF AUTHORIZATIONS, PERMITS, AND CERTIFICATIONS

Table H-1 contains a list of the environmental-related authorizations, permits, and certifications potentially required by Federal, State, regional, local, and affected Native American Tribal agencies related to site preparation, construction, and operation of two or more small modular reactors at the Clinch River Nuclear Site. Table H-1 was adapted from Table 1.2-2 of the Tennessee Valley Authority's (TVA's) August 1, 2017 submittal to the U.S. Nuclear Regulatory Commission (NRC) (TVA 2017-TN4922), which was incorporated into Revision 1 of its application (TVA 2017-TN4921).

H.1 References

TVA (Tennessee Valley Authority). 2017. "Clinch River Nuclear Site Early Site Permit Application, Part 03—Environmental Report (Revision 1)." Chattanooga, Tennessee. Accession No. ML18003A471. TN4921.

TVA (Tennessee Valley Authority). 2017. Letter from J.W. Shea to NRC, dated August 1, 2017, regarding "Submittal of Supplemental Information Related to the Environmental Audit in Support of Early Site Permit Application for Clinch River Nuclear Site." CNL-17-097, Chattanooga, Tennessee. Accession No. ML17234A003. TN4922.

Table H-1. Authorizations Required for Preconstruction, Construction, and Operation Activities

Agency	Authority	Requirement	Activity Covered
NRC	Atomic Energy and Energy Reorganization Acts 10 CFR Part 52 Subpart C or 10 CFR 50.10(e)(1)	Early site permit or combined license (COL) or Limited Work Authorization, in addition to applicable By-Product License Source Material Licenses, and Special Nuclear Material License	Site licensing, including safety-related construction activities and operation of a nuclear power facility
Federal Aviation Administration	Federal Aviation Act 49 U.S.C. § 106; 14 CFR Part 77	Construction Notice	Notice of erection of structures more than 200 ft high that potentially may affect air navigation
U.S. Department of Transportation (DOT)	Hazardous Material Transportation Act 49 CFR Part 107 Subpart G	Certificate of Registration	Transportation of hazardous materials.
Tennessee Department of Transportation (TDOT)	TCA 54-5-302	Entrance Permits	This includes ramps, driveways, and other access points. Requires traffic studies and engineering designs to show design and potential impacts of proposed changes.
TDOT	TCA § 54-5-302	Right-of-way (ROW) Permit	Required for installing utilities in highway ROWs
U.S. Army Corps of Engineers (USACE)	Clean Water Act, 33 CFR Parts 323 and 330	Section 404 Permit	Disturbance, crossing, or filling-in of wetland areas or navigable waters from site
	Rivers and Harbors Act, 33 U.S.C. § 403 et seq.	Section 10 Permit	Construction and maintenance of intake, discharge, and barge structures in navigable waters of the United States
U.S. Coast Guard	Ports and Waterways Safety Act, 33 U.S.C. §§ 1221 et seq.	Private Aids to Navigation Permit	Construction of discharge pipeline in navigable waters

Table H-1. (contd)

Agency	Authority	Requirement	Activity Covered
U.S. Environmental Protection Agency (EPA) and Tennessee Department of Environment and Conservation (TDEC)	Resource Conservation and Recovery Act, Section 3010	Acknowledgement of Notification of Hazardous Waste Activity	Hazardous Waste Generation
	EPA Facility Response Plan (40 CFR Part 112), and the EPA Hazardous Waste Contingency Plan	Facility Response Plan Approval	Spill/Discharge Response Program
	Spill Prevention, Control and Countermeasures (SPCC) rule (40 CFR Part 112), Appendix F, Sections 1.2.1 and 1.2.2	SPCC/Integrated Pollution Prevention (IPP) Plan	Spill/Discharge Prevention Plan
U.S. Fish and Wildlife Service (FWS)	Endangered Species Act Section 7 (16 U.S.C. § 1536)	Consultation/Biological Assessment	Evaluation of effects on listed species
FWS	Migratory Bird Act/Executive Order 13186	Responsibility of Federal Agencies to Protect Migratory Birds	TVA is exempt from the Act requirements, but complies voluntarily; TVA is subject to the Executive Order.
City of Oak Ridge		Municipal Site Plan Approval	Coordination with the Planning Board and/or Zoning Board of Adjustment for development of the site in compliance with city ordinances
		Flood Encroachment Permit/Floodplain Permit	Compliance with City of Oak Ridge Zoning Article IX Special Districts 9.08 a, b, c Floodway Districts, Floodway Fringe Area; mostly covered in Stormwater Pollution Prevention Plan and grading permit

Table H-1. (contd)

Agency	Authority	Requirement	Activity Covered
		Sanitary Sewer Connection	Compliance with the City Industrial Pre-treatment Program if required, or connection to the City Wastewater Treatment System
		Potable Water	A potable water line on the small modular reactor site would tap into the existing City of Oak Ridge water line on Bear Creek Road. If the existing waterline has to be extended for TVA, additional planning and approvals would be necessary by the city.
		Construction Permits	Construction of the new plant facilities in compliance with city ordinances
TDEC	Federal Clean Water Act (33 U.S.C. §§ 1251 et seq.) and Tennessee Code Annotated (TCA) § 69-3-108: Tennessee Water Quality Control Act of 1977	Notice of Intent (NOI) for coverage under an Individual National Pollution Discharge Elimination System (NPDES) Permit for stormwater discharges associated with construction activities.	Compliance with Federal and State water-quality standards, discharges to waters of the state due to construction of the new plant, switchyards, and transmission lines (aboveground and underground). Construction/operation of stormwater control measures (detention basins, etc.). Provided that pollution prevention measures are implemented, the construction general permit covers discharges associated with: • construction activities • construction support activities (e.g., concrete or asphalt batch

Table H-1. (contd)

Agency	Authority	Requirement	Activity Covered
			plants, equipment staging yards, material storage areas, excavated material disposal areas, borrow areas) • dewatering of work areas of collected stormwater and groundwater • water used to wash vehicles • water used to control dust • routine building washdown • uncontaminated groundwater • unpolluted foundation or footing drains. Appropriate dewatering controls include, but are not limited to, weir tank, dewatering tank, gravity bag filter, sand media particulate filter, pressurized bag filter, cartridge filter or other control units providing the level of treatment necessary to comply with permit requirements.
TDEC (continued)	Federal Clean Water Act (33 U.S.C. §§ 1251 et seq.) and TCA § 69-3-108: Tennessee Water Quality Control Act of 1977 (continued)	Stormwater Pollution Prevention Plan, to include Common Plan of Development, Soil Erosion and Sediment Control Plan (structural control measures, engineering design of sediment basin/controls for projects 10 ac or greater), etc.	Compliance with Federal and State water-quality standards, discharges to waters of the state due to construction of the new plant, switchyards, and transmission lines (aboveground and underground)
		Aquatic Resource Alteration Permit required for alterations of a stream or wetland, including diversion of surface waters of the state.	Clinch River arm of the Watts Bar Reservoir water required for cooling purposes. Portions of the new plant site, proposed causeway, switchyards, and onsite

Table H-1. (contd)

Agency	Authority	Requirement	Activity Covered
			and potential offsite transmission lines may be located in freshwater wetlands and transitional areas.
		NPDES Industrial Stormwater General Permit for plant operation activities; EPA Application Forms 2D (Application for Permit to Discharge Process Wastewater) and 2F (Application for Permit to Discharge Stormwater Discharges Associated with Industrial Activity)	Cooling water, service water, and stormwater runoff discharge from plant operations
		NOI for NPDES General Permit of Discharges from the Application of Pesticides (TNP100000)	Point source discharges of pesticides used for mosquito and other flying insect pest control, weed and algae control, animal pest control, and forest canopy pest control to waters of the state
		Sanitary Waste Water – Portable Facilities	Must use licensed wastewater hauler
		Permanent Sanitary Waste Water	Connect to Wastewater Treatment Plant
	Tennessee Water Resources Information Act, TCA §§ 69-7-301 et seq.	Water Resources Notification; Water Withdrawal Registration	Surface-water or groundwater withdrawal of an average of ≥10,000 gal/day
	Federal Clean Air Act, 42 U.S.C. § 7401 et seq.	Title V Operating Permit; Prevention of Significant Deterioration Preconstruction Permit	Discharge of air pollutants from cooling tower(s), emergency generators, auxiliary boiler(s), and ancillary equipment

Table H-1. (contd)

Agency	Authority	Requirement	Activity Covered
Texas Department of State Health Services, Radiation Control Program, Radiation Safety Licensing Branch	25 Texas Administrative Code (TAC) § 289.252 “Licensing of Radioactive Material”	Emergency Plan for the response to an accident or incident involving shipments of radioactive waste. Proof of financial responsibility such as insurance that the carrier has in order to comply with DOT requirements.	Transportation of low-level radioactive waste (LLRW) to the Texas Disposal Facility
	25 TAC § 289.257 “Packaging and Transportation of Radioactive Material”	Provide a list of approved shipping containers along with their certificates of compliance or other certifying documentation. For shippers that manufacture their own containers they must submit their quality assurance procedures.	Shipping of LLRW to the Texas Disposal Facility
TDEC Division of Radiological Health (DRH)	TCA § 68-202-201 et seq. TDEC Rule 0400- 20-10-.32	Obtain a License-for-Delivery from the DRH (Form RHS 8-30). Persons whose activities result in the generation of radioactive waste have the primary responsibility for assuring that a License-for-Delivery is obtained.	Transportation of radioactive waste within the State of Tennessee to a disposal/processing facility
TN State Historic Preservation Office (SHPO) Tribal Historic Preservation Officer (THPO)	Section 106 of the National Historic Preservation Act (NHPA)	As a Federal agency, TVA is required to comply with Section 106 of the NHPA, which includes SHPO/THPO, and identification of potentially affected resources, i.e., a site survey.	Protection of archaeological and historical resources

APPENDIX I
CLINCH RIVER NUCLEAR SITE CHARACTERISTICS AND PLANT PARAMETER ENVELOPE VALUES

The specific early site permit (ESP) site characteristics and plant parameter envelope (PPE) values used in this document are from Tables 3.1-1 and 3.1-2 of the Environmental Report (TVA 2017-TN4921) and Table 2.0-1 of the Site Safety Analysis Report (TVA 2017-TN5387). The review team used these characteristics and values, as appropriate, in its independent evaluation of the environmental impacts of the proposed new units. Appendix J captures additional representations and assumptions made by the review team when assessing the environmental impacts associated with construction and operation of a new nuclear power plant. The ESP site characteristics and PPE values used in the review team's evaluation are presented in Tables I-1, I-2, and I-3, respectively. Any mention of figures or tables in Tables I-1, I-2, or I-3 refer to figures or tables in the Environmental Report or Site Safety Analysis Report.

I.1 References

TVA (Tennessee Valley Authority). 2017. "Clinch River Nuclear Site Early Site Permit Application, Part 02—Site Safety Analysis Report (Revision 1)." Chattanooga, Tennessee. Accession No. ML18003A374. TN5387.

TVA (Tennessee Valley Authority). 2017. "Clinch River Nuclear Site Early Site Permit Application, Part 03—Environmental Report (Revision 1)." Chattanooga, Tennessee. Accession No. ML18003A471. TN4921.

Table I.1. Clinch River Nuclear Environmental Site Characteristics

PPE Section[a]	Definition	Parameter Type	PPE Value	ER Section
9. Unit Vent/Airborne Effluent Release Point				
9.1 Atmospheric Dispersion (X/Q) (Accident)				
9.1.1 0-2 hr @ EAB	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases in the limiting two hour interval.	Site	5.58E-04 s/m^3	7.1
9.1.2 0-8 hr @ low population zone (LPZ)	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases in the first eight hours.	Site	4.27E-05s/m^3	7.1
9.1.3 8-24 hr @ LPZ	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases between hours 8 and 24 after the accident.	Site	3.80E-05 s/m^3	7.1
9.1.4 1-4 day @ LPZ	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases between the first day and the fourth day after the accident	Site	2.94E-05 s/m^3	7.1
9.1.5 4-30 day @ LPZ	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases between day four until the end of the first 30 days after the accident.	Site	2.04E-05 s/m^3	7.1
9.3 Calculated Dose Consequences				
9.3.1 Normal	The design radiological dose consequences due to airborne releases from normal operation of the plant.	Site	10 CFR 20, 10 CFR 50 Appendix I	5.42, 7.22
9.3.2 Post-Accident	The design radiological dose consequences due to airborne releases from postulated accidents.	Site	10 CFR 52.17 (a)(1) (ix), 10 CFR 100.20	5.42, 7.22

(a) The numbering of the PPE listing is not meant to be sequential, and was compiled from and is consistent with the list developed by industry and refined for this early site permit application.

Table I.2. Clinch River Nuclear Site-Related Design Parameters

PPE Section[a]	Definition	Parameter Type	PPE Value	ER Section
1. Structure				
1.1 Building Characteristics				
1.1.1 Height (w/o Stack and Cooling Towers)	The height from finished grade to the top of the tallest power block structure, excluding cooling towers (excludes stairway towers, elevator, etc.).	Rx	160 ft	2.5.2, 3.1, 4.4, 5.8
1.1.2 Foundation Embedment	The depth from finished grade to the bottom of the basemat or the most deeply embedded power block structure (excavation depth is the same elevation as embedment depth).	Rx	138 ft	3.1
3. Normal Plant Heat Sink				
3.1 Condenser				
3.1.2 Condenser/Heat Exchanger Duty	Design value for the waste heat rejected to the circulating water system across the condensers.	Eng	5593 MBTU/hr for site	3.4
3.2 Non-Safety Related Service Water Systems				
3.2.3 Miscellaneous Plant Water Uses Intake	The maximum, and normal, water intake of the plant neglecting cooling-tower makeup, potable/sanitary water users, and liquid radwaste treatment.	Eng	Maximum: 5,100 gpm; normal: 1,345 gpm See Figure 3.3-1	3.4
3.2.4 Miscellaneous Plant Water Uses Discharge	The maximum, and normal, water discharge of the plant neglecting cooling-tower makeup, potable/sanitary water users, and liquid radwaste treatment.	Eng	Maximum: 4,200 gpm; normal: 445 gpm See Figure 3.3-1	3.4
3.3 Mechanical Draft Cooling Towers				
3.3.1 Acreage	The land required for cooling towers, including support facilities such as equipment sheds, basins, canals, or shoreline buffer areas.	Eng	See Figure 3.1-1	3.4, 5.3
3.3.3 Blowdown Constituents and Concentrations	The maximum expected concentrations for anticipated constituents in the cooling-water systems blowdown to the receiving waterbody.	Eng	Table 3.6-1 (values for site)	3.6
3.3.4 Blowdown Flow Rate	The normal (and maximum) flow rate of the blowdown stream from the cooling-water systems to the receiving waterbody for closed system designs.	Eng	Maximum: (2 COC) 12,800 gpm, Expected: (4 COC) 4270 gpm See Figure 3.3-1	3.4

Table I.2. (contd)

PPE Section[(a)]	Definition	Parameter Type	PPE Value	ER Section
3.3.5 Blowdown Temperature	The maximum expected blowdown temperature at the point of discharge to the receiving waterbody.	Eng	90 F	3.4
3.3.6 Cycles of Concentration	The ratio of total dissolved solids in the cooling-water blowdown streams to the total dissolved solids in the makeup water streams.	Eng	Maximum: 4; minimum: 2	3.4, 5.3
3.3.7 Evaporation Rate	The expected (and maximum) rate at which water is lost by evaporation from the cooling-water systems.	Eng	12,800 gpm (expected and maximum) - values for site	3.4
3.3.8 Height	The vertical height above finished grade of mechanical draft cooling towers associated with the cooling-water systems.	Eng	65 ft	3.4, 5.3, 5.8
3.3.9 Makeup Flow Rate	The expected (and maximum) rate of removal of water from a natural source to replace water losses from closed cooling-water system.	Eng	17,078 gpm (expected), 25,608 gpm (maximum)	3.4
3.3.10 Noise	The maximum expected sound level produced by operation of cooling towers, measured at 1,000 ft from the noise source.	Eng	<70 dba	5.3, 5.8, 9.3
3.3.11 Cooling Tower Temperature Range	The temperature difference between the cooling water entering and leaving the towers.	Eng	18 F	3.4
3.3.12 Cooling Water Flow Rate	The total cooling-water flow rate through the condenser/heat exchangers.	Eng	755,000 gpm	3.4, 5.3
3.3.14 Maximum Consumption of Raw Water	The expected maximum short-term consumptive use of water by the cooling-water systems (evaporation and drift losses).	Eng	12,808 gal	3.4
3.3.16 Stored Water Volume	The quantity of water stored in cooling-water system impoundments, basins, tanks and/or ponds.	Eng	5 million gal	3.4
3.3.17 Drift	Rate of water lost from the tower as liquid droplets entrained in the vapor exhaust air stream.	Eng	8 gpm	3.4
5. Potable Water/Sanitary Waste System				
5.1 Discharge to Site Water Bodies				
5.1.1 Flow Rate (Potable/Sanitary Normal)	The expected (normal) effluent flow rate from the potable/sanitary system to the receiving waterbody.	Rx	50 gpm	3.4, 3.6, 5.5
5.1.2 Flow Rate (Potable/Sanitary Maximum)	The maximum effluent flow rate from the potable/sanitary the receiving waterbody.	Rx	100 gpm	3.4, 3.6, 5.5
9.5 Source Term				
9.5.1 Gaseous (Normal)	The expected annual activity, by radionuclide, contained in routine plant airborne effluent streams, excluding tritium.	Rx	Table 3.5-3	3.5

Table I.2. (contd)

PPE Section[a]	Definition	Parameter Type	PPE Value	ER Section
10. Liquid Radwaste System				
10.2 Release Point				
10.2.1 Flow Rate	The discharge (including minimum dilution flow, if any) flow rate of liquid potentially radioactive effluent streams from plant systems to the receiving waterbody.	Eng	900 gpm - expected normal and maximum -	3.4
10.3 Source Term				
10.3.1 Liquid	The annual activity, by radionuclide, contained in routine plant liquid effluent streams, excluding tritium.	Rx	Table 3.5-1 ([value per site)	3.5
11. Solid Radwaste System				
11.2 Solid Radwaste				
11.2.1 Activity	The annual activity, by radionuclide, contained in solid radioactive wastes generated during routine plant operations.	Rx	Table 3.5-5 (site value)	3.5
11.2.3 Volume	The expected volume of solid radioactive wastes generated during routine plant operations.	Rx	5,000 cubic ft/yr (site value)	3.5, 3.8, 5.7, 7.4
13. Auxiliary Boiler System				
13.1 Exhaust Elevation	The height above finished plant grade at which the flue gas effluents are released to the environment.	Eng	Plant Grade	3.6
13.2 Flue Gas Effluents	The expected combustion products and anticipated quantities released to the environment due to operation of the auxiliary boilers.	Eng	Table 3.6-2	3.6
14. Standby Power System				
14.1 Diesel				
14.1.2 Diesel Exhaust Elevation	The elevation above finished grade of the release point for standby diesel exhaust releases.	Eng	25 ft	3.6
14.1.3 Diesel Flue Gas Effluents	The expected combustion products and anticipated quantities released to the environment due to operation of the emergency standby diesel generators.	Eng	Table 3.6-3 (value per site)	3.6
14.2 Gas Turbine				
14.2.2 Gas-Turbine Exhaust Elevation	The elevation above finished grade of the release point for standby gas turbine exhaust releases.	Eng	50 ft	3.6
14.2.3 Gas-Turbine Flue Gas Effluents	The expected combustion products and anticipated quantities released to the environment due to operation of the emergency standby gas-turbine generators.	Eng	Table 3.6-4	3.6

Table I.2. (contd)

PPE Section[(a)]	Definition	Parameter Type	PPE Value	ER Section
15. Plant Layout Considerations				
15.1 Access Routes				
15.1.1 Heavy Haul Routes	The land usage required for permanent heavy-haul routes to support normal operations and refueling.	Eng	5 ac	3.9
15.2 Acreage to Support Plant Operations	The land area required to provide space for plant facilities.	Eng	See Figure 3.1-1	3.7
16. Plant Operations Considerations				
16.1 Megawatts Thermal	The thermal power generated by one unit (may be the total of several modules). Specify both core thermal power and reactor coolant pump (RCP) thermal power (if there are RCPs in the design).	Rx	800 MW(t) (core) 805 MW(t) (core + RCP), 2,420 MW(t) total for site	5.7, 7.4
16.2 Plant Design Life	The operational life for which the plant is designed.	Rx	60 years	3.2
16.3 Plant Population				
16.3.1 Operation	The estimated number of total permanent staff to support operations of the plant.	Eng	500 (value per site)	3.10,5.8, 9.3
16.3.2 Refueling/Major Maintenance	The estimated additional number of temporary staff required to conduct refueling and major maintenance activities.	Eng	1,000	5.8, 9.3
16.4 Station Capacity Factor	The percentage of time that a plant is capable of providing power to the grid.	Eng	Maximum: 98%; minimum: 90%	5.7, 7.4
16.6 Megawatts Electrical (at 100% power with 85ºF circulating water)	Best estimate of MW(e) generator output.	Eng	800 MW(e) (value for site)	3.2, 5.7, 5.9, 7.4, 9.4, 10.1
17. Construction				
17.2 Acreage				
17.2.1 Laydown Areas	The land area required to provide space for construction support facilities. Provide a list of what buildings and/or areas and the associated acreage for each.	Eng	See Figure 3.1-1	3.7
17.3 Construction				
17.3.1 Noise	The maximum expected sound level due to construction activities, measured at 50 ft from the noise source.	Eng	101 dB at 50 ft	3.9
17.4 Plant Population				
17.4.1 Construction	Maximum number of people onsite during construction.	Eng	2,200 (value per site)	3.10
18. Miscellaneous Items				

Table I.2. (contd)

PPE Section[a]	Definition	Parameter Type	PPE Value	ER Section
18.0.1 Fuel Characteristics	What is the form of the reactor fuel and the burnup (GWd/MTU)?	Rx	UO_2, 51 GWD/MTU	5.7, 7.4
18.0.2 Fuel assemblies	Provide the active length of the reactor fuel. Provide the number of fuel assemblies per core and the weight (in MTU) of each assembly.	Rx	Number of fuel assemblies: 96 weight of each assembly: 0.304 MTU	3.8, 5.7, 7.4
18.0.4 Refueling	Provide the refueling frequency, average number of assemblies per refueling, fuel pool capacity (in years), and cooling time in pool.	Rx	Frequency: 2 years, assemblies per refueling: 96, capacity: 6 years ,	3.8, 5.7, 5.8
18.0.5 Irradiation fuel transportation	Provide the weight of irradiated fuel per spent fuel shipping cask (MTU).	Rx	21.2 MTU	5.7
18.1 Maximum Fuel Enrichment	Concentration (weight percent fraction) of U-235 in the fuel uranium.	Rx	<5% U-235	3.2, 5.7, 7.4
18.2 Maximum Average Assembly Burnup	Maximum assembly average burnup at end of assembly life.	Rx	51 GWD/MTU	3.2, 5.7, 7.4
18.3 Peak fuel rod exposure at end of life	Peak fuel rod exposure at end of life.	Rx	62 GWD/MTU	3.2
18.7 Clad Material	Fuel rod clad material.	Rx	Zirc Alloy (Zircaloy)	5.7

(a) The numbering of the PPE listing is not meant to be sequential, and was compiled from and is consistent with the list developed by industry and refined for this early site permit application.

Notes: RX = Reactor Parameter; Eng = Owner Engineered Parameter; COC = Cycles of Concentration.

Table I.3. Safety Site Characteristics

Characteristic/Parameter	Site-Specific Value[a]	Description	SSAR Section
Geography and Demography			
Exclusion Area Boundary (EAB)	Clinch River Property Boundary	The area surrounding the reactors, in which the reactor licensee has the authority to determine all activities, including exclusion or removal of personnel and property from the area.	2.1.1
Low Population Zone	1 mi from CRN Site center point	The area immediately surrounding the exclusion area, which contains residents, the total number and density of which are such that there is a reasonable probability that appropriate protective measures could be taken on their behalf in the event of a serious accident.	2.1.3.4
Population Center Distance	4.8 mi (southeast)	The distance from the site center point to the nearest boundary of a densely populated center containing more than about 25,000 residents.	2.1.3.5
Meteorology and Hydrology			
Winter Precipitation			
100-yr Snowpack	12.2 psf	The weight of the 100-year return period snowpack (to be used in determining normal precipitations loads for roofs).	2.3.1.3.6.2
48-hour Probable Maximum Winter Precipitation (PWMP)	23.5 in.	Probable Maximum Precipitation (PMP) during the winter months (to be used in conjunction with the 100-year snowpack in determining normal precipitation loads for roofs).	2.3.1.3.6.2
Normal Winter Precipitation Event	21.9 psf	The maximum of the 1) 100-year return snowpack (snow cover), 2) historical snowpack (snow cover), 3) 100-year return snowfall event, or 4) historical maximum snowfall event.	2.3.1.3.6.2
Extreme Frozen Precipitation Event	21.9 psf	The maximum of the 1) 100-year return snowfall event or 2) historical maximum snowfall event.	2.3.1.3.6.2
Extreme Liquid Winter Precipitation Event	Equivalent to the 48-hour PWMP	The extreme winter precipitation event is defined as the theoretically greatest depth of precipitation (inches of water) for a 48-hour period that is physically possible over a 25.9 square kilometer (10 square mile) area at a particular geographical location during those months with the historically highest snowpacks.	2.3.1.3.6.2
Potential for Frazil Ice in Ultimate Heat Sink (UHS) Water Storage Facility	N/A	Potential for accumulated ice formation in the UHS Water Storage Facility in a turbulent flow condition.	2.4.7
Maximum Rainfall Rate	18.8 in./hr 6 in./5-minutes	PMP for 1-hour and for 5-minute durations at the site estimated from Hydro-Meteorological Report HMR-52.	2.3.1.3.3

Table I.3. (contd)

Characteristic/Parameter	Site-Specific Value[(a)]	Description	SSAR Section
Maximum Flood (or Tsunami)	799.9 ft NGVD29 (799.5 ft NAVD88) –Still water 6.1 ft (wind-wave) 806.0 ft NGVD29 (805.6 ft NAVD88) –Combined	Predicted maximum flood level (including wave run-up) from external events, not including local PMP.	2.4.2, 2.4.3, and 2.4.10
Maximum Ground Water	816.1 ft NAVD88	Maximum groundwater level under deep foundation structures in power-block area.	2.4.12
Basic Wind Speed	96.3 mph for a 3-second gust	Wind velocity at 33 ft above ground for Exposure Category C associated with a 100-year return period in the site area.	2.3.1.3.2
Historical Maximum Wind Speed	87 mph for a 3-second gust 73 mph fastest mile	Wind velocity at 33 ft above ground associated with the most severe hurricane wind that has been historically observed in the site region.	2.3.1.3.2
Design-Basis Hurricane Windspeed	130 mph for a 3-second gust	The resulting windspeed for nominal 3-second peak-gust values at a height of 33 ft in flat open terrain.	2.3.1.3.5
Tornado			
Maximum Pressure Drop	1.2 psi	Decrease in ambient pressure from normal atmospheric pressure at the site due to passage of a tornado having a probability of occurrence of 10^{-7} per year.	2.3.1.3.4
Maximum Rotational Speed	184 mph	Rotation component of maximum wind speed at the site due to passage of a tornado having a probability of occurrence of 10^{-7} per year.	2.3.1.3.4
Maximum Translational Speed	46 mph	Translation component of maximum wind speed at the site due to the movement across the ground of a tornado having a probability of occurrence of 10^{-7} per year.	2.3.1.3.4
Maximum Wind Speed	230 mph	Sum of the maximum rotational and translational wind speed components at the site due to passage of a tornado having a probability of occurrence of 10^{-7} per year.	2.3.1.3.4
Radius of Maximum Rotational Speed	150 ft	Distance from the center of the tornado at which the maximum rotational wind speed occurs at site due to passage of a tornado having a probability of occurrence of 10^{-7} per year.	2.3.1.3.4
Rate of Pressure Drop	0.5 psi/s	Maximum rate of pressure drop at site due to passage of a tornado having a probability of occurrence of 10^{-7} per year.	2.3.1.3.4

Table I.3. (contd)

Characteristic/Parameter	Site-Specific Value[(a)]	Description	SSAR Section
Site Characteristic			
Ambient Air Temperatures		Site characteristic wet bulb and dry bulb temperatures associated with the listed exceedance values and the 100-year return period.	2.3.1.4
Maximum Dry Bulb Temperature with Maximum Wet Bulb Temperature			
2% Annual Exceedance	90°F Dry Bulb 73.7°F Coincident Wet Bulb		
1% Annual Exceedance	92°F Dry Bulb 74.2°F Coincident Wet Bulb		
0.4% Annual Exceedance	95°F Dry Bulb 74.9°F Coincident Wet Bulb		
0% Annual Exceedance	105°F Dry Bulb 74.6°F Coincident Wet Bulb		
100-Year Return Period	107°F Dry Bulb 73.1°F Coincident Wet Bulb		
Maximum Non-Coincident Wet Bulb Temperature			
2% Annual Exceedance	75.7°F		
1% Annual Exceedance	76.7°F		
0.4% Annual Exceedance	77.6°F		
0% Annual Exceedance	81.7°F		
100-Year Return Period	83.6°F		
Minimum Dry Bulb Temperature			
2% Annual Exceedance	25°F		
1% Annual Exceedance	21°F		
0.4% Annual Exceedance	16°F		
0% Annual Exceedance	-9°F		
100-Year Return Period	-9.9°F		

Table I.3. (contd)

Characteristic/Parameter	Site-Specific Value[(a)]	Description	SSAR Section
Atmospheric Dispersion (X/Q) (Accident)		Atmospheric dispersion coefficients used in the design safety analyses to estimate dose consequences of accident airborne releases.	2.3.4
0-2 hr @ EAB	4.96×10^{-3} s/m^3		
0-8 hr @ LPZ	3.10×10^{-4} s/m^3		
8-24 hr @ LPZ	2.26×10^{-4} s/m^3		
1-4 day @ LPZ	1.14×10^{-4} s/m^3		
4-30 day @ LPZ	4.30×10^{-5} s/m^3		
Atmospheric Dispersion (X/Q) (Annual Average)	Refer to Table 2.3.5-10	Atmospheric dispersion coefficient used in the safety analysis for the dose consequences of normal airborne releases.	2.3.5
Gaseous Releases			
Does Consequences			
Normal	10 CFR Part 20, App. B 10 CFR Part 50, App. I	Estimated design radiological dose consequences due to gaseous releases from normal operation of the plant.	11.3.3
Post-Accident	10 CFR 52.17(a)(1)(ix)	Estimated design radiological dose consequences due to gaseous releases from postulated accidents.	15
Minimum Distance from Release Point to EAB	1,100 ft	Minimum lateral distance from the effluent release boundary to the EAB.	2.1.1.2 and 2.3.4
Liquid Releases			
Dose Consequences			
Normal	10 CFR Part 20, App. B 10 CFR Part 50, App. I	Estimated design radiological dose consequences due to liquid effluent releases from normal operation of the plant.	11.2.3
Post-Accident	10 CFR Part 20, App. B DC/COL-ISG-013	Estimated design radiological dose consequences due to liquid effluent releases from postulated accidents.	2.4.13
Geology, Seismology, and Geotechnical Engineering			
Ground Motion Response Spectra	Figure 2.5.2-78	The design response spectra used to establish a plant's seismic design.	2.5.2
Capable Tectonic Structures or Sources	None	The assumption made in a plant design about the presence of capable faults or earthquake sources in the vicinity of the plant site (e.g., no fault displacement potential within the investigative area).	2.5.3
Soil Properties			
Liquefaction	None	Liquefaction potential at the site.	2.5.4
Minimum Bearing Capacity (Static)	110 ksf	Allowable load-bearing capacity of layer supporting plant structures.	2.5.4

Table I.3. (contd)

Characteristic/Parameter	Site-Specific Value[a]	Description	SSAR Section
Minimum Shear Wave Velocity	4,650 fps	Propagation velocity of shear waves through foundation materials.	2.5.4
Dynamic Bearing Capacity	110 ksf	Capacity of the foundation soil/rock to resist loads imposed by the structures in the event of an earthquake.	2.5.4
Minimum Soil Angle of Internal Friction	36°	Minimum value of the internal friction angle of foundation soils, fill soils, or excavation slopes that would provide a safe design of the plant through soil structure interaction analyses including sliding along the base.	2.5.4

(a) Values shown are for a single unit, but would be the same value for each additional unit.

APPENDIX J
REPRESENTATIONS AND ASSUMPTIONS

If an early site permit (ESP) for the Tennessee Valley Authority's (TVA's) Clinch River Nuclear (CRN) Site is issued and an applicant references that ESP in a subsequent application for a construction permit (CP) or a combined construction permit and operating license (combined license or COL), the applicant would have to demonstrate that the design selected for the site falls within the bounds of the U.S. Nuclear Regulatory Commission's (NRC's) ESP analysis in this environmental impact statement (EIS). With regard to the environmental impacts associated with construction and operation of a new nuclear power plant at the CRN Site, TVA made a number of representations in its application. As listed in this appendix, the staff used these representations and staff-developed assumptions when assessing the environmental impacts associated with construction and operation of a new nuclear power plant. As such, fulfillment of these representations and assumptions provides part of the basis for the final EIS. If a CP or COL applicant references the ESP, and the NRC staff ultimately determines that a representation or assumption has not been satisfied at the CP/COL stage, that information would be considered new and potentially significant, and the affected impact area could be subject to re-examination.

Table J-1 references TVA's representations and the NRC staff's assumptions in this EIS about plant design (Appendix I); authorizations, permits, and certifications (Appendix H); and mitigation (Sections 4.11 and 5.12). Table J-2 contains references to representations and assumptions organized by technical area, without repeating the information in Table J-1.

Within the Environmental Report (ER) (TVA 2017-TN4921), TVA provides:

- representations to address certain issues in the design, construction, and operation of the facility;
- representations of planned compliance with current laws, regulations, and requirements;
- representations of future activities and actions that it would take if it receives an ESP and decides to apply for a COL for the Clinch River Site; and
- representations of TVA's estimates of future activities and actions of others and the likely environmental impacts of those activities and actions that would be expected if TVA decides to apply for a CP or COL.

The following tables are meant to aid the staff and the applicant in the event this EIS is referenced in a CP or COL application. The tables are not meant to replace the analyses in the EIS.

Table J-1. Appendix I, Appendix H, Section 4.11, and Section 5.12 Assumptions and Commitments

Area	Representation/Assumption
Site characteristics	An applicant referencing this EIS will demonstrate its application is bounded by the site characteristics contained in Tables I-1 and I-3.
Plant parameter envelope (PPE) values	An applicant referencing this EIS will demonstrate its application is bounded by the PPE values contained and referenced in Table I-2.
Authorizations and permits	An applicant referencing this EIS will provide the status of the authorizations and permits specified in Appendix H.
Mitigation of construction impacts	An applicant referencing this EIS will address whether its application contains the mitigation measures contained in Section 4.11.
Mitigation of operational impacts	An applicant referencing this EIS will address whether its application contains the mitigation measures contained in Section 5.12.
New and significant information	An applicant referencing this EIS will provide, in its application, in accordance with Title 10 of the *Code of Federal Regulations* (CFR) 51.50(c)(1) (TN250), any new information that could affect the technical basis or conclusions for determination of an impact level in the EIS.

Table J-2. Assumptions by Technical Area Not Covered in Table J-1

Technical Area	Representations/Assumptions	Source
Land Use		
	The CRN Site construction footprint is shown in Figure 3.1-2 in the ER.	ER Figure 3.1-2[a]
	The CRN Site would total 935 ac. The barge/traffic area (BTA) would total 203 ac.	ER Table 2.2-1[a]
	An estimated 494 ac of the existing 935-ac CRN Site would be affected by the construction of a new nuclear power plant.	ER Figure 3.1-2[a]
	Permanent facilities and structures (primarily the power-block area, cooling-tower area, and intake structures and their associated pipelines) for new small modular reactor (SMR) units would occupy approximately 327 ac and temporary facilities would occupy approximately 167 ac.	ER Table 4.1-1[a]
	In the BTA, 30 ac would be permanently disturbed with new roadways and barge-landing improvements and 15 ac would be temporarily disturbed for the installation of the new roadways.	ER Table 4.1-1[a]
	Building activities, including barge slip reconditioning activities, would not require dredging.	ER Section 4.1.1[a]
	No prime farmland impacts exceeding U.S. Department of Agriculture thresholds would result from the proposed. project	ER Section 4.1.1 [a]
	Heritage Rail Offload Area would be refurbished and stabilized for deliveries. The U.S. Department of Energy (DOE) former K-25 Barge-Loading Area between State Route (SR) 58 and the CRN Site entrance would also be refurbished for deliveries. Alternatively, a new barge slip may be constructed.	ER Section 4.1.1 [a]
	Salt drift from any cooling-tower design would be localized with some areas of drift during summer exceeding NRC guidance thresholds (EIS Figure 5-2). Exceedance areas would be located in early successional habitat within the CRBRP footprint that mostly would be occupied by facilities and to a lesser extent in forested habitat that would be cleared during preconstruction. No fogging or icing impacts are expected on transportation areas around the CRN Site.	ER Section 5.3.3.3.1[a]
	A new switchyard would be constructed for use with new SMR units at the CRN Site.	ER Section 3.7.1[a]
	The extent of land required for borrow pits would not exceed designated capacities.	ER Section 4.1.1[a];

Table J-2. (contd)

Technical Area	Representations/Assumptions	Source
	Potential areas for the temporary storage of earthwork and excavation spoils have been identified on the site. The total amount of spoils and the extent of land required have not been determined but are assumed to not extend beyond the construction footprint identified in Figure 4.3-1 in the ER. The excavated material would be managed with the appropriate erosion and sediment control measures, and best management practices (BMPs) would be used as necessary for these storage areas.	ER Section 4.1.1 and Figure 4.3-1 [a]
	A minor intrusion to the Clinch River 100-year floodplain would be disturbed by clearing and grading activities necessary to building the proposed intake and blowdown structures, and installing the makeup and blowdown lines. Most impacts would be temporary, except for building and operating the CRN plant intake and discharge structures.	CNL-17-097 (TVA 2017-TN4922), Attachment 7
	The hypothesized offsite transmission lines with assumed modifications to affected rights-of-way are based on injecting 800 MW(e) to the grid at the CRN Site.	ER Figure 3.7-7[a]
	Hypothesized offsite transmission corridor impacts included a 12.7-mi segment where lines will be rebuilt, including potential excavation work. These impacts would be confined to established right-of-ways.	ER Section 3.7[a]
	Hypothesized transmission line upgrades would affect currently unspecified areas within existing right-of-ways of a total of 439 mi or 5,327 ac of offsite transmission line corridors.	TVA 2017-TN4922; ER Figure 3.7-7[a]
Water Use and Quality		
	Stormwater runoff from the CRN Site would be controlled via engineered structures, collected in engineered retention ponds, and infiltrated to the ground, or released to the Clinch River in a controlled manner according to the terms of the National Pollutant Discharge Elimination System (NPDES) permit. This permit would be obtained prior to any building activities at the site.	ER Section 4.2[a]
	No dredging during building would occur.	ER Section 4.2[a]
	Underwater excavation for construction of the intake and discharge structures would use BMPs to limit disturbance of sediments according to applicable regulations, including procedures of the Watts Bar Interagency Agreement Working Group.	ER Section 4.2[a]
	Underwater excavation material would be sampled and characterized for contamination, and disposed of according to applicable regulations.	ER Section 4.2[a]
	Engineering control measures (e.g., grouting of fractures) would be used during construction to limit the rate of excavation dewatering required.	ER Section 4.2[a]

Table J-2. (contd)

Technical Area	Representations/Assumptions	Source
	Excavation dewatering required would be similar to the Clinch River Breeder Reactor Project (CRBRP) experience: the rate would be low. Monitoring would be carried out to evaluate the effect of dewatering on the surrounding groundwater and any nearby surface waterbodies, including wetlands.	ER Section 4.2[a]
	Dewatering flows would be routed to one of the stormwater retention ponds.	ER Section 4.2[a]
	Construction of a Melton Hill Dam bypass capable of providing 400 cfs of continuous discharge from the dam would be constructed prior to operations at the site. Construction of the bypass would be conducted with appropriate engineering controls to avoid water-quality impacts.	ER Section 4.2[a]
	Installation of the underground 69-kV transmission line would be conducted with minor localized and temporary effects on streams traversed.	EIS Section 4.2
	Construction water would be obtained from the City of Oak Ridge and would not exceed 231,660 gpd. Any upgrades to existing infrastructure would conform to applicable local, State, and Federal permits.	ER Section 4.2[a]
	Surface water would be obtained directly from the Clinch River for dust suppression and other building purposes and would not exceed 5,000 gpd.	ER Section 4.2[a]
	No groundwater would be used during construction.	ER Section 4.2[a]
	Potable and sanitary water services during operations would be obtained from the City of Oak Ridge.	ER Section 5.2[a]
	Makeup water for a new plant's circulating-water system would be obtained from the Clinch River arm of the Watts Bar Reservoir.	ER Section 5.2[a]
	TVA would continue to follow current reservoir operating policy so that average and drought flows in the Clinch River arm of the Watts Bar Reservoir during operations would be similar to those during the period 2004–2013.	EIS Section 5.2
	Net water demand in the Clinch River basin, including consumptive water use of a plant at the CRN Site would not exceed the demand projections used in the development of the current reservoir operations policy.	ER Section 5.2[a]
	No groundwater would be used during operations.	ER Section 5.2[a]
	No dredging during operation would occur.	ER Section 5.2[a]
	The Melton Hill Dam bypass would operate continuously during plant operations.	ER Section 5.2[a]
	Plant discharge would be in compliance with terms and conditions of the NPDES permit.	ER Section 5.2[a]

Table J-2. (contd)

Technical Area	Representations/Assumptions	Source
	CRBRP wells were either destroyed or removed and would not provide pathways of preferential transport of contaminants to groundwater.	EIS Section 5.2
	Design and construction of the holding pond would preclude groundwater contamination during site operations.	EIS Section 5.2
Terrestrial Ecology – Clinch River Site, Barge/Traffic Area, 69-kV Buried Transmission Line		
	The CRN Site would total 935 ac. The BTA would total 203 ac.	ER Table 2.2-1[a]
	An estimated 494 ac of the existing 935-ac CRN Site and an estimated 45 ac of the existing 203-ac BTA would be affected by the construction of two or more SMRs.	ER Figures 3.1-2 and 4.3.1[a]
	The CRN Site and BTA construction footprint would generally be as shown in Figure 4.3.1 in the ER	ER Figure 4.3.1[a]
	Permanent disturbance would occur on approximately 327 ac, and temporary disturbance would occur on approximately 167 ac on the CRN Site.	ER Table 4.3-1[a]
	Permanent disturbance would occur on approximately 30 ac, and temporary disturbance would occur on approximately 15 ac on the BTA.	ER Table 4.1-1[a]; Section 4.3.1.1
	Disturbance for the buried 69-kV transmission line, extending from the CRN Site to the Bethel Valley Substation would occur only within the corridor of an existing 500-kV transmission line.	ER Section 4.3.1.1[a]
	Disturbance of wetland habitat would total an estimated 1.8 ac on the CRN Site and BTA.	ER Section 4.3.1.2[a]
	Mechanical draft cooling towers approximately 65 ft in height or less would be used to cool the SMRs.	ER Table 3.1-2
	The design would call for use of mechanical draft cooling towers with input parameters to the Seasonal and Annual Cooling Tower Impact (SACTI) prediction code modeling (EPRI 2015-TN4864) expected to generally result in salt drift equivalent to or lower than that predicted by the modeling discussed in Section 5.3.1.	ER Section 5.3.3.2 and Table 5.3-5[a]
	TVA would propose use only of those borrow pits (without expansion) that were presented in the ESP application.	ER Section 2.2.3, 2.9, 4.1.1[a]
	TVA would comply with all required wetland mitigation measures determined for jurisdictional wetlands that could be affected by the building and operating at the CRN Site.	
	TVA would follow the State of Tennessee BMPs and TVA BMPs and when working in wetlands.	

Table J-2. (contd)

Technical Area	Representations/Assumptions	Source
	Temporarily affected areas would be revegetated or otherwise restored after construction using native or noninvasive plant species.	ER Section 4.3.1[(a)]
	The potential impacts on Federally listed threatened and endangered terrestrial species and designated critical habitats would be documented in the Biological Assessment in Appendix M. TVA would support NRC as necessary to comply with terms or conditions of any Biological Opinion and Incidental Take Statement issued by the U.S. Fish and Wildlife Service (FWS) as part of the ESP licensing review.	
	Any offsite transmission line upgrades proposed by TVA would be limited to the existing rights-of-way of the transmission lines presented in the ESP application.	ER Figure 3.7-7[(a)] ; TVA 2016-TN5145)
	Any ground disturbance from the offsite transmission line upgrades would not encroach into land outside of the existing right-of-ways.	ER Section 4.3.1.6; TVA 2016-TN5145
	TVA would prevent or minimize to the extent practicable impacts to forests, wetlands, or sensitive biota due to ground disturbance resulting from the offsite transmission line upgrades by using established BMPs.	ER Section 4.3.1.6; TVA 2016-TN5145
Aquatic Ecology		
	Onsite and offsite descriptions of aquatic resources for the CRN Site, consistent with NUREG–1555 (NRC 2000-TN614), would be as provided in Sections 2.4.2.1 and 2.4.2.2, respectively.	EIS Sections 2.4.2.1 and 2.4.2.2
	Important aquatic species are would be as discussed in Section 2.4.2.3 of the EIS.	EIS Section 2.4.2.3
	The potential impacts on Federally listed threatened and endangered aquatic species and designated critical habitats would be documented in the Biological Assessment in Appendix M and would comply with terms or conditions of any Biological Opinion and Incidental Take Statement issued by the FWS as part of the ESP licensing review.	EIS Appendix M

Table J-2. (contd)

Technical Area	Representations/Assumptions	Source
	Building activities that could directly affect onsite and offsite aquatic ecosystems would include site preparation for installation of plant structures and the barge slip in the barge transport area; installing the cooling-water system intake and discharge structures; and burying a 69-kV underground transmission line in the existing 500-kV transmission line corridor where it crosses streams or creeks. This includes the use of BMPs including silt-curtains and cofferdams as appropriate. Shoreline installation and site preparation activities would require a stormwater pollution prevention plan, developed as part of the Tennessee Department of Environment and Conservation (TDEC) stormwater permit, which would describe BMPs to control sedimentation and erosion and provide stormwater management. In-water building activities (e.g., pile driving, excavation) would comply with the terms and conditions (e.g., dredging methodology, seasonal restrictions, and dredged material disposal requirements) included in the Department of the Army permit issued by the U.S. Army Corps of Engineers (USACE) and the TDEC NPDES permit.	EIS Section 4.3.2
	TVA would comply with all required mitigation measures determined for jurisdictional streams that could be affected by building and operating at the CRN Site.	
	The location, design, construction, and capacity of the cooling-water intake structure would reflect the best technology available for minimizing environmental impacts and would be compliant with U.S. environmental protection Agency 316(b) Phase I requirements (40 CFR Part 125-TN254).	EIS Section 5.3.2.1
	Any ground disturbance from the transmission line upgrades would not encroach into streams or other aquatic habitats and would not affect any known locations of protected or sensitive biota.	EIS Section 5.3.2.1 and 5.3.2.2
	The Melton Hill Dam bypass would be installed and functioning before the plant operations are started.	EIS 5.3.2.1
Socioeconomics		
	Construction materials would be shipped to the CRN Site and construction debris and associated waste not placed in the onsite disposal pit would be removed from the site via road, rail, and/or barge. A portion of Bear Creek Road and access to the Rail Offload Area would be modified to handle heavy-haul traffic. The CRN Site Access Road would also be modified to handle heavy-haul traffic into the CRN Site. River Road would be improved to handle regular patrol traffic.	ER Section 4.1.1[a]
	Definition of the affected demographic and economic regions would be those suggested in the ER. The review team relied upon American Community Survey 2011–2015 5-year data for most demographic statistics and for the analyses of potential impacts. Populations projections would be based on information from the State of Tennessee.	EIS Section 2.5.1

Table J-2. (contd)

Technical Area	Representations/Assumptions	Source
	Site preparation and construction activities would continue for approximately 6 years and would employ as many as 3,300 construction workers. TVA would employ up to 500 operations and 1,000 outage workers.	ER Sections 3.10.1.2 and 3.10.3[(a)]
	The in-migrating building and operations workforce would be distributed geographically in a manner similar to the existing Oak Ridge Reservation workforce.	ER Sections 4.4.2.2 and 5.4.2[(a)]; EIS Sections 4.4.2 and 5.4.2
	Traffic impacts would be based on the AECOM Technical Services Inc. traffic impact analysis (AECOM 2015-TN5000).	ER Section 4.4.2.3[(a)]
	The household size for in-migrating workers is would be 2.53 persons	EIS Sections 4.4.2 and 5.4.2
	TVA would construct two or more SMRs with the combined capacity listed in the plant parameter envelope (PPE) (800 MW(e)). The cost of reactors is would be $5,183—7,256 per kW(e) in 2016 dollars. (Used the Bureau of Economic Analysis' Regional Input-Output Modeling System II multipliers for indirect workforce.)	EIS Sections 4.4.3.1 and 5.4.3.1
	Construction worker annual income would be $42,300 and operations worker income would be $65,520.	EIS Sections 4.4.3.2 and 5.4.3.2
	Aesthetic impacts would include 160-ft-tall mechanical draft cooling towers and associated plumes.	EIS Sections 4.4.1.6 and 5.4.1.6
	Water and wastewater services would be 145 and 75 gpd, respectively.	EIS Sections 4.4.4.4 and 5.4.4.4
	All construction and operations noise would be sufficiently attenuated by TVA's identified mitigation and the physical properties (i.e., topography, foliage, etc.) of the area to reduce the overall noise levels to below the NRC threshold for minor impacts (65 dBA).	EIS Section 4.8.2 and 5.8.2
Environmental Justice		
	American Community Survey 2011–2015 5-year data were used as the baseline for the analyses of potential impacts. Minority and low-income populations would continue to exist in the same proportions and locations as populations increase.	EIS Section 2.6

Table J-2. (contd)

Technical Area	Representations/Assumptions	Source
	Field reconnaissance did not reveal evidence of any special populations or subsistence activities in close proximity to the CRN Site. Assume these populations cannot be identified for environmental justice analysis.	EIS Section 2.6
Historic and Cultural Resources		
	TVA has executed a Programmatic Agreement (PA) in accordance with 36 CFR Part 800 (TN513) that outlines how TVA would avoid, minimize, or mitigate impacts on historic and cultural resources from preconstruction and construction activities within the onsite and offsite direct- and indirect-effects areas of potential effect (APE). The PA also outlines a process for TVA to amend the APE as project plans are finalized for the COL application. Included in this process are the steps TVA would take to identify, evaluate, and mitigate newly identified significant historic and cultural resources as well as inadvertent discoveries. Notification and consultation with Tennessee Historical Commission (THC) and American Indian Tribes are also stipulated for these steps. TVA has committed to keeping the NRC informed of updates concerning its National Historic Preservation Act (NHPA) Section 106 consultation (TVA 2017-TN4922).	EIS Section 4.6
	It is expected that the USACE would be a cooperating agency on the COL EIS. The USACE would defer its Section 106 NHPA consultation until the COL stage of the application process and would define its permit area at that time.	EIS Section 4.6
	To avoid and minimize unintentional impacts on historic and cultural resources from operation and maintenance activities, TVA would follow appropriate Federal historic and cultural resource protection requirements (i.e., NHPA; 54 U.S.C. § 300101 *et seq*.-TN4157), Archaeological Resources Protection Act (16 U.S.C. § 470aa *et seq*.-TN1687), Native American Graves Protection and Repatriation Act (25 U.S.C. § 3001 *et seq*.-TN1686), and Archeological and Historic Preservation Act (54 U.S.C. § 312501 *et seq*.-TN4844), American Indian Religious Freedom Act (42 U.S.C. § 1996 *et seq*.-TN5281), Executive Order (EO) 13007 "Indian Sacred Sites" (TN5250), and EO 13175 "Consultation and Coordination with Indian Tribal Governments" (TN4846). These laws also require TVA to notify the THC and American Indian Tribes in the event of inadvertent discovery of human remains or historic and cultural resources. These requirements would also apply to the COL application.	EIS Section 4.6
Meteorology and Air Quality		
	Temporary emissions, including fugitive dust and construction equipment engine exhaust, would be minimized with a preconstruction and construction-related mitigation plan. These mitigation measures could include any or all of the measures identified in Section 4.4.1.2 of this EIS.	ER Section 4.4.1.2[(a)] ER Section 4.6[(a)] ER Section 4.7.5.1.1[(a)]

Table J-2. (contd)

Technical Area	Representations/Assumptions	Source
	Meteorological data for the CRN Site are presented in the Environmental Report (ER). The data from 2011 to 2013 are assumed to be representative.	ER Section 2.7[a] ER Section 6.4[a]
	Air emissions from the CRN Site would be bounded by those listed in EIS Sections 4.7, 5.7, 6.1.3, 6.3, and 7.6. Greenhouse gas emissions would be bounded by those in Appendix K over the life cycle of the facility	Various
	Auxiliary boilers and diesel generators and/or gas turbines are assumed to be required for a new nuclear power plant, and these devices would release permitted pollutants to the air. The ER describes the annual estimated emissions, and these emissions have been considered in EIS Table 5-14.	EIS Section 5.8[a]
	The normal heat sink that would be used to dissipate heat from the turbine cycle for a new nuclear power plant would use cooling towers to reject that heat directly into the atmosphere.	ER Section 3.4.1.1[a]
	Cooling towers would have drift eliminators comparable in effectiveness to the drift eliminators in current-generation cooling towers.	ER Section 5.3.3.1[a]
	The maximum salt deposition rate from the two linear mechanical draft cooling towers was estimated to be 6,276 kg/km^2 per month and would occur at a distance of 100 m west of the towers.	ER Section 5.3.3.2.1[a]
	A meteorological monitoring program would be re-established for the operational phase of the project. The monitoring program would be a similar to the meteorological monitoring program for the site preparation monitoring.	ER Section 6.4[a]
Nonradiological Human Health – CRN Site		
	The nearest sensitive receptor (residence) would be approximately 0.36 mi (1,900 ft) from the planned cooling-tower location.	EIS Section 4.8.2
	Nighttime construction activities would not exceed 65 dBA at the site boundary.	ER Section 4.3.1.4
	The peak noise level would be 102 dBA measured from 50 ft from the source during construction. Peak noise levels during operations would be 70 dBA 1,000 ft from the source, and would be primarily from cooling-tower operation.	ER Table 3.9-2; ER Table 3.1-2
	All construction and operations noise would be sufficiently attenuated by TVA's identified mitigation and the physical properties (i.e., topography, foliage, etc.) to levels below the NRC threshold for minor impacts (65 dBA) at the site boundary.	EIS Section 4.8.2 and 5.8.2; ER Sections 4.3.1.4 and 4.4.1.1

Table J-2. (contd)

Technical Area	Representations/Assumptions	Source
	Noise levels associated with blasting activities during construction are infrequent, temporary, and limited to daytime hours. Although this noise-producing activity is discussed in the Terrestrial Ecology sections of this EIS, it is not appropriate for analysis with respect to human health.	ER Section 3.9.6, EIS Section 4.3.1.1.3
Nonradioactive Waste		
	Water and wastewater services would be 100 gpd and 75 gpd, respectively.	EIS Sections 4.4.4.4 and 5.4.4.4[a]
Radiological Human Health		
	Radioactive waste management systems would be designed to minimize releases from reactor operations to values as low as is reasonably achievable. These systems would be designed and maintained to meet the requirements of 10 CFR Part 20 (TN283) and Appendix I in 10 CFR Part 50 (TN249).	ER Section 3.5[a]
	The expected single unit annual activities by isotope contained in the airborne effluent, liquid effluent, and solid radioactive waste streams generated during routine plant operations are based on the PPE approach, where bounding direct radiation and liquid and gaseous radiological effluents were used in the evaluation.	ER Sections 3.5.1 to 3.5.5[a]
	The exposure pathways considered and the analytical methods used to estimate doses to the maximally exposed individual and to the population surrounding a new nuclear power plant are based on NRC Regulatory Guide 1.109, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I* (Rev.1, October 1977 [TN249]) (RG 1.109, NRC 1977-TN90), and NRC Regulatory Guide 1.111, *Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors* (Revision 1, July 1977) (RG 1.111, NRC 1977-TN91).	ER Sections 5.4.1 to 5.4.3[a]
	ER Table 5.4-15 estimates the total body and organ doses to the maximally exposed individual from liquid effluents and gaseous releases per unit based on the PPE approach for analytical endpoints prescribed in 10 CFR Part 50, Appendix I (TN249).	ER Section 5.4.3[a]
	The estimated annual doses from all pathways for the CRN Site are summarized in ER Table 5.4-16. ER Table 5.4-16 compares these doses to the public dose criteria in 40 CFR Part 190 (TN739). TVA states that by demonstrating compliance with the requirements of 40 CFR Part 190 (TN739), it in turn demonstrates compliance with the requirements of 10 CFR 20.1301 (TN283).	ER Section 5.4.3[a]

Table J-2. (contd)

Technical Area	Representations/Assumptions	Source
	Because a specific reactor design has not been selected, the calculated construction worker direct doses are based on data available for the Westinghouse Advanced Passive 1000 (AP1000) pressurized water reactor (PWR). Although thought to be bounding, it is possible that these dose rates would increase in the future as site conditions change. However, the site would be monitored continually during the construction period, and appropriate actions would be taken as necessary to ensure that the construction workers are protected from radiation.	ER Sections 4.5.3.1 and 4.5.4.4[(a)]
	The new nuclear power plant would release liquid effluents to the Clinch River arm of the Watts Bar Reservoir via the cooling-water discharge stream.	ER Sections 3.5.1 and 5.4.1.1[(a)]; EIS Sections 5.9.1 and G.2.1
Transportation		
	Overall, the generating output of the SMRs at the CRN Site or alternative sites would be 800 MW(e) and the station capacity factor would be 90 percent.	ER Section 7.4[(a)], EIS Section 6.2
	Unirradiated fuel assemblies would be shipped to the CRN Site by truck only shortly before they would be needed.	ER Section 5.7.2[(a)]), EIS Section 6.2.1
	Radioactive waste and spent fuel would be shipped from the CRN Site by truck only. The number of radioactive waste shipments was based on 2.34 m^3/shipment. The number of spent fuel shipments was based on 0.5 MTU/shipment.	ER Section 5.7.2[(a)], EIS Section 6.2.2 and 6.2.3
	The radionuclide inventory used in the transportation accident analysis was based on AP1000 reactor fuel.	ER Section 7.4[(a)], EIS Section 6.2.2
	The new nuclear power plant would have storage capacity exceeding that needed to accommodate 5-year cooling of irradiated fuel before transport offsite.	ER Section 5.7.2[(a)], EIS Section 6.2.2
	The transportation impact analysis for the surrogate SMR spent fuel shipments assumed the radiation dose rate emitted from the shipments would be the maximum allowed by Federal regulations.	EIS Section 6.2.2
	It was assumed that shipping casks for the surrogate SMR spent fuel would provide equivalent mechanical and thermal protection of the spent fuel cargo (relative to the current light water reactor [LWR] spent fuel shipping cask designs).	EIS Section 6.2.2

Table J-2. (contd)

Technical Area	Representations/Assumptions	Source
	For this assessment, release fractions for current-generation LWR fuels were used to approximate the impacts from advanced reactor spent fuel shipments. This essentially assumes that the behavior of fuel materials and containment systems (e.g., cladding and fuel coatings) is similar to that of the current-generation LWR fuel under applied mechanical and thermal conditions.	EIS Section 6.2.2
	The proposed geologic repository at Yucca Mountain was used as a surrogate destination for spent fuel shipments.	ER Sections 5.7.2 and 7.4[a], EIS Section 6.2.2
	It was assumed that no shipments of unirradiated fuel, irradiated fuel, or radioactive waste would be made by barge or rail.	ER Sections 5.7.2 and 7.4[a], EIS Section 6.2
	It was assumed that shipments of spent nuclear fuel would be shipped directly to a geologic repository. Shipment of spent nuclear fuel to an interim storage facility followed by shipment to a geologic repository was not analyzed.	ER Sections 5.7.2 and 7.4[a], EIS Section 6.2
Decommissioning		
	Impacts from decommissioning new reactor unit(s) designs are considered to be bounded by those in NUREG–0586, Supplement 1 (NRC 2002-TN665).	EIS Section 6.3
Nuclear Fuel Cycle and Fuel Storage		
	All of the SMR technologies considered have a design storage capacity for spent fuel pools of a minimum of 6 years, a period sufficient to accommodate a 5-year cooling period, as required in 10 CFR Part 961, Appendix E (TN300).	ER Section 3.8.2[a]
	After a sufficient decay period of at least 5 years, the fuel would be removed from the pool and packaged in spent fuel shipping/storage casks either for storage onsite at an independent spent fuel storage installation (ISFSI) or for transportation offsite. Onsite storage would be licensed in accordance with 10 CFR Part 72 (TN4884), “Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Waste, and Reactor-Related Greater than Class C Waste,” and transferred either to an ISFSI facility onsite or an offsite disposal facility. Offsite transportation would be conducted in accordance with 49 CFR Part 173 (TN298), 49 CFR Part 178 (TN5160), and 10 CFR Part 71 (TN301).	ER Section 3.8.2[a]
Accidents		
	The exclusion area boundary (EAB) is greater than 0.21 mi (1,100 ft or 335 m) in all directions from the footprint of the new nuclear power plant. No major roads, public buildings, or residences are located within the exclusion area.	ER Section 2.7.5-, EIS Section 5.11.1

Table J-2. (contd)

Technical Area	Representations/Assumptions	Source
	Because TVA's ESP application does not rely on information based on an approved SMR design certification, the design basis accident (DBA) analysis is based on a surrogate SMR and only applying a loss of coolant accident (LOCA) source term as a bounding calculation.	ER Section 7.1.1[a], EIS Section 5.11.1
	The LOCA source term is based on the vendor design of the four SMR designs under consideration that resulted in the highest doses at both the EAB and the low-population zone boundary. The source term is based on uranium fuel enriched to no more than 5 percent, which is representative of the SMR designs under consideration, a maximum single unit power level of 800 megawatts thermal (MW(t)), and a maximum average burnup of 51 gigawatt days per metric tons of uranium (GWD/MTU), while the maximum average burnup for the remaining SMR designs is less than 41 GWD/MTU.	ER Section 7.1.2[a], EIS Section 5.11.1
	In accordance with RG 1.183 (NRC 2000-TN517), the DBA dose for the EAB is from the 2-hour period that yields the maximum dose.	ER Section 7.1[a], EIS Section 5.11.1
	Population growth in the vicinity of the CRN Site would not alter the population distribution in the region.	ER Section 2.5.1[a], EIS Section 2.5.1
	The severe accident source term was based on a ratio of the maximum PPE thermal power rating of 800 MW(t) to that of a large PWR previously analyzed.	ER Section 7.2.1[a], EIS Section 5.11.2
	The severe accident risks are based on the assumption that 99.5 percent of the population evacuates within the 2 mi and 10 mi emergency planning zones (EPZs) and the other 0.5 percent of the population does not evacuate. No evacuation is assumed to occur for the site boundary EPZ analysis.	ER Section 7.2.3[a], EIS Section 5.11.2
	The core damage frequencies are based on the largest SMR considered for the CRN Site based on proprietary vendor information provided to TVA.	ER Section 7.2.1[a], EIS Section 5.11.2
	To assess health risks from a severe accident, the projected population that resides within a 50-mi radius of the CRN Site in 2067 was assumed.	ER Section 7.2.2[a], EIS Section 5.11.2
	The spent fuel pool would be constructed at or below grade level. The spent fuel pools have a design storage capacity of a minimum of 6 years, a period sufficient to accommodate a 5-year cooling period, as required in 10 CFR Part 961, Appendix E (TN300). The spent fuel assemblies would remain in the pool for at least 5 years, after which they would be transferred to onsite dry storage at an independent spent fuel storage installation (ISFSI).	ER Section 3.8.2[a], EIS Section 5.11.2

Table J-2. (contd)

Technical Area	Representations/Assumptions	Source
	An appropriately sized ISFSI would be constructed and operational within 6 years from the commencement of operations. After a sufficient decay period of at least 5 years, the fuel would be removed from the pool and packaged in spent fuel shipping/storage casks either for storage onsite at an (ISFSI or for transportation offsite.	ER Section 3.8.2[a]
System Design Alternatives		
	Water-treatment alternatives for the circulating-water system were not described in the ER and not evaluated in the ESP EIS. Therefore, this issue is not resolved.	EIS Section 9.4
Cumulative Impacts		
	The proposed nearby projects and activities that could have a cumulative effect on the construction or operation of a new nuclear power plant at the CRN Site are those identified in EIS Sections 2.12 and 7.0	EIS Section 2.12 and 7.0

(a) TVA 2017-TN4921

J.1 References

10 CFR Part 20. *Code of Federal Regulations*, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation." Washington, D.C. TN283.

10 CFR Part 50. *Code of Federal Regulations*, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities." Washington, D.C. TN249.

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." Washington, D.C. TN250.

10 CFR Part 71. *Code of Federal Regulations*, Title 10, *Energy*, Part 71, "Packaging and Transportation of Radioactive Material." Washington, D.C. TN301.

10 CFR Part 72. *Code of Federal Regulations*, Title 10, *Energy*, Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste." Washington, D.C. TN4884.

10 CFR Part 961. *Code of Federal Regulations*, Title 10, *Energy*, Part 961, "Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste." Washington, D.C. TN300.

36 CFR Part 800. *Code of Federal Regulations*, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties." Washington, D.C. TN513.

40 CFR Part 125. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 125, "Criteria and Standards for the National Pollutant Discharge Elimination System." Washington, D.C. TN254.

40 CFR Part 190. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations." Washington, D.C. TN739.

49 CFR Part 173. *Code of Federal Regulations*, Title 49, *Transportation*, Part 173, "Shippers—General Requirements for Shipments and Packagings." Washington, D.C. TN298.

49 CFR Part 178. *Code of Federal Regulations*, Title 49, *Transportation*, Part 178, "Specifications for Packagings." Washington, D.C. TN5160.

16 U.S.C. § 470aa *et seq*. Archaeological Resources Protection Act of 1979, as amended. TN1687.

25 U.S.C. § 3001 *et seq*. Native American Graves Protection and Repatriation Act. TN1686.

42 U.S.C. § 1996 *et seq*. American Indian Religious Freedom Act, as amended. TN5281.

54 U.S.C. § 300101 *et seq*. National Historic Preservation Act. TN4157.

54 U.S.C. § 312501 *et seq*. Archeological and Historic Preservation Act of 1974, as amended. TN4844.

AECOM (AECOM Technical Services, Inc.). 2015. *Clinch River Site Traffic Assessment.* Final Technical Report, L98 160208 008, Greenville, South Carolina. Accession No. ML17334A043. TN5000.

EO 13007. May 24, 1996. *Executive Order 13007—Indian Sacred Sites*. Office of the President, Washington, D.C. TN5250.

EO 13175. November 6, 2000. *Executive Order 13175—Consultation and Coordination with Indian Tribal Governments*. Office of the President, Washington, D.C. TN4846.

EPRI (Electric Power Research Institute). 2015. "Seasonal/Annual Cooling Tower Impacts (SACTI) Version 2.0 with Source Code." Palo Alto, California. Available at http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002006350. TN4864.

NRC (U.S. Nuclear Regulatory Commission). 1977. *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I*. Regulatory Guide 1.109, Revision 1, Washington, D.C. Accession No. ML003740384. TN90.

NRC (U.S. Nuclear Regulatory Commission). 1977. *Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors.* Regulatory Guide 1.111, Revision 1, Washington, D.C. Accession No. ML003740354. TN91.

NRC (U.S. Nuclear Regulatory Commission). 2000. *Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors.* Regulatory Guide 1.183, Washington, D.C. Accession No. ML003716792. TN517.

NRC (U.S. Nuclear Regulatory Commission). 2000. *Environmental* Standard *Review* Plan—Standard *Review Plans for Environmental Reviews for Nuclear Power Plants*. NUREG–1555, Main Report and 2007 Revisions, Washington, D.C. Available at http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/toc/. TN614.

NRC (U.S. Nuclear Regulatory Commission). 2002. *Final Generic Environmental Impact Statement of Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors*. NUREG–0586, Supplement 1, Volumes 1 and 2, Washington, D.C. Accession Nos. ML023470327, ML023500228. TN665.

TVA (Tennessee Valley Authority). 2016. Letter from J.W. Shea to NRC, dated December 13, 2016, regarding "Submittal of Supplemental Information Regarding Terrestrial Ecology in Support of Early Site Permit Application for Clinch River Nuclear Site." CNL-16-200, Chattanooga, Tennessee. Accession No. ML16348A552. TN5145.

TVA (Tennessee Valley Authority). 2017. "Clinch River Nuclear Site Early Site Permit Application, Part 03—Environmental Report (Revision 1)." Chattanooga, Tennessee. Accession No. ML18003A471. TN4921.

TVA (Tennessee Valley Authority). 2017. Letter from J.W. Shea to NRC, dated August 1, 2017, regarding "Submittal of Supplemental Information Related to the Environmental Audit in

Support of Early Site Permit Application for Clinch River Nuclear Site." CNL-17-097, Chattanooga, Tennessee. Accession No. ML17234A003. TN4922.

APPENDIX K
GREENHOUSE GAS FOOTPRINT ESTIMATES FOR A REFERENCE 1,000-MW(E) LIGHT WATER REACTOR (LWR)

The review team estimated the greenhouse gas (GHG) footprint of various activities associated with nuclear power plants. These activities include building, operating, and decommissioning a nuclear power plant. The GHG emission estimates include direct emissions from the nuclear facility and indirect emissions from workforce transportation and the uranium fuel cycle.

Preconstruction/construction equipment estimates listed in Table K-1 are based on hours of equipment use estimated for a single nuclear power plant at a site requiring a moderate amount of terrain modification (UniStar 2007-TN1564). Preconstruction/construction equipment carbon monoxide (CO) emission estimates were derived from the hours of equipment use, and carbon dioxide (CO_2) emissions were then estimated from the CO emissions using a scaling factor of 172 tons of CO_2 per ton of CO (Chapman et al. 2012-TN2644). The scaling factor is based on the ratio of CO_2 to CO emission factors for diesel fuel industrial engines as reported in Table 3.3-1 of AP-42 *Compilation of Air Pollutant Emission Factors* (EPA 2012-TN2647). A CO_2 to total GHG equivalency factor of 0.991 is used to account for the emissions from other GHGs, such as methane (CH_4) and nitrous oxide (N_2O) (Chapman et al. 2012-TN2644). The equivalency factor is based on non-road/construction equipment in accordance with relevant guidance (NRC 2014-TN3768; Chapman et al. 2012-TN2644). Equipment emissions estimates for decommissioning are assumed to be one-half of those for preconstruction/construction. Data on equipment emissions for decommissioning are not available; the one-half factor is based on the assumption that decommissioning would involve less earthmoving and hauling of material, as well as fewer labor hours, when compared with preconstruction/construction (Chapman et al. 2012-TN2644).

Table K-1. GHG Emissions from Equipment Used in Preconstruction/Construction and Decommissioning (MT CO2e)

Equipment	Preconstruction/Construction Total[(a)]	Decommissioning Total[(b)]
Earthwork and Dewatering	12,000	6,000
Batch Plant Operations	3,400	1,700
Concrete	5,400	2,700
Lifting and Rigging	5,600	2,800
Shop Fabrication	1,000	500
Warehouse Operations	1,400	700
Equipment Maintenance	10,000	5,000
Total[(c)]	39,000	19,000

(a) Based on hours of equipment usage over a 7-year period.
(b) Based on equipment usage over a 10-year period.
(c) Results are rounded to the nearest 1,000 MT CO_2e.

Table K-2 lists the review team's estimates of the CO_2 equivalent (CO_2e) emissions associated with workforce transportation. Workforce estimates for new plant preconstruction/construction are conservatively based on estimates in various combined license (COL) applications (Chapman et al. 2012-TN2644), and the operational and decommissioning workforce estimates are based on Supplement 1 to NUREG–0586 (NRC 2002-TN665). The table lists the assumptions used to estimate total miles traveled by each workforce and the factors used to convert total miles to metric tons (MT) of CO_2e. The workers are assumed to travel in gasoline-powered passenger vehicles (cars, trucks, vans, and sport utility vehicles) that get an average of 21.6 mi/gal of gasoline (FHWA 2012-TN2645). Conversion from gallons of gasoline burned to CO_2e is based on U.S. Environmental Protection (EPA) emission factors (EPA 2012-TN2643).

Table K-2. Workforce GHG Footprint Estimates

	Preconstruction/ Construction Workforce	Operational Workforce	Decommissioning Workforce	SAFSTOR Workforce
Commuting Trips (round trips per day)	1,000	550	200	40
Commute Distance (miles per round trip)	40	40	40	40
Commuting Days (days per year)	365	365	250	365
Duration (years)	7	40	10	40
Total Distance Traveled (miles)[a]	102,000,000	321,000,000	20,000,000	23,000,000
Average Vehicle Fuel Efficiency[b] (miles per gallon)	21.6	21.6	21.6	21.6
Total Fuel Burned[a] (gallons)	4,700,000	14,900,000	900,000	1,100,000
CO_2 Emitted Per Gallon[c] (MT CO_2)	0.00892	0.00892	0.00892	0.00892
Total CO_2 Emitted[a] (MT CO_2)	42,000	133,000	8,000	10,000
CO_2 Equivalency Factor[c] (MT CO_2/MT CO_2e)	0.977	0.977	0.977	0.977
Total GHG Emitted[a] (MT CO_2e)	43,000	136,000	8,000	10,000

(a) Results are rounded.
(b) Source: FHWA 2012-TN2645.
(c) Source: EPA 2012-TN2643.

10 CFR 51.51(a) (TN250) states that every Environmental Report prepared for the COL stage of a light-water-cooled nuclear power reactor shall take Table S-3, Table of Uranium Fuel Cycle Environmental Data, from 10 CFR 51.51(b) (TN250) as the basis for evaluating the contribution of the environmental effects of uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor. 10 CFR 51.51(a) (TN250) further states that Table S-3 shall be included in the Environmental Report and may be supplemented by a discussion of the environmental significance of the data set forth in the table as weighted in the analysis for the proposed facility.

Table S-3 of 10 CFR 51.51(b) does not provide an estimate of GHG emissions associated with the uranium fuel cycle; it only addresses pollutants that were of concern when the table was promulgated in the 1980s. However, Table S-3 states that 323,000 MWh is the assumed annual electric energy use for the reference 1,000 MW(e) nuclear power plant and that this 323,000 MWh of annual electric energy is assumed to be generated by a 45 MW(e) coal-fired power plant burning 118,000 MT of coal. Table S-3 also assumes that approximately 135,000,000 standard cubic feet (scf) of natural gas is required per year to generate process heat for certain portions of the uranium fuel cycle. The review team estimates that burning 118,000 MT of coal and 135,000,000 scf of natural gas per year results in approximately 253,000 MT of CO_2e being emitted into the atmosphere per year because of the uranium fuel cycle (Harvey 2013-TN2646).

The review team estimated GHG emissions related to plant operations from a typical usage of various onsite diesel generators (UniStar 2007-TN1564). CO emission estimates were derived assuming an average of 600 hours of emergency diesel generator operation per year (four generators, each operating 150 hr/yr) and 200 hours of station blackout diesel generator operation per year (two generators, each operating 100 hr/yr) (Chapman et al. 2012-TN2644). A scaling factor of 172 was then applied to convert the CO emissions to CO_2 emissions, and a CO_2 to total GHG equivalency factor of 0.991 was used to account for the emissions from other GHGs such CH_4 and N_2O (Chapman et al. 2012-TN2644).

Given the various sources of GHG emissions discussed above, the review team estimated the total life-cycle GHG footprint for a reference 1,000 MW(e) nuclear power plant with an 80 percent capacity factor to be about 10,500,000 MT, with a 7-year preconstruction and construction phase, 40 years of operation, and 10 years of decommissioning (Chapman et al. 2012-TN2644). The components of the GHG emissions footprint are summarized in Table K-3. The uranium fuel-cycle component of the footprint is a significant portion of the overall estimated GHG emissions. This emissions estimate for the uranium fuel cycle is directly related to the assumed power generated by the plant. As a result, it is reasonable to use reactor power to scale the overall GHG footprint to reactors with different power generation capacities.

Table K-3. Nuclear Power Plant Lifetime GHG Footprint

Source	Activity Duration (yr)	Total Emissions (MT CO_2e)
Preconstruction/Construction Equipment	7	39,000
Preconstruction/Construction Workforce	7	43,000
Plant Operations	40	181,000
Operations Workforce	40	136,000
Uranium Fuel Cycle	40	10,100,000
Decommissioning Equipment	10	19,000
Decommissioning Workforce	10	8,000
SAFSTOR Workforce	40	10,000
TOTAL[a]		10,500,000

(a) Results are rounded to the nearest 1,000 MT CO_2e

The Intergovernmental Panel on Climate Change (IPCC) released a special report on renewable energy sources and climate change mitigation in 2012 (IPCC 2012-TN2648). Annex II of the IPCC report includes an assessment of previously published works on life-cycle GHG emissions from various electric generation technologies, including nuclear energy. The IPCC report included only reference material that passes certain screening criteria for quality and relevance in its assessment. The IPCC screening yielded 125 estimates of nuclear energy life-cycle GHG emissions from 32 separate references. The IPCC-screened estimates of the life-cycle GHG emissions associated with nuclear energy, as shown in Table A.II.4 of the IPCC report, ranged more than two orders of magnitude, from 1 to 220 grams (g) of CO_2e per kWh, with 25th percentile, 50th percentile, and 75th percentile values of 8 g CO_2e/kWh, 16 g CO_2e/kWh, and 45 g CO_2e/kWh, respectively. The range of the IPCC estimates is due, in part, to assumptions regarding the type of enrichment technology employed, how the electricity used for enrichment is generated, the grade of mined uranium ore, the degree of processing and enrichment required, and the assumed operating lifetime of a nuclear power plant. The review team's life-cycle GHG estimate of approximately 10,500,000 MT CO_2e for the reference 1,000 MW(e) nuclear plant is equal to about 37.5 g CO_2e/kWh, which places the review team estimate between the 50th and 75th percentile values of the IPCC estimates in Table A.II.4 of the IPCC report.

In closing, the review team considers the footprint estimated in Table K-3 to be appropriately conservative. The GHG emissions estimates for the dominant component (uranium fuel cycle) are based on 30-year-old enrichment technology, assuming that the energy required for enrichment is provided by coal-fired generation. As can be seen in Table K-3, only the scaling of the uranium fuel-cycle emissions estimate makes a significant difference in the total carbon footprint of the project. Other reasonable assumptions related to the source of energy used for enrichment or the enrichment technology could lead to a significantly reduced footprint estimate.

Emissions estimates presented in this environmental impact statement use values presented in this appendix, which the review team considers conservative for the proposed project. Plant operations emissions are adjusted to represent the number of large GHG emissions sources (diesel generators, boilers, etc.) associated with the proposed project. The workforce emissions estimates are scaled to account for differences in workforce numbers and commuting distance. Finally, equipment emissions estimates are scaled by estimated equipment usage.

References

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." Washington, D.C. TN250.

Chapman, E.G., J.P. Rishel, J.M. Niemeyer, K.A. Cort, and S.E. Gulley. 2012. *Assumptions, Calculations, and Recommendations Related to a Proposed Guidance Update on Greenhouse Gases and Climate Change*. PNNL-21494, Pacific Northwest National Laboratory, Richland, Washington. Accession No. ML12310A212. TN2644.

EPA (U.S. Environmental Protection Agency). 2012. "Clean Energy: Calculations and References." Accession No. ML12292A648. TN2643.

EPA (U.S. Environmental Protection Agency). 2012. "Stationary Internal Combustion Sources." Chapter 3 in *Technology Transfer Network Clearinghouse for Inventories & Emissions Factors: AP-42.* "Compilation of Air Emission Factors." Fifth Edition, Research Triangle Park, North Carolina. Accession No. ML12292A637. TN2647.

FHWA (Federal Highway Administration). 2012. "Highway Statistics 2010 (Table VM-1)." Office of Highway Policy Information, Washington, D.C. Accession No. ML12292A645. TN2645.

Harvey, B. 2013. "Greenhouse Emissions for the Fossil Fuel Sources Identified in Table S-3." Office of New Reactors, U.S. Nuclear Regulatory Commission, Washington, D.C. Accession No. ML12299A401. TN2646.

IPCC (Intergovernmental Panel on Climate Change). 2012. *Renewable Energy Sources and Climate Change Mitigation—Special Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom. TN2648.

NRC (U.S. Nuclear Regulatory Commission). 2002. *Final Generic Environmental Impact Statement of Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors*. NUREG–0586, Supplement 1, Volumes 1 and 2, Washington, D.C. Accession Nos. ML023470327, ML023500228. TN665.

NRC (U.S. Nuclear Regulatory Commission). 2014. *Attachment 1: Staff Guidance for Greenhouse Gas and Climate Change Impacts for New Reactor Environmental Impact Statements, COL/ESP-ISG-026*. Washington, D.C. Accession No. ML14100A157. TN3768.

UniStar (UniStar Nuclear Energy, LLC). 2007. *Technical Report in Support of Application of UniStar Nuclear Energy, LLC and UniStar Nuclear Operating Services, LLC for Certificate of Public Convenience and Necessity Before the Maryland Public Service Commission for Authorization to Construct Unit 3 at Calvert Cliffs Nuclear Power Plant and Associated Transmission Lines*. Public Service Commission of Maryland, Baltimore, Maryland. Accession No. ML090680053. TN1564.

APPENDIX L
THE EFFECT OF CLIMATE CHANGE ON THE EVALUATION OF ENVIRONMENTAL IMPACTS

The review team has determined that it is reasonably foreseeable that climate change may substantially alter the affected environment described in Chapter 2 of this environmental impact statement (EIS). Climate change is a global phenomenon that the construction and operation of two or more small modular reactors (SMRs) at the Clinch River Nuclear (CRN) Site will not appreciably alter. However, climate change will provide a new environment that may result in changed impacts from the proposed project.

The objective of this appendix is to document the review team's consideration of the potential changes in impacts that may occur as a result of a new future environment. This appendix is not intended to be a comprehensive climate change assessment for the affected region. It documents the review team's qualitative determination of the likely shifts in the impacts described in this EIS, if the environment is altered in a manner consistent with the predictions in current climate change literature.

The U.S. Nuclear Regulatory Commission (NRC) staff documents the review of the safety of the site in the Site Safety Analysis Report. The staff's overall safety review process includes periodic reconfirmation of natural hazards, such as flooding as discussed in SECY-15-0137 (NRC 2015-TN4731).

This appendix documents the review team's assessment of the potential effects of climate change on its evaluation of the environmental impacts of the proposed action. The results of this assessment are presented below in three sections: (1) description of the assessment process, (2) potential climate change impacts in the region, and (3) assessment summary.

L.1 Description of the Assessment Process

The NRC staff developed a process to ensure that the potential effects of climate change are adequately considered for all resource areas in a new reactor licensing National Environmental Policy Act (42 U.S.C. § 4321 *et seq*.-TN661) review. This EIS does not include an exhaustive discussion of climate change alterations to the existing environment. Throughout this Appendix, the review team references the comprehensive evaluation completed by the U.S. Global Change Research Program (GCRP) (GCRP 2014-TN3472). The interagency GCRP was established under the Global Change Research Act of 1990 (P.L. 101-606) (15 U.S.C. § 2921 *et seq*.-TN3330) "to understand, assess, predict, and respond to human-induced and natural processes of global change" and is the authoritative U.S. government source on likely climate change impacts in the United States.

In the first step of the process, the review team created a master table identifying plausible connections between nuclear power station resource area concerns and likely climate change-caused alterations to the existing environment as identified in the most recent climate change impacts report issued by the GCRP. The review team used the master table to identify whether GCRP-identified climate change impacts were likely to increase, decrease, or leave unchanged the assessed impact of a proposed facility on the environment, and to identify areas where scientific uncertainty precludes a definitive assessment. The comprehensive master table can be found in the NRC's Agencywide Documents Access and Management System (ADAMS), which is accessible from the NRC website at www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room) under ADAMS accession number ML18022A104 (NRC 2018-TN5405).

The review team generated a resource table specific to the CRN Site by removing irrelevant GCRP climate impacts and NRC resource area issues from the master table, and by using specific Southeast regional predictions identified by the GCRP. For example, the review team determined GCRP-identified direct impacts related to sea-level rise were not relevant to the CRN project environment and therefore did not include this information in the site-specific resource table. The review team used the site-specific resource table (NRC 2018-TN5406) in its assessment of the potential effects of climate change on relevant resource areas as discussed in Section L.3 of this appendix.

While general scientific consensus is that climate change is occurring and will continue to occur for the foreseeable future, significant uncertainty remains about the magnitude of the changes for specific regions and the precise magnitude and form of the alterations to the environment as a result of climate change (GCRP 2014-TN3472). The review team acknowledges these circumstances and explicitly notes in this appendix where uncertainty in future climate predictions and uncertainty in resulting impacts may make it impossible at this time to conclude qualitatively what the influence of climate change may be on a specific resource area or issue.

L.2 Potential Climate Change Impacts in the Region

The recent compilation of the state of knowledge in this area—GCRP's climate change impacts report (GCRP 2014-TN3472)—was considered in the preparation of this EIS. Most GCRP projections are expressed as a change expected for the later part of the 21st century (2071–2099) relative to average conditions existing in the later part of the 20th century (1970–1999). Projected changes in the GCRP report are dependent on future emissions of heat-trapping gases. The GCRP's climate change impacts report includes projections for wide-ranging scenarios in which such emissions are rapidly reduced and where they continue to increase.

An early site permit (ESP) is valid only for a particular site; it is not an authorization to build or operate a nuclear power plant. An ESP is valid for up to 20 years and may be renewed for an additional 10 to 20 years (10 *Code of Federal Regulations* [CFR] 52.26, 10 CFR 52.33) (TN251); a combined construction permit and operating license (COL) is valid for 40 years (10 CFR 52.103-TN251). The Tennessee Valley Authority (TVA) has indicated that it expects to apply for a COL for two or more SMRs at the CRN Site in the future. The timeline provided in TVA's ESP application indicates that once a COL is obtained, site preparation for and construction of two or more SMRs at the CRN Site would take approximately 6 years before the last unit commences operation. TVA's environmental analysis assumed that site preparation would start in mid-2020, and the last unit would commence operation in mid-2027. The Atomic Energy Act (42 U.S.C. § 2011 *et seq*.-TN663) and NRC regulations (10 CFR 52.103-TN251) limit commercial power reactor licenses to an initial 40 years but also permit such licenses to be renewed. If granted, under TVA's anticipated schedule the COL(s) would be valid until 2067. Because a COL could be issued at any time during the period an ESP is valid, changes in TVA's anticipated schedule could extend this date beyond 2067. Therefore, the review team considered GCRP impacts report projections for the 2071–2099 period to be bounding for assessing the effects of climate change on the resource area impacts presented in this EIS.

As discussed above, projected changes used in this section are taken from the GCRP impacts report (GCRP 2014-TN3472). Unless indicated otherwise, the review team refers to changes for the 2041–2070 and 2071−2099 periods relative to the 1970−1999 period under a continued increasing emissions scenario in this section.

Projected changes in the climate for eastern Tennessee include an increase in average surface air temperature of 8°F to 9°F (GCRP 2014-TN3472). The hottest and coldest days expected in a 20-year period at the end of this century (2081−2100) are projected to be 10°F to 15°F warmer than those experienced at the turn of the last century (1986−2005) (GCRP 2014-TN3472). Eastern Tennessee is projected to experience 16 to 20 fewer days with temperatures below 32°F during the 2041−2070 period relative to 1971−2000 (GCRP 2014-TN3472); the frost-free season would increase by 30 to 40 days in the 2070–2099 period relative to 1971−2000 (GCRP 2014-TN3472).

Projected precipitation changes in eastern Tennessee vary seasonally, but are generally within the range of natural variability. For the Southeast in general, GCRP (2014-TN3472) notes that “while change in projected precipitation for this region has high uncertainty, there is still a reasonable expectation that there will be reduced water availability due to the increased evaporative losses resulting from rising temperature alone.” In eastern Tennessee, annual water yield (availability) is projected to decrease 2.5 percent to 5 percent per decade for the period 2010–2060, relative to 2010 (GCRP 2014-TN3472). Without consideration of the impacts of climate change, water demand in eastern Tennessee is projected to increase by 10 to 25 percent by 2060, relative to 2005, based on combined changes in population and socioeconomic conditions. Accounting for climate change, water demand in eastern Tennessee is projected to increase by 25 to 50 percent by 2060, relative to 2005 (GCRP 2014-TN3472).

The Southeast region currently contains “…existing power plant capacity to produce 32 percent of the nation’s electricity,” but also currently consumes 27 percent of the nation’s total capacity, more than any other GCRP-defined region. Higher temperatures caused by climate change and the resulting increased use of air conditioning are projected to increase regional energy demand, “potentially stress[ing] electricity generating capacity, distribution infrastructure, and energy costs” (GCRP 2014-TN3472).

Other climate change impacts in the Southeast region identified in the GCRP report and relevant to the CRN project area include effects on fisheries and fishery habitats due to wetland loss; spread of non-native plants; decreased crop production and livestock yield; increased formation of allergens and air pollutants, including ozone; and increases in harmful algal blooms and other surface-waterborne disease-causing agents.

L.3 Assessment Summary

This section summarizes the review team’s assessment of the effects of climate change on relevant resource areas using the process outlined in Section L.1.

L.3.1 Land Use

L.3.1.1 Land-Use Summary

Climatological changes are not likely to influence, or lead to, any changes in plant-related impacts on local/regional land-use classifications or economic development plans. Climate change could lead to changes in the distribution of land use in eastern Tennessee. However, once the operational workforce is housed in the initial years of operation, operation of a reactor is not expected to alter land use. Therefore, there is little potential for interaction between land-use changes resulting from climate change and land-use changes caused by later operation of the reactor.

L.3.1.2 Land-Use Conclusion

Climatological changes are not expected to affect the land-use impacts assigned in the EIS.

L.3.2 Hydrology

L.3.2.1 Summary

Reduced water availability in the Clinch River basin would increase the fraction of the mean annual flow consumptively used by the proposed project. Even with the maximum projected decrease in annual water yield of 5 percent per decade, however, consumptive use of the proposed project would be less than 1 percent of the projected mean annual flow in the Clinch River arm of Watts Bar Reservoir during the period that corresponds to the final years of TVA's projected COL schedule (2060–2070). As a result of reduced water availability in the region, there would be an increase in the occurrence of periods of low flow in the Clinch River. Under TVA's current reservoir operation policy (TVA 2004-TN4913), the minimum daily average release from Melton Hill Dam would remain unchanged, so that the maximum fraction of Clinch River flows withdrawn and consumptively used by a nuclear power plant at the CRN Site would remain bounded by the values described in Section 5.2.2 of this EIS. However, the fraction of time during which the plant is using Clinch River water during low-flow periods would increase.

Increased temperatures in the region would result in an increase in Clinch River water temperatures at the CRN Site. However, the incremental increases in water temperatures resulting from plant discharges would remain similar. As a result, the review team expects that there could be minor changes in the extent of the anticipated thermal plume resulting from the plant discharge, but these would not be noticeable at downstream withdrawal locations.

L.3.2.2 Conclusion

The review team determined that the water-use impacts caused by the proposed project could increase due to a reasonably foreseeable alteration in the environmental baseline associated with climate change. Under the current reservoir operations policy, however, climatological changes are unlikely to shift the water-use impact determination discussed in the EIS. The review team identified no shift in the potential water-quality impacts caused by the proposed project due to a reasonably foreseeable alteration in the environmental baseline associated with climate change.

L.3.3 Terrestrial and Wetland Ecology

L.3.3.1 Summary

Climate change may affect baseline environmental conditions for terrestrial and wetland habitats and wildlife. Potential effects depend upon the responses of many species to changed conditions, based on their capacity for resilience and adaptation. Increased temperatures are generally expected to result in somewhat lesser water yield due to increased forest uptake of water and evapotranspiration. The timing of water availability may shift to earlier in the growing season with earlier onset of summer dry periods, and increased drought frequency, duration, and intensity, resulting in decreased stream baseflows and groundwater recharge. Habitat in the vicinity of the CRN Site is expected to range from slightly resilient to slightly vulnerable to such effects (Glick et al. 2015-TN5314). Oak-hickory forest in the vicinity is expected to persist, albeit with perhaps some minor changes in plant species composition, including some possible encroachment from pines (Glick et al. 2015-TN5314) and invasive species adapted to drier conditions. Wetland size and persistence may decrease, resulting in a loss of habitat for wetland-dependent wildlife and plant species. Any such changes would take place slowly over the passage of decades. The frequency and severity of wildfires is also anticipated to change, with longer fire seasons and larger burns. Insect outbreaks may also increase. Dramatic events such as fires and insect outbreaks would result in a sudden resetting of mature forest to an earlier stage of forest succession and somewhat greater prevalence of such areas on the landscape and associated early successional and edge wildlife.

Wildlife response to climate change is expected to be species-specific. Most mammal (including the Federally listed Indiana bat [*Myotis sodalis*], northern long-eared bat [*Myotis septentrionalis*], and gray bat [*Myotis grisescens*]), bird, and reptile species are considered stable or likely to increase in response to the above effects of climate change, primarily because of their dispersal ability (Glick et al. 2015-TN5314) and ability to adapt to spatial shifts in suitable habitat (e.g., increased temperature making bat hibernacula unsuitable). Some amphibians (e.g., gray tree frog [*Hyla versicolor*], American toad [*Anaxyrus americanus*]) are considered moderately vulnerable to the effects of climate change due to their reliance on ephemeral pools for reproduction, which may become fewer or decrease in quality, and because of their limited dispersal ability. Many other amphibians (e.g., eastern box turtle [*Terrapene carolina carolina*]) are considered stable (equally vulnerable and resilient/adaptive). Some plant species are considered moderately to extremely vulnerable to the effects of climate change in the region (due to restricted habitat range, dispersal barriers, and sensitivity to temperature and moisture), while many others are considered stable or likely to increase (e.g., ginseng [*Panax quinquefolius*]) (Glick et al. 2015-TN5314).

L.3.3.2 Conclusion

Climate change would place additional stress on the habitats and wildlife affected by the proposed project. However, habitats and most wildlife and plants are generally anticipated to be resilient or to adapt to such changes. Thus, it is anticipated that changes in the environmental baseline due to climate change would not cause an appreciable change (increase or decrease) in the impacts on terrestrial resources discussed in the EIS.

L.3.4 Aquatic Ecology

L.3.4.1 Summary

Projected changes such as the higher temperatures and increases in the occurrence of periods of low flow in the Clinch River will affect the baseline conditions in the habitat of aquatic biota (Glick et al. 2015-TN5314). Higher water temperatures may detrimentally alter low dissolved oxygen conditions in the Clinch River arm of the Watts Bar Reservoir and could put coldwater fish species closer to their thermal tolerance levels. As a result, the resilience and adaptive ability of specific species may be diminished. Fish are the taxonomic group found to be most vulnerable to climate change in Tennessee (Glick et al. 2015-TN5314). Species discussed in Chapter 2 of this EIS that are among the most vulnerable include the Lake Sturgeon (*Acipenser* *vulvescens*), considered extremely vulnerable, and the hellbender (*Cryptobranchus alleganiensis*), considered highly vulnerable.

Changes in water temperature can also create more favorable conditions for invasive species that are better able to tolerate the warmer water (Glick et al. 2015-TN5314). The increase in invasive species may create an additional source of stress to the native species from competition or in some cases due to the parasitic behavior of the invasive species.

As mentioned previously, incremental increases in water temperatures resulting from nuclear power plant discharges would remain similar. However, minor changes in the extent of the thermal plume are possible, causing the plume to extend farther downstream or increasing the width of the plume at the discharge point or slightly upstream in worst-case weather and flow conditions. Although the extent of these changes is not known, it is likely that the thermal plume would remain small enough that the free passage of fish would be retained for all conditions.

Climate change is not expected to noticeably affect the ability of agencies to coordinate on the protection of aquatic species. The importance of close coordination would, however, be greater.

L.3.4.2 Conclusion

The review team did not identify a shift in the assigned impacts on aquatic ecology caused by the proposed project when accounting for the reasonably foreseeable alteration of baseline conditions associated with climate change.

L.3.5 Socioeconomics

L.3.5.1 Summary

The review team expects that any physical change in the environment from global climate change would proceed too gradually to induce substantial adaptation by residents to the new conditions or cause individuals to move out of the area. Thus no changes to baseline conditions would be expected to be directly attributable to climate change. Consequently, the impact of global climate change on demographics and housing in the economic region would not change due to plant operations. Similarly for local services and resources including public schools, recreational resources, and first-responder agencies, the effects described in Section L.2 are likely to progress too gradually to cause changes in impacts related to plant operations. Consequently, the review team determined the global climate change impacts on community services would not change due to plant operations.

The review team expects that for traffic related to the operational workforce, deliveries, and similar activities, climatological changes are not likely to alter the impacts of plant activities on local transportation infrastructure. The pace of climate change is not likely to be rapid enough to affect noticeable changes in plant operations, and therefore would not result in any noticeable change in transportation related impacts.

The review team expects that, like traffic, the gradual effects of climate change would not significantly change the aesthetic appeal of local recreation areas and the public's access to local recreation areas. Therefore, the project-related impacts to local recreation areas would remain unchanged. There may be linkage between the hypothesized reduction in days below freezing identified in Section L.2 and steam plume visibility during winter. If these conditions occur, the visual intrusion of steam plumes during winter months may be reduced, but the size and frequency of visible steam plumes under climate change is not known.

The review team expects that because the plant would continue to operate in accordance with all permits and regulations during its license period, impacts of plant activities on local employment, wage and salary income, economic output, and tax revenues would not be affected by climate change.

L.3.5.2 Conclusion

As indicated in the EIS, the review team did not identify any significant shifts in socioeconomic impacts as a result of possible climatological changes in the environmental baseline. Potential impacts on socioeconomics including infrastructure, community services, and local economics as a result of climate change effects on plant operations would be gradual and would be addressed through regional and local governmental strategic adaptive plans.

L.3.6 Environmental Justice

L.3.6.1 Summary

Climate change could present challenges to minority and low-income communities, which the GCRP climate change impacts report refers to as “socially vulnerable populations,” within the demographic region of the proposed project. The potential impacts for such populations include challenges associated with the ability to cope with climate change effects (e.g., water temperature increases, changing weather patterns), the capacity to adapt, and the ability to relocate. The review team believes it is not unreasonable to expect decision makers in the area to incrementally adapt to the climate change effects by implementing strategic adaptation plans and mitigating measures that would inform and assist minority and low-income communities. Therefore, the conclusions in the EIS regarding environmental justice would remain unchanged.

L.3.6.2 Conclusion

Overall, the impacts assigned to environmental justice in the EIS would not change as a result of possible climatological changes in the environmental baseline. Potential impacts on environmental justice communities as a result of climate change would continue to be addressed through regional and local governmental strategic adaptive plans.

L.3.7 Historic and Cultural Resources

L.3.7.1 Summary

Significant historic and cultural resources could be impacted by construction, operation, or maintenance of the proposed project. The majority of these resources are located close to the Clinch River, including the Melton Hill Dam National Register of Historic Places-eligible historic district. Because TVA regulates flows and water levels in the Clinch River via the operation of their dams (as described in Section 2.3.1 of this EIS), the review team determined that there would be no shift in the impacts on historic and cultural resources caused by the proposed project due to a reasonably foreseeable alteration in the environmental baseline associated with climate change.

L.3.7.2 Conclusion

The climatological changes would not alter the historic and cultural impacts because the Clinch River is already a highly regulated system.

L.3.8 Meteorology and Air Quality

L.3.8.1 Summary

The expected climatological changes would largely be unlikely to affect cooling system impacts from the proposed project on local weather. Projected temperature increases due to climate change may lead to a decrease in fogging from the cooling tower.

Climatological changes may affect the sources, types, and estimates of annual air emissions from the proposed project and transmission lines. For example, changes in climate such as increases in the temperature of both the hottest and coldest days may lead to an increase in air pollutant formation due to elevated temperatures. Because of expected increases in temperature over the period of operation, the health impacts of operational air emissions may increase. In a higher temperature environment, the formation of ozone due to emissions of nitrogen oxides from the diesel generators and other equipment is likely to increase, thereby leading to an increase in health impacts.

It is unclear whether additional emergency equipment would actually be needed in a changing climate, or whether testing of that equipment would increase, causing an increase in air emissions. Any additional equipment would be subject to Clean Air Act (42 U.S.C. § 7401 *et seq*.-TN1141) Title V permitting requirements.

L.3.8.2 Conclusion

Impacts from the cooling system on local weather, discussed in EIS Section 5.7.2, should not change as a result of reasonably foreseeable climate changes.

Estimates of air emissions are likely to remain the same, with a possible increase in health impacts due to increased ozone formation from emergency equipment nitrogen oxides emissions in a higher temperature environment. Given the intermittency of the operation of emergency equipment, and the expected emissions rate, air-quality impacts, discussed in EIS Section 5.7.1, should not change significantly as a result of reasonably foreseeable climate changes.

L.3.9 Nonradiological Health

L.3.9.1 Summary

It is not known how changes in climate will affect the presence of etiological agents associated with the proposed project (e.g., receiving waters and cooling tower operations). However, it is reasonable to expect that currently existing laws and regulations protecting workers and members of the public would continue, or would be adjusted as necessary, to be as protective as they are under current climate conditions.

Climatological changes are not likely to have an effect on noise produced by the proposed project; therefore, there would be no change in the health impacts from noise discussed in the EIS.

It is not likely that climatological changes would affect potential health impacts from electromagnetic fields associated with plant operations because regulations protecting workers and members of the public from electromagnetic fields would likely be adjusted to avoid impacts.

It is not likely that climatological changes would affect occupational health risks for operational plants because regulations protecting workers would be adjusted to avoid impacts on workers.

As discussed in EIS Section L.3.5.1, the long-term effects of global climate change are not expected to have a deleterious impact on the current level of infrastructure in the area. The review team expects that any physical changes would occur slowly enough that adaptive measures would limit potential health impacts from traffic-related accidents.

L.3.9.2 Conclusion

Overall, the expected climatological changes would not change the nonradiological health resource impacts assigned in the EIS. Potential impacts from noise, etiological agents, exposure to electromagnetic fields, and occupational injuries are and would continue to be regulated to be protective of human health. Although there is some uncertainty surrounding predicted climatological changes, it is likely that regulations governing occupational and public health would be adjusted accordingly if needed.

L.3.10 Radiological Impacts

L.3.10.1 Summary

The review team determined that the expected climatological changes over the time period considered by the review team would affect the possibility of exposure to radiation from the operating facility as follows:

- Existing low population exposures of humans to radiation from the proposed project would remain low because the level of effluent releases and regulatory requirements should not significantly change.
- Existing low nonhuman biota exposures to radiation from the proposed project should not change because the level of effluent releases and regulatory requirements should not significantly change.
- The level of effluent releases, regulatory requirements (including those for occupational doses), and existing low exposures should not significantly change. The level of the expected normal radioactive gaseous effluent releases would remain the same. Normal radioactive liquid effluent releases should remain unchanged.

L.3.10.2 Conclusion

The level of effluent releases, regulatory requirements, and existing low population exposures should not significantly change over the time period considered by the review team. Therefore, review team identified no shift in the radiological impacts caused by the operation of the proposed project due to reasonably foreseeable environmental alterations associated with climate change.

L.3.11 Nonradioactive Waste

L.3.11.1 Summary

Changes in land-use decisions may lead to changes in disposal options for nonradioactive waste and mixed wastes. However, solid, liquid, gaseous, hazardous, and mixed wastes generated during operation of the proposed project would still have to be handled, transported, stored, and disposed of according to county, State, and Federal regulations. It is reasonable to expect that currently existing laws and regulations related to nonradioactive and mixed waste would continue, or would be adjusted as necessary to address changing conditions.

L.3.11.2 Conclusion

Because nonradioactive and mixed wastes would still be subject to applicable Federal, State, and local requirements, climatological changes are unlikely to shift the impact determination discussed in the EIS.

L.3.12 Accidents

L.3.12.1 Summary

Climatological changes are expected to affect the site-specific, 50th percentile atmospheric dilution factor (i.e., χ/Q) used to evaluate dose consequences from postulated design basis accidents. The χ/Q around the site is dependent on local meteorological conditions (wind speed, direction, and stability class). The expected variations for these parameters as a result of climate change may increase, likely leading to less stability, which could increase dispersion and decrease the corresponding radiological effects. However, if predominant wind direction changes, such that higher χ/Qs shift along the site boundary, low-population zone, and beyond to areas with higher population densities, the impact would increase. Therefore, the overall impact is unknown.

Climatological changes might affect the average environmental risks of severe accidents because of changes in either severe accident probabilities due to an increase in the rate of severe natural phenomena and/or associated consequences due to altered patterns of atmospheric dispersion. While the potential severity of storms and other natural phenomena might increase, nuclear power plants must be designed to withstand all credible natural events at the site of concern.

The NRC would require any licensee to monitor and review the impacts of climate change on plant operation, severe accident mitigation, and availability of nearby structures required for plant operation and safety. If the NRC determines additional safety enhancements are necessary, it can require that they will be implemented in a timely manner to assure adequate protection of the public through the current NRC regulatory process. Possible increases in the severity of natural phenomena would be examined to ensure the plant licensing basis is appropriately reviewed and updated. It is generally expected that the low core damage frequencies (CDFs) for the SMR designs are not likely to change appreciably because of climate change. Therefore, even if consequences of severe accidents slightly change as a result of climate change, severe accident risk is likely to remain SMALL because CDFs are expected to be low.

L.3.12.2 Conclusion

The impacts assigned in this EIS should remain unchanged due to reasonably foreseeable environmental alterations associated with climate change. The overall risks for severe accidents are significantly lower than the current generation of nuclear power plants and any climate change effect would have to change the risks by several orders of magnitude to result in a change in the impacts assigned in this EIS.

L.3.13 Transportation of Radiological Materials

L.3.13.1 Summary

The number and type of radioactive material shipments, regulatory requirements, and existing low maximally exposed individual and population exposures and risks from accidents for these types of shipments should not significantly change over the time period considered by the review team for climate change. Radiological doses are strong functions of the radiation dose rate emitted from the shipment, exposure distance, and exposure duration. None of these parameters would be directly or disproportionately influenced by the impacts of climate change. Transportation accident risks are a function of weather conditions. Climate change may increase or decrease dispersion conditions depending on changes in the frequency of storms and severe weather. As a result, the changes in transportation impacts potentially caused by climate change are not expected to be significant, but there are substantial uncertainties about impacts on weather conditions in specific areas and demographic changes that could affect transportation impacts.

L.3.13.2 Conclusion

Impacts are not expected to change as a result of the effects of climate change, but significant uncertainties are associated with the impacts of climate change on local weather conditions and demographics along the transportation route(s).

L.4 References

10 CFR Part 50. *Code of Federal Regulations*, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities." Washington, D.C. TN249.

10 CFR Part 52. *Code of Federal Regulations*, Title 10, *Energy*, Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." Washington, D.C. TN251.

15 U.S.C. § 2921 *et seq*. Global Change Research Act of 1990. TN3330.

42 U.S.C. § 2011 *et seq.* Atomic Energy Act of 1954. TN663.

42 U.S.C. § 4321 *et seq.* National Environmental Policy Act (NEPA) of 1969, as amended. TN661.

42 U.S.C. § 7401 *et seq*. Clean Air Act. TN1141.

GCRP (U.S. Global Change Research Program). 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. J.M. Melillo, T.C. Richmond, and G.W. Yohe (eds.). U.S. Government Printing Office, Washington, D.C. Accession No. ML14129A233. TN3472.

Glick, P., S.R. Palmer, and J.P. Wisby. 2015. *Climate Change Vulnerability Assessment for Tennessee Wildlife and Habitats.* National Wildlife Federation and The Nature Conservancy Tennessee for the Tennessee Wildlife Resources Agency, Nashville, Tennessee. Accession No. ML18023A185. TN5314.

NRC (U.S. Nuclear Regulatory Commission). 2015. *Proposed Plans for Resolving Open Fukushima Tier 2 and 3 Recommendations*. SECY-15-0137, Washington, D.C. Accession No. ML15254A006. TN4731.

NRC (U.S. Nuclear Regulatory Commission). 2018. "Climate Change Master Table." Washington, D.C. Accession No. ML18022A104. TN5405.

NRC (U.S. Nuclear Regulatory Commission). 2018. "Climate Change Table Specific to Clinch River Nuclear Site." Washington, D.C. Accession No. ML18022A108. TN5406.

TVA (Tennessee Valley Authority). 2004. *Programmatic Environmental Impact Statement, Tennessee Valley Authority Reservoir Operations Study Record of Decision.* Knoxville, Tennessee. Accession No. ML17334A041. TN4913.

APPENDIX M
BIOLOGICAL ASSESSMENT FOR THE U.S. FISH AND WILDLIFE SERVICE REGARDING THE CLINCH RIVER SMALL MODULAR REACTOR EARLY SITE PERMIT APPLICATION

Biological Assessment

U.S. Fish and Wildlife Service

Clinch River Small Modular Reactor Early Site Permit Application

U.S. Nuclear Regulatory Commission Early Site Permit Application
Docket No. 52-047

Roane County, Tennessee

February 2018

U.S. Nuclear Regulatory Commission
Rockville, Maryland

CONTENTS

FIGURES

TABLES

ABBREVIATIONS/ACRONYMS

7Q10	7-day average flow that occurs every 10 years
ac	acre(s)
BA	biological assessment
BMP	best management practice
BTA	barge/traffic area
CFR	*Code of Federal Regulations*
cfs	cubic feet per second
COL	combined construction permit and operating license
CP	Construction Permit
CRBR	Clinch River Breeder Reactor
CRM	Clinch River mile
CRN	Clinch River Nuclear
CWA	Clean Water Act
CWS	cooling-water system
dB	decibel(s)
dBA	A-weighted decibel(s)
DBH	diameter at breast height
DOE	U.S. Department of Energy
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ER	environmental report
ESA	Endangered Species Act of 1973, as amended
ESP	Early Site Permit
ESWEMS	Essential Service Water Emergency Makeup System
ESWS	Essential Service Water System
FR	*Federal Register*
ft	foot/feet
fps	feet per second
FWS	U.S. Fish and Wildlife Service
GEIS	generic environmental impact statement
GIS	geographic information system
ha	hectare(s)
IBCF	Indiana Bat Conservation Fund
in.	inch(es)
IPaC	Information for Planning and Consultation

JPA	joint permit application
kg	kilogram(s)
kV	kilovolt(s)
Mgd	million gallons a day
mi	mile(s)
mo	month(s)
NLEB	northern long-eared bat
NRC	U.S. Nuclear Regulatory Commission
OL	Operating License
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PEM	palustrine emergent
PEP	protection and enhancement plan
PFO	palustrine forested
PNNL	Pacific Northwest National Laboratory
PPE	plant parameter envelope
PRT	potential roost tree(s)
PSS	palustrine shrub-scrub
SMR	small modular reactor
SMZ	streamside management zones
SWPP	storm water pollution prevention plan
TDEC	Tennessee Department of Environment and Conservation
TDS	total dissolved solids
TVA	Tennessee Valley Authority
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
WNS	white nose syndrome
WSDOT	Washington State Department of Transportation
yr	year(s)

M.1 Proposed Action

On May 12, 2016, the U.S. Nuclear Regulatory Commission (NRC) received an application, pursuant to Title 10 of the *Code of Federal Regulations* (CFR) Part 52 (TN251), from the Tennessee Valley Authority (TVA), for an early site permit (ESP) for a site in Oak Ridge, Roane County, Tennessee. TVA anticipates using the site to build and operate two or more small modular reactors (SMRs) that have a maximum total electrical output of 800 megawatts electric (MW(e)) to demonstrate SMR technology (TVA 2016-TN5002). An ESP makes it possible to evaluate and resolve safety and environmental issues related to siting prior to seeking a combined construction permit and operating license (COL) to construct and operate a reactor under 10 CFR Part 52 or a construction permit (CP) and operating license (OL) under 10 CFR Part 50 (TN249). Construction activities are a specific subset of building activities and are defined by the NRC in their regulations in 10 CFR 51.4. The ESP and COL (or CP and OL) are separate major Federal actions. If an ESP is approved, TVA can "bank" the Clinch River Nuclear (CRN) Site for up to 20 years for future reactor siting. An ESP does not, however, authorize construction and operation of a nuclear power plant. TVA may eventually seek to obtain the necessary authorization to construct and operate two or more SMRs that have a maximum total electrical output of 800 MW(e) to demonstrate the capability of SMR technology.

The proposed NRC action related to the TVA application is the issuance of an ESP for the CRN Site as suitable for the future demonstration of the construction and operation of two or more SMR units with characteristics that fit within the plant parameter envelope (PPE) that is described in the ESP application. TVA's application is based on a PPE that encompasses four light water SMRs under development in the United States at the time the application was prepared (BWX Technologies, Holtec, NuScale Power, and Westinghouse [TVA 2016-TN5002]). The PPE provides bounding parameters and characteristics of the reactors and the associated facilities so that an assessment of site suitability can be made.

The NRC is currently preparing an environmental impact statement (EIS) as a basis for assessing site suitability and its decision about whether to issue an ESP. The Nashville District, Regulatory Division of the U.S. Army Corps of Engineers (USACE) is a cooperating agency with the NRC in preparing the EIS. The USACE plans to rely on the EIS to support its decision about whether to issue Department of the Army permits (Section 10 and Section 404), if TVA submits a Department of the Army permit application at a future date.

A regional map depicting the CRN Site is provided in Figure M-1. The CRN Site is located adjacent to the U.S. Department of Energy (DOE) Oak Ridge Reservation (ORR) on property owned by TVA in Roane County, Tennessee (Figure M-1 and Figure M-2).

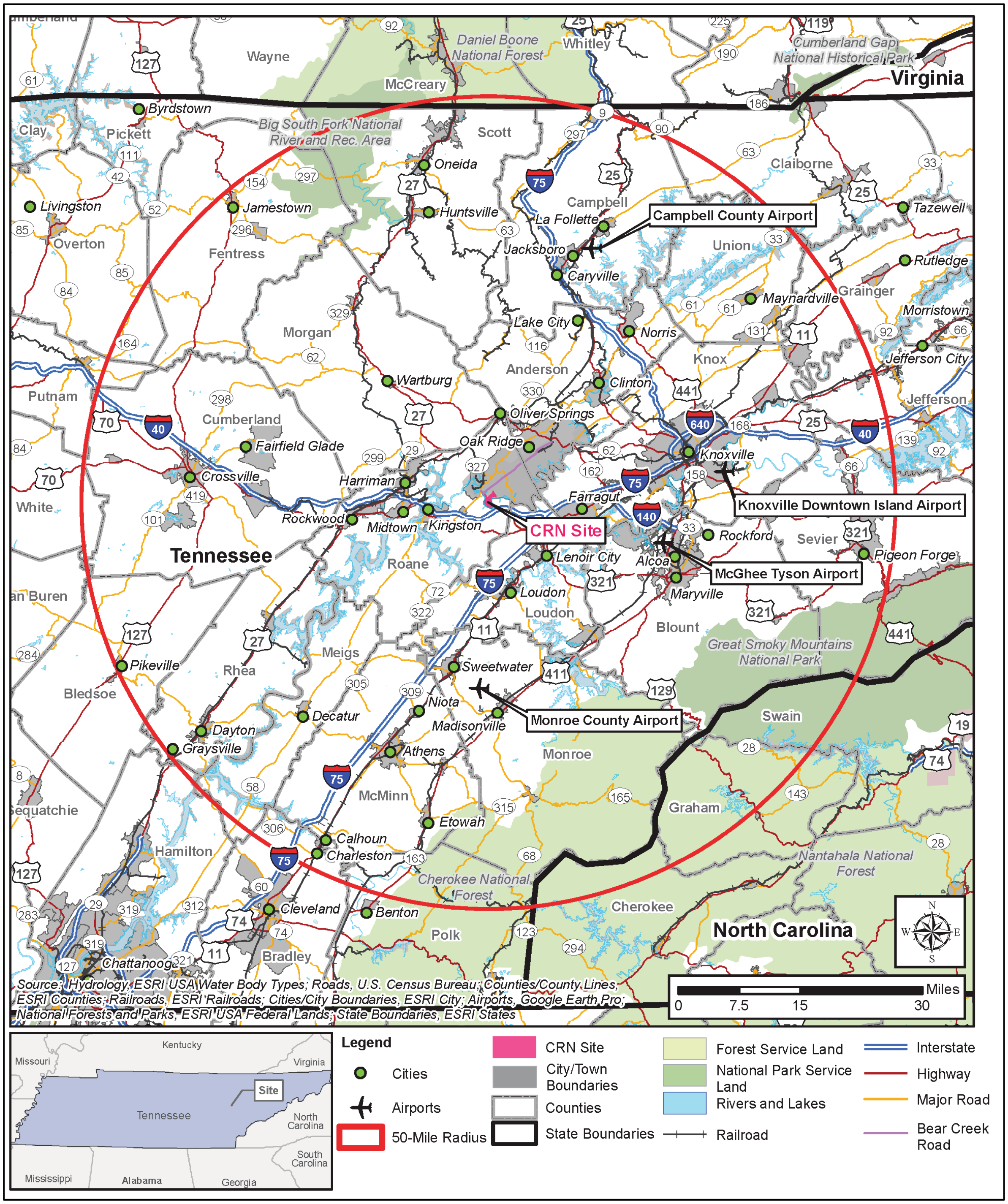


Figure M-1. Location of the CRN Site and Areas within a 50-Mi Radius

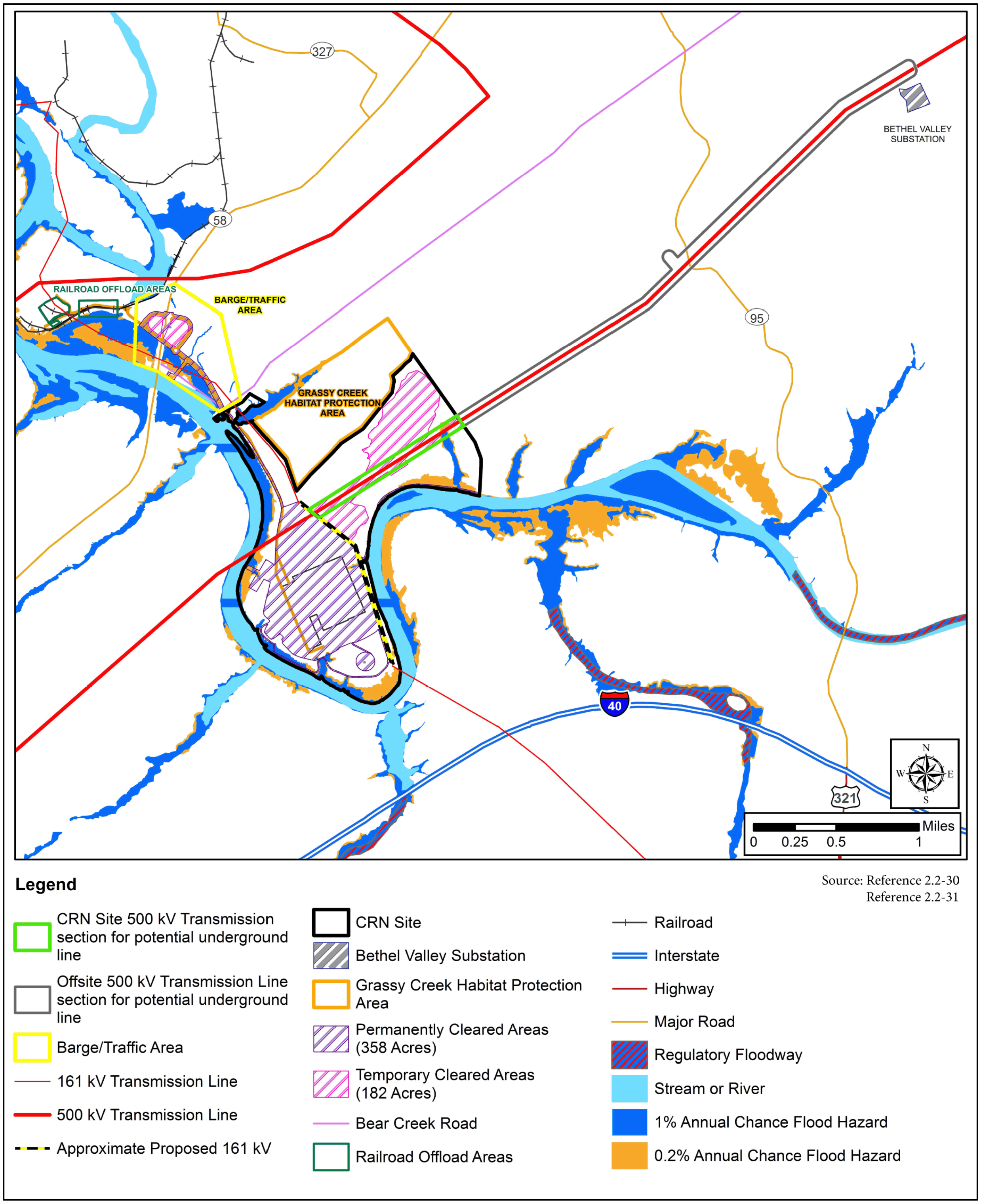


Figure M-2. Area Surrounding the CRN Site

The NRC and the USACE have prepared this biological assessment (BA) to support a joint consultation with the U.S. Fish and Wildlife Service (FWS) in accordance with Section 7 of the Endangered Species Act of 1973, as amended (ESA) (16 U.S.C. § 1531 *et seq*.-TN1010). The BA is organized as follows.

- Section M.1 – Introduction. Provides background information regarding the reason for producing the BA.
- Section M.2 – Consultation. Outlines the history of communications between the NRC and USACE staffs and the FWS.
- Section M.3 – CRN Site and Possible Future Facilities Description. Describes the collective environmental baseline for potentially affected terrestrial and aquatic resources. Also briefly describes the facilities that may be built if TVA pursues a COL or CP and OL.
- Sections M.4 and M.5 – Building Impacts and Operation Impacts. Evaluates the possible collective impacts on terrestrial and aquatic biota from building and operating facilities at the CRN Site.
- Section M.6 – Species Description/Environmental Baseline. Provides life history information and describes baseline conditions for each potentially occurring listed species and critical habitat.
- Section M.7 – Potential Effects on Species and Habitats. Evaluates the potential effects from building and operating SMRs and related facilities on individual species within relevant Action Areas and critical habitats regulated under the ESA.
- Section M.8 – Cumulative Effects. Evaluates potential cumulative impacts on listed species and critical habitats.
- Section M.9 – Conclusions. Summarizes the conclusions drawn by the NRC and USACE staff regarding potential effects on each listed species and critical habitat addressed in the BA.
- Section M.10 – References. Provides a list of references cited in the BA.
- Section M.11 – Contributors. Provides a list of contributors to the BA.

M.2 Consultation History

In a letter dated April 20, 2017, the NRC requested that the FWS Field Office in Cookeville, Tennessee, provide information regarding Federally listed, proposed, and candidate species and critical habitat that may occur in areas potentially affected by building and operating SMRs at the CRN Site and associated offsite facilities (NRC 2017-TN5089). The FWS provided a response on May 5, 2017 (FWS 2017-TN5090), and an updated response on July 20, 2017 (FWS 2017-TN5091). The updated FWS letter contains recommended lists of species and critical habitats to be considered in this BA. A representative of the FWS attended a site audit in May 2017 at which a team of interdisciplinary staff from the NRC and the USACE met with interdisciplinary TVA staff at the CRN Site to tour the site and ask technical questions about possible environmental impacts (NRC 2018-TN5386).

The FWS contacted Pacific Northwest National Laboratory (PNNL) (NRC's environmental contractor for review of the ESP application) by telephone on October 23, 2017, to outline topics for an upcoming conference call. On October 24, 2017, the conference call was convened between representatives of NRC, FWS, and PNNL to coordinate initiation of the BA. Topics discussed included Action Areas, the CRN project design, species and habitats, offsite transmission lines, blasting and demolition, nearby caves, and use of Natural Heritage Program data to augment information in the FWS July 20, 2017 letter (FWS 2017-TN5091). On November 2, 2017, PNNL representatives informed FWS by telephone of its intent to use geographic information system (GIS) data as the basis for evaluating a series of possible upgrades to existing offsite overhead transmission lines in TVA's service territory. The FWS indicated that they preferred that PNNL use this approach.

Pursuant to Section 7(c) of the ESA (16 U.S.C. § 1531 *et seq.*-TN1010), this BA examines whether the considered species and critical habitats may be affected by building and operating a nuclear plant at the CRN Site and any associated offsite facilities. The review team, comprising terrestrial and aquatic biologists, preparing this BA plans to continue to communicate frequently and regularly with the FWS staff as FWS reviews the BA and completes the Section 7 consultation process. This BA is prepared based on a conceptual design of future SMR nuclear plants at the CRN Site that TVA describes in the ESP application it submitted to the NRC. The NRC and USACE expect that they will eventually prepare a subsequent BA if and when TVA decides to apply for a COL or CP that would authorize TVA to construct and operate the reactors at the CRN Site.

M.3 Clinch River Nuclear Site and Possible Future Facilities Description

The CRN Site is located in the southwestern part of the City of Oak Ridge, Tennessee, on a tract of undeveloped property owned by TVA in Roane County, Tennessee. The TVA Oak Ridge property comprises approximately 1,200 ac situated just south and west of the ORR on a peninsula in the Clinch River arm of Watts Bar Reservoir (Figure M-3). The property includes the 935-ac CRN Site as well as the 265-ac Grassy Creek Habitat Protection Area, which is not planned for development and hence is not included within the CRN Site (Figure M-3) (TVA 2017-TN4921).

Possible future CRN activities consist of the following components:

- Building and operating SMRs with characteristics that fit within the PPE and associated facilities and infrastructure on the CRN Site (Figure M-3). Building activities at the CRN Site would permanently disturb approximately 326 ac and temporarily disturb approximately 167 ac on the site. It would also include the installation and operation of an intake and a discharge structure.

- Refurbishing and operating an inactive barge terminal and building and operating road facilities on undeveloped ORR lands, termed the barge/traffic area (BTA), situated immediately north of the CRN Site (Figure M-3). Building activities would permanently disturb approximately 30 ac and temporarily disturb approximately 15 ac in the BTA.

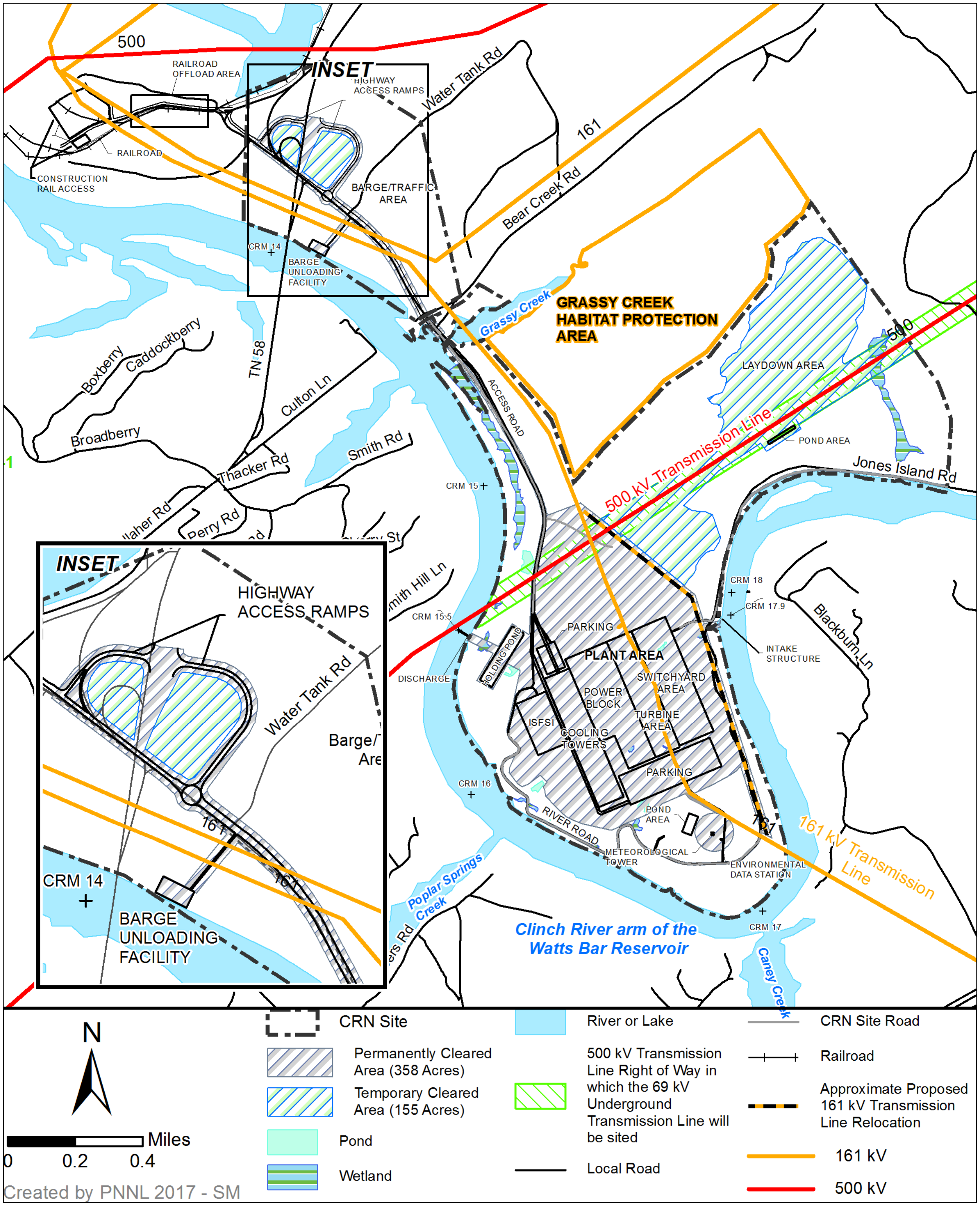


Figure M-3. CRN Site, BTA, and Proposed New Facilities and Plant Layout

- Installing an underground 69-kv transmission line from the CRN Site east to the Bethel Valley Substation on the ORR (Figure M-2). Building the underground transmission line would temporarily disturb approximately 210 ac of land off of the CRN Site, situated entirely within an existing right-of-way for an existing 500-kV overhead transmission line.
- Upgrading (rebuilding, uprating, or reconductoring) multiple existing offsite overhead transmission line segments within TVA's service territory (Figure M-4) to prepare the TVA transmission line grid to receive power generated at the CRN Site.

In this BA, the NRC and the USACE review team evaluates the potential effects from (1) building and operating SMRs at the CRN Site, (2) transportation improvements in the BTA, (3) building and operating the 69-kV underground transmission line, and (4) the offsite overhead transmission line upgrades. The review team discusses potential direct and indirect effects on species and habitats in Section M.7 of this BA. Section M.7 also identifies specific action areas where effects on terrestrial and aquatic species may occur.

Figure M-3 depicts a plan view of the possible future CRN facilities on the CRN Site and in the BTA. The inactive barge terminal is situated on the ORR at CRM 14.1, near the entrance to the northwest corner of CRN Site and Bear Creek Road. TVA anticipates refurbishing the barge terminal by improving the existing retaining wall and installing bollards or mooring cells to secure barges at the terminal. TVA plans to use the barge terminal to offload materials or equipment for overland transport across the BTA to the CRN Site.

TVA expects to dig an open trench to install the 69-kV underground transmission line and to subsequently backfill the trench, but it plans to explore the possibility of boring the trench beneath streams and wetlands traversed by the route if possible to avoid disturbance of those features (TVA 2017-TN4921).

Most of the offsite overhead transmission line right-of-way segments subject to upgrading are situated in Tennessee, but some are situated in southern Kentucky or northern Georgia (Figure M-4).

Section M.3.1 describes terrestrial and aquatic habitats potentially affected by activities at the CRN Site, BTA, and vicinity. Section M.3.2 describes habitats potentially affected by upgrading the offsite transmission lines. Section M.3.3 describes the possible future CRN facilities.

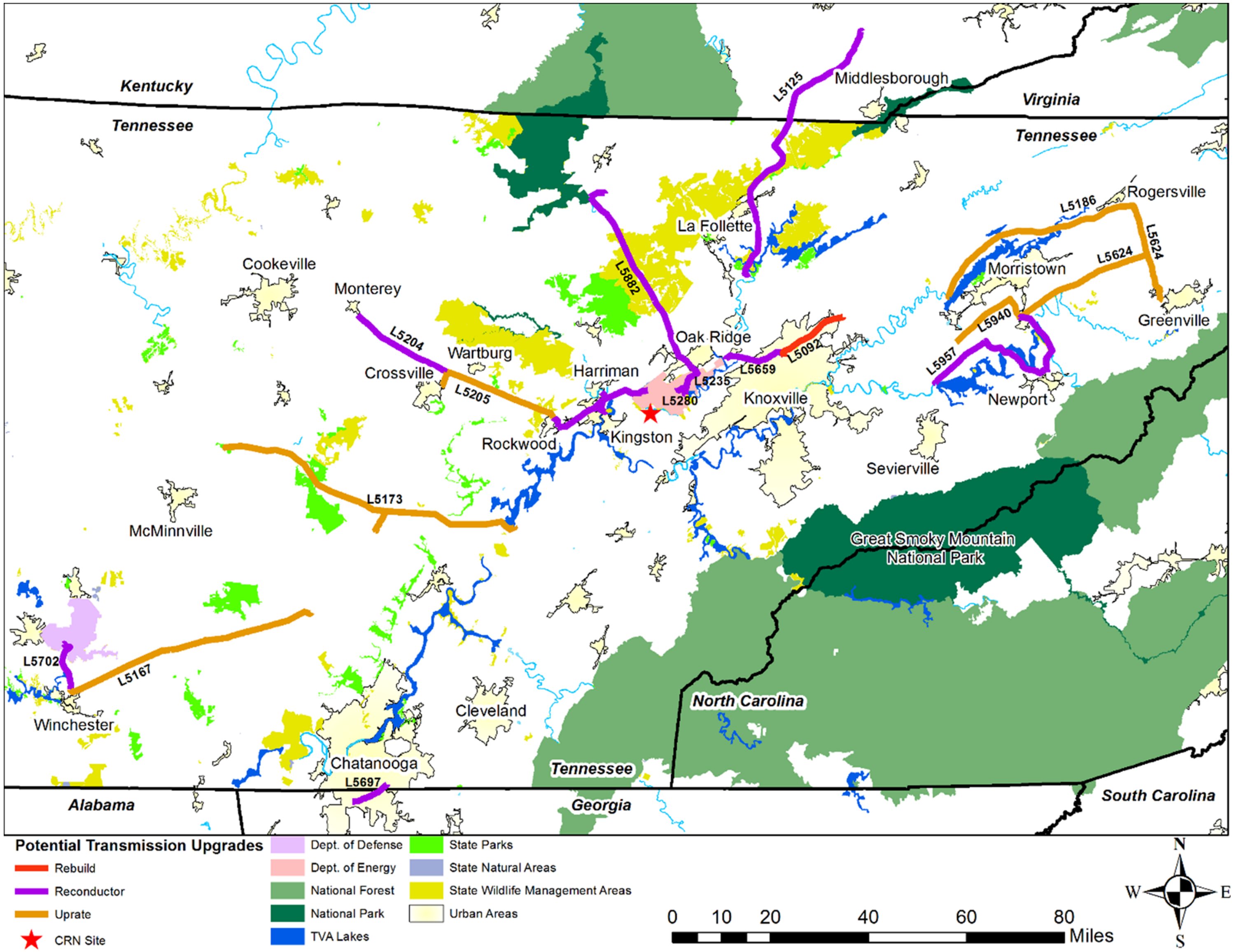


Figure M-4. Affected Offsite TVA Transmission Corridors (Source: TVA 2017-TN4921)

M.3.1 CRN Site and Vicinity

The sections below describe baseline terrestrial and aquatic resources on the CRN Site, in the BTA, and in the vicinity.

M.3.1.1 Upland Habitats

The CRN Site lies in the Ridge and Valley Ecoregion, which extends from the Saint Lawrence Valley in southeastern New York southwest through the Gulf Coastal Plain in Alabama. The ecoregion is about 40 mi wide in eastern Tennessee and is characterized by alternating forested ridges and agricultural valleys that have a variety of geologic materials containing numerous springs and caves (EPA 2013-TN5033; Tucci 1992-TN5034; USGS 2016-TN5035; Woods et al. 1999-TN1805; Woods et al. 2003-TN1806). The CRN Site spans two subdivisions of the Ridge and Valley Ecoregion: (1) Southern Limestone/Dolomite Valleys and Low Rolling Hills and (2) Southern Dissected Ridges and Knobs (USGS 1998-TN5159). The latter subdivision covers only the southeastern corner of the CRN Site (EPA 2004-TN5158). The former subdivision covers the remainder of the CRN Site (EPA 2004-TN5158). Three land-cover types dominate the ecoregion: (1) forest (56 percent), (2) agriculture (about 30 percent), and (3) developed areas (about 9 percent) (USGS 2016-TN5035).

The CRN Site topography includes a series of roughly parallel ridges with elevations ranging from about 860 to 940 ft above mean sea level (MSL). Several small drainages extend from the ridges to the Clinch River. The southeastern portion of the peninsula is relatively flat, with a few small hills, and an elevation of around 780 ft MSL. The northeastern portion of the CRN Site consists of interspersed hills and valleys with elevations ranging from approximately 780 MSL to 940 MSL (TVA 2017-TN4921).

The CRN Site history has influenced the current terrestrial resource baseline on the site. Some of the low elevation areas between the ridges onsite appear in aerial photography to have been farmed prior to 1939 (TVA 2017-TN4920). The ORR was established in 1942 and then included what is now the 1,200-ac TVA Clinch River property, after which farming was discontinued throughout the ORR, including what is now the CRN Site (DOE 2017-TN5081). The 1,200-ac Clinch River property, including the CRN Site, was transferred to TVA in the late 1970s for the purpose of building and operating the Clinch River Breeder Reactor (CRBR) (TVA 2017-TN4921; BRC 1985-TN5245). Aerial photography from 1983 (TVA 2017-TN4920) indicates the southern portion of the CRN Site was substantially altered by initial construction of the CRBR, starting with site preparation and excavation in 1982, when about 240 ac were cleared and grubbed (TVA 2017-TN4920) and about 1.5 million cubic yards of rock were removed and used as structural fill or spoil. The 240 ac comprise part of the permanently cleared area shown in Figure M-3. Construction of the CRBR ceased in 1983 prior to completion (TVA 2017-TN4921; BRC 1985-TN5245). Redress for future industrial use was implemented (DOE et al. 1984-TN5221) and consisted of (1) reconfiguring rock to make the site self-draining and directing runoff from compacted soils to five onsite treatment ponds and (2) stabilizing soil and spoils via reseeding disturbed areas with herbaceous species. Some areas were replanted with pine seedlings (DOE 1984-TN5282). The CRBR footprint is currently in a state of early old-field succession. The CRN Site is also traversed by two existing overhead transmission lines (Figure M-3).

TVA surveyed and mapped plant communities on the CRN Site in 2011 and 2013 (Cox et al. 2015-TN5193). TVA surveyed plant communities in the BTA in May 2015 but did not field map them (Cox et al. 2015-TN5193). The surveys covered all lands included in the expected land-clearing footprint. TVA identified 178 plant species in the field surveys (Cox et al. 2015-TN5193). Table M-1 lists plant communities across the CRN Site based on land-use/land-cover data modified by field mapping, and across the BTA based on land-use/land-cover data (NASS 2017-TN5144). Forest cover on the CRN Site and in the BTA consists mostly of deciduous forest (Table M-1) (TNC 2003-TN5036). Figure M-5 depicts the distribution of plant communities across the CRN Site and BTA.

Table M-1. Extent of Habitat Types on the CRN Site and in the BTA

Habitat Type	CRN Site (ac)[(a)]	BTA (ac)[(b)]
Mixed Evergreen-Deciduous Forest	389	3
Deciduous Forest	279	117
Scrub-Shrub/Herbaceous	202	--
Evergreen Forest	32	6
Wetlands	16	8
Grass/Pasture	--	14
Roads/Developed Areas	14	42
Ponds/Open Water	3	12
Shrubland	--	1
Barren	--	1
Total	935	204

(a) Habitat types and acreages on the CRN Site are based on the interpretation of aerial imagery, in conjunction with the descriptions of vegetation communities, wetlands, and waterbodies provided by field surveys (TVA 2017-TN5226).
(b) Habitat types and acreages in the BTA are based on 2016 land-use/land-cover data (NASS 2017-TN5144).

Following are descriptions of specific upland plant communities/habitat types on the CRN Site. Where such occur in the BTA (Table M-1), they are similar to those on the CRN Site. Note that the grass/pasture habitat category listed in Table M-1 for the BTA is similar to the shrub-scrub/herbaceous community listed for the CRN Site and described below.

M.3.1.1.1 Mixed Evergreen-Deciduous Forest

Mixed evergreen-deciduous forest is dominated by oaks (black [*Quercus velutina*], chestnut [*Q. montana*], northern red [*Q. rubra*], southern red [*Q. falcata*], and white [*Q. alba*]); hickories (mockernut [*Carya tomentosa*], pignut [*C. glabra*], and shagbark [*C. ovata*]); and Virginia pine (*Pinus virginianus*), with sparse eastern red cedar (*Juniperus virginiana*). Blackgum (*Nyssa sylvatica*), muscle wood (*Carpinus caroliniana*), and sourwood (*Oxydendrum arboreum*) are common species found in the understory, which also is home to a variety of herbaceous species listed by Cox et al. (2015-TN5193).

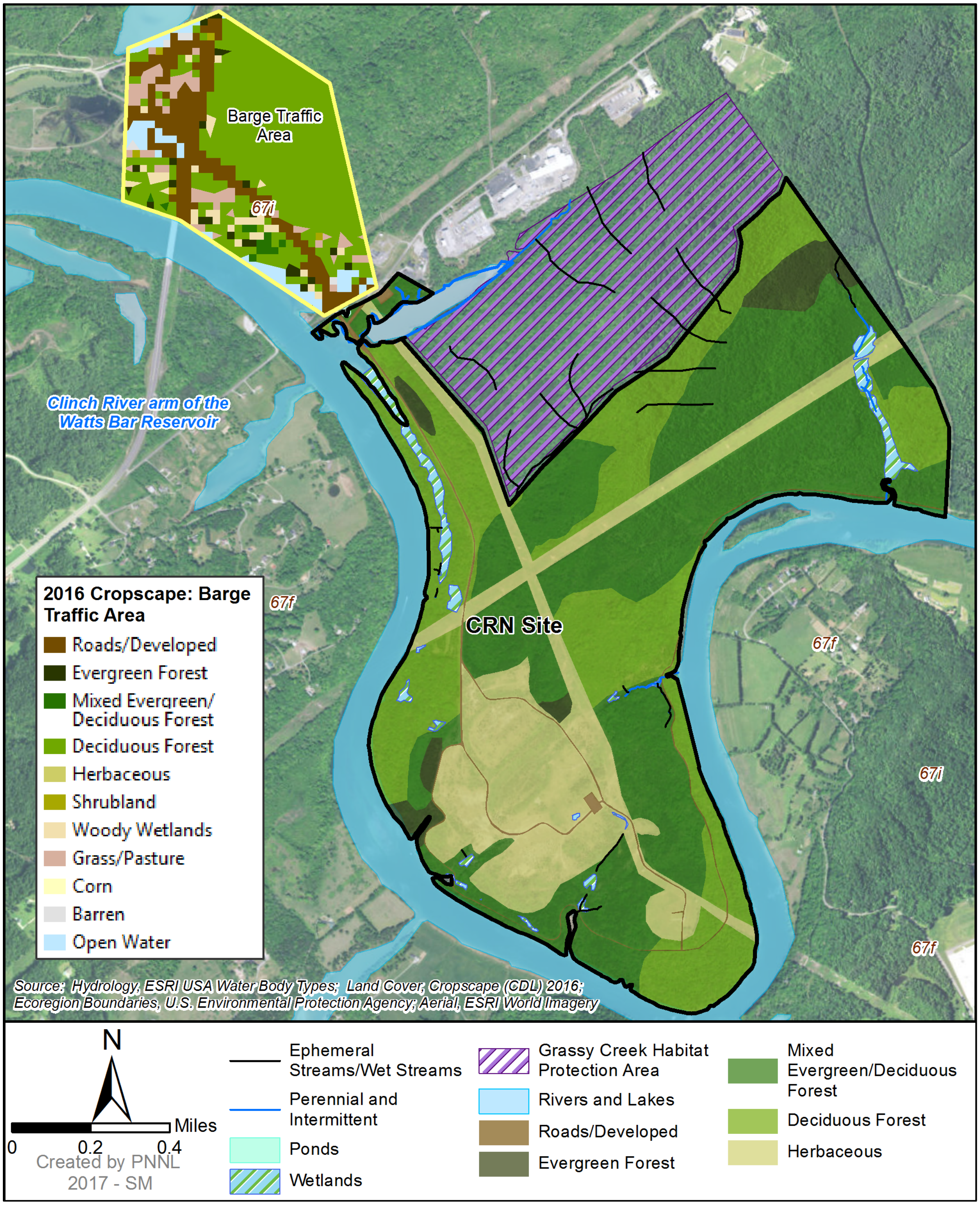


Figure M-5. Plant Communities and Habitat Types across the CRN Site and BTA. CRN Site data are based on aerial imagery modified by descriptions of vegetation communities, wetlands, and waterbodies provided by field surveys (TVA 2017-TN5226). BTA data based on 2016 land-use/land-cover data (NASS 2017-TN5144).

M.3.1.1.2 Deciduous Forest

Deciduous forest is dominated by tulip poplar (*Liriodendron tulipifera*) and includes American beech (*Fagus grandifolia*), white oak, and yellow buckeye (*Aesculus flava*). The understory is varied and includes a variety of shrub and herbaceous species (Cox et al. 2015-TN5193). A subtype of deciduous forest, calcareous forest, occurs in areas underlain by limestone, mostly in the Grassy Creek Habitat Protection Area (situated on TVA property immediately north of the CRN Site) and a few mesic slopes adjacent to the Clinch River. Additional woody species in this subtype include bladdernut (*Staphylea trifolia*), eastern red cedar, and eastern redbud (*Cercis canadensis*) and a variety of herbaceous species (Cox et al. 2015-TN5193).

M.3.1.1.3 Evergreen Forest

Evergreen forest consists of remnant loblolly pine (*Pinus taeda*) and white pine (*Pinus strobus*) plantations (Cox et al. 2015-TN5193). This forest likely comprises remnant pine seedlings planted when the CRBR footprint was redressed (noted above).

M.3.1.1.4 Scrub-Shrub/Herbaceous

The scrub-shrub/herbaceous community comprises approximately 240 ac previously cleared of forest for the CRBR (part of the herbaceous community on the CRN Site depicted in Figure M-5) (Cox et al. 2015-TN5193). Some of this land was revegetated with non-native herbaceous species such as sericea lespedeza (*Lespedeza cuneata*) and tall fescue (*Schedonorus arundinaceus*). These areas likely lack natural topsoil and soil horizons because of prior disturbance for the CRBR and are thus still slowly undergoing early forest succession and still support a number of old-field species and eastern red cedar seedlings and saplings (Cox et al. 2015-TN5193).

Habitat within the existing 500-kV overhead transmission line right-of-way where the 69-kV line would be buried consists entirely of scrub-shrub/herbaceous vegetation similar to that described above for the CRN Site and BTA (TVA 2017-TN4921, TVA 2016-TN5145). It is typical of maintained transmission line right-of-ways in the region. Habitat adjacent to the existing Bethel Valley Substation (Figure M-2) where the buried 69-kV line would tie in (TVA 2017-TN4921, TVA 2016-TN5145) consists of similar scrub-shrub/herbaceous vegetation.

M.3.1.2 Wetland Habitats

TVA delineated wetlands using routine USACE procedures (USACE 1987-TN2066, USACE 2010-TN5325). TVA used its Rapid Assessment Method to assess wetland indicator functions (Mack 2001-TN5289) that differentiate wetlands based on three condition categories (Pilarski-Hall and Lees 2015-TN5299). Category 1 wetlands are “limited quality waters” because they are degraded, have limited potential for restoration, and have relatively low functionality. Category 2 includes wetlands of moderate quality that are degraded but exhibit reasonable potential for restoration. Category 3 generally includes wetlands of very high quality or of concern regionally and/or statewide, such as wetlands that provide habitat for threatened or endangered species (Pilarski-Hall and Lees 2015-TN5299).

TVA delineated 12 wetlands on the CRN Site between January and May 2011 (Pilarski-Hall and Lees 2015-TN5299) (Figure M-5 and Table M-2). The USACE verified this wetland delineation in September 2013 (Pilarski-Hall and Lees 2015-TN5299). TVA delineated five wetlands in the BTA in April 2015 (Figure M-5 and Table M-2) (Pilarski-Hall and Kennon 2015-TN5290). Most wetland acreage on the CRN Site is forested (Table M-2). Most forested wetlands occur along the reservoir shoreline and in the riparian areas of tributaries. Most wetland acreage in the BTA supports scrub-shrub vegetation, situated as narrow strips along streams within pronounced valleys and swales.

Table M-2. Type, Condition, and Size of Wetlands on the CRN Site and in the BTA. Adapted from TVA (Pilarski-Hall and Lees 2015-TN5299; Pilarski-Hall and Kennon 2015-TN5290).

Wetland Number	Wetland Type[(a)]	TVA Condition Category[(b)]	Size (ac)
CRN Site			
W001	PF01E	2	0.67
W002	PEM1E	1	0.13
W003	PF01E	2	0.18
W004	PF01E	2	0.24
W005	PF01E	2	0.36
W006	PEM1E/PSS1E	2	0.11
W007	PSS1E/PF01E	2	0.17
W008	PF01E	2	0.23
W009	PEM1E/PSS1E/PFO1E	3	5.66
W010	PEM1E/PSS1E/PFO1E	2	1.79
W011	PF01E	3	5.87
W012	PEM1E	1	0.13
Total			15.54
BTA			
W013	PSS1E/PEM1E	2	3.73
W014	PSS1E/PEM1E	2	3.05
W015	PF01E	2	1.95
W016	PEM1E	2	0.11
W017	PSSHh	3	1.33
Total			10.17

(a) Classification codes as defined in Cowardin et al. 1979-TN5186: PEM1E = Palustrine emergent, persistent vegetation, seasonally flooded/saturated; PFO1E = Palustrine forested, broad-leaved deciduous vegetation, seasonally flooded/saturated; PSS1E = Palustrine scrub-shrub, broad-leaved deciduous vegetation, seasonally flooded/saturated; PSSHh = Palustrine scrub-shrub, broad-leaved deciduous vegetation, permanently flooded, diked/impounded.

Category 1 = degraded; Category 2 = moderate quality; Category 3 = high quality

Following are brief descriptions of wetland plant communities on the CRN Site. Where such occur in the BTA, they are similar to those on the CRN Site.

- Forested wetland vegetation is generally dominated by tree species such as American sycamore (*Platanus occidentalis*), silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), box elder

(*Acer negundo*), and black willow (*Salix nigra*) that are common along the reservoir. Forested wetland vegetation also includes a variety of shrub and herb species (Cox et al. 2015-TN5193).

- Scrub-shrub wetland vegetation is dominated by saplings of tree species such as green ash, American sycamore, black willow, and red maple, and also includes a variety of shrub and herb species (Pilarski-Hall and Kennon 2015-TN5290).
- Emergent wetlands are dominated by squarestem spikerush (*Eleocharis quadrangulata*), broad-leaf cattail (*Typha latifolia*), softstem bulrush (*Schoenoplectus tabernaemontana*), tall fescue, and rushes (*Juncus* spp.), with small black willow amid the emergent vegetation (Pilarski-Hall and Lees 2015-TN5299).

Most of the wetlands are small and of moderate quality (Pilarski-Hall and Lees 2015-TN5299).

M.3.1.3 Aquatic Habitats

Aquatic habitats in the project area of the CRN Site and vicinity include streams and ponds on the CRN Site and in the BTA (TVA 2017-TN4921). They also include the streams crossed by the proposed route for the 69-kV underground transmission line and the Clinch River arm of the Watts Bar Reservoir from above the location of the intake at approximately CRM 17.9, on the east side of the CRN Site to approximately CRM 14 just downstream of the barge-unloading facility and approximately 1.5 mi downstream of the discharge (located at approximately CRM 15.5 on the west side of the CRN Site).

TVA surveyed and mapped the locations of the waterbodies within the CRN Site using global positioning system units in April and May of 2011 and October of 2013 and 2014. TVA conducted additional surveys during October 2014 in the BTA (TVA 2017-TN4921). Howard et al. (2015-TN5049) describe the waterbodies on the CRN Site and in the BTA, which are depicted in Figure M-6. Each pond on the CRN Site is manmade, and all but one were developed to serve as stormwater retention ponds for the CRBR (Howard et al. 2015-TN5049). Two additional ponds were identified on the southeast edge of the BTA in the area that could be affected by building activities. One is characterized as a large pond and the other as a “small pond connected to the backwater of the reservoir” (TVA 2017-TN4921).

The streams on the CRN Site and BTA are classified as:

- Perennial – 5 streams on the CRN Site and 2 in the BTA
- Intermittent – 1 on the CRN Site and 4 in the BTA
- Ephemeral – 19 on the CRN Site and 15 in the BTA.

During March 2015, TVA conducted biological surveys on four perennial and three intermittent streams focusing on pools, riffles, and runs appearing likely to support communities of aquatic biota. Surveys were conducted with a seine and a backpack electrofishing unit. Three of the streams (S01, S05, and S06) were located in the CRN Site, and four (S07, S08, S09, and S12) were in the BTA. An eighth stream, Grassy Creek, which is located close to the site but not within the boundaries of the project, also was sampled. None of the surveys of onsite streams or ponds identified any Federally protected species (TVA 2017-TN4921).

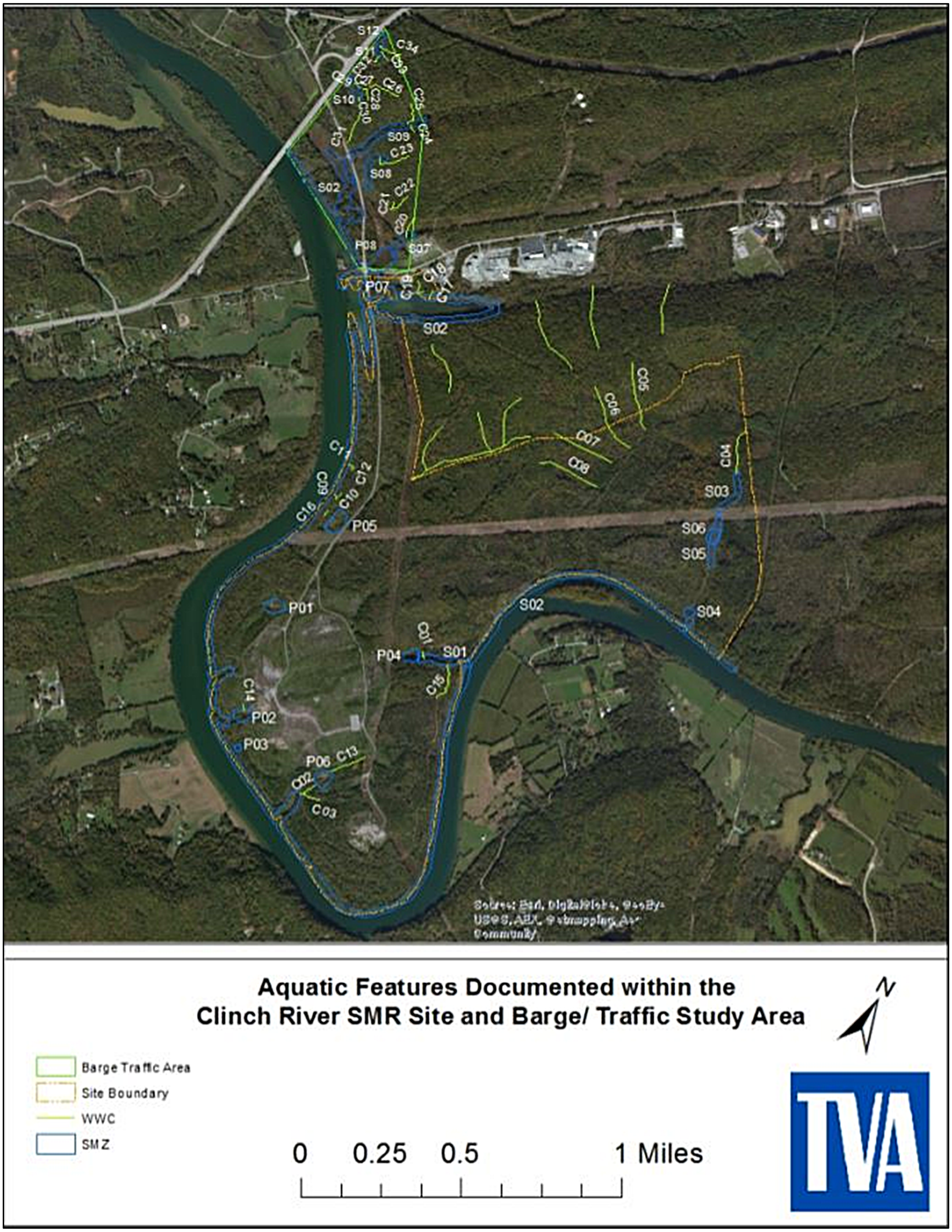


Figure M-6. Aquatic Features Documented within the Clinch River Site and Barge/Traffic Area (Map from Howard et al. 2015-TN5049)

M.3.1.3.1 Streams Crossed by the Proposed Route for the 69-kV Underground Transmission Line

The 69-kV underground transmission line route proposed by TVA crosses six streams in an existing 500-kV transmission line corridor that runs from the Bethel Valley Substation to the CRN Site. The streams include:

- Ish Creek, a second-order tributary of the Clinch River that contains a 2.1-mi Aquatic Natural Area. Ish Creek originates as a spring and flows toward the Clinch River approximately 0.5 mi east of the site. Surveys conducted by Oak Ridge National Laboratory (ORNL) (Baranski 2011-TN5164; ORNL 2017-TN5358) did not find any Federally protected species.
- White Oak Creek is a second- and third-order stream (depending on specific location), and the Northwest Tributary consists of three first-order streams and part of a second-order stream (Baranski 2011-TN5164). Two of these streams cross the right-of-way approximately 2.0 to 2.5 mi east of the CRN Site (TVA 2017-TN4921). Studies did not indicate the presence of any Federally protected species (Baranski 2011-TN5164).
- Upper Fifth Creek, is located slightly southwest of the Bethel Valley Substation and is characterized as a spring-fed, first-order stream. It is also part of the White Oak Creek drainage. Sampling studies did not report any Federally protected species (Baranski 2011-TN5164).
- Streams S03 and S06 are near the northwest corner of the CRN Site. Stream S06 is a perennial stream, for which no fish or crayfish were reported during sampling studies. Stream S03, an intermittent stream, was not sampled because of lack of water at the time of the surveys (Henderson and Phillips 2015-TN5162).

M.3.1.3.2 Clinch River Arm of Watts Bar Reservoir

Watts Bar Reservoir, including the Clinch River arm, was impounded by Watts Bar Dam, 52 river miles downstream of the CRN site in 1942. The CRN Site is located approximately 4 mi downstream of Melton Hill Dam, which was completed in 1963. Approximately 57 mi upstream from Melton Hill Dam is Norris Dam, which was built in 1936.

Historical impoundment of the Clinch River both below and above the CRN Site has greatly altered the dynamics of river flow. For example, spring floods that once occurred along the river no longer occur, and the expansive rocky or gravel shoals that once abounded in the Tennessee River system no longer exist (Etnier and Starnes 1993-TN5054). In addition, changes in water depth and temperature, reductions in the amount of dissolved oxygen, and increased sedimentation have resulted from placement of dams. These changes have affected or are continuing to affect biota and have resulted in detectable changes in the aquatic ecosystem compared to pre-impoundment (NRC 2013-TN5165).

The assemblage of organisms living in the river has changed in response to the impoundments. According to Parmalee and Bogan (1998-TN5166), 11 species of the unionid mussel genus *Epioblasma* that once inhabited shoals and riffles in the Tennessee River and its tributaries are now extinct. Parmalee and Bogan (1998-TN5166) attribute this to direct or indirect results of impoundment. As Neves and Angermeier (1990-TN5053) reported, obligate river species typically do not survive in reservoirs. Further, they reported that, even though fish sampling on the Tennessee River system was not extensive in the years before construction of the dams, enough surveys were conducted to allow documentation of the adverse effects that impoundment had on native fish species. For example, fish surveys conducted before and after impoundment of Melton Hill Reservoir (as reported in 1968) showed a shift in fauna. Those species requiring shoal and riffle habitats were no longer present in the post-impoundment surveys (NRC 2013-TN5165).

The impoundments helped to create good reservoir fisheries for sport and commercial fishermen. According to Etnier and Starnes (1993-TN5054), resource managers and others, whether purposely or accidentally, have introduced other species (including nuisance species) into the system. Nuisance species are those non-native species whose introduction causes, or is likely to cause, economic or environmental harm.

The water temperature in the Clinch River arm of the Watts Bar Reservoir is affected by operation of the Bull Run Fossil Plant located in the Melton Hill Reservoir in combination with the operation of Norris and Melton Hill Dams. The thermal discharges from the Bull Run Fossil Plant result in the thermal stratification of the Melton Hill Reservoir. This results in hourly water temperature fluctuations of as much as 4°F between a monitor at CRM 22.6 (downstream of Melton Hill Dam) and one further downstream at CRM 16.1 at the location of the proposed CRN discharge (TVA 2017-TN4921).

There is hazardous and radioactive contamination of the sediments in the Clinch River from above Melton Hill Reservoir (CRM 44) to the confluence of the Clinch River with the main stem of the Tennessee River (CRM 0). As a result, the State of Tennessee has issued fish consumption advisories for contaminants (polychlorinated biphenyls) for striped bass (*Morone saxatilis*) with a precautionary advisory for catfish (*Family Ictaluridae*) and sauger (*Sander canadensis*) as a result of polychlorinated biphenyls (TDEC 2016-TN5172).

TVA conducted benthic macroinvertebrate sampling in 2011 at two locations: CRM 15.0 (slightly downstream from the proposed discharge) and CRM 18.8 (approximately a mile upstream of the proposed intake). Ten samples were taken at each location in May, July, and October 2011. Between September 21 and 26, 2011, a mollusk and habitat survey was conducted using semi-quantitative and qualitative sampling methods (TRC 2011-TN5168). A total of 74 living native mussels were collected from six different species. No Federally protected species including the pink mucket (*Lampsilis abrupta*) and the sheepnose mussel (*Plethobasus cyphyus*) were identified in either survey. The survey of mollusks observed that zebra mussels (*Dreissena polymorpha*) were found attached to 71 of the 74 living native mussels. The average area of coverage on an individual mussel was 28 percent and coverage ranged from 5 to 100 percent (TRC 2011-TN5168). The presence of zebra mussels is detrimental to the survival of native mussels. Zebra mussels affect the growth and reproduction of native mussels by competing for space and food, interfering with the native mussel's ability to open and close their shells, impairing movement of the native mussels, and depositing metabolic wastes on native mussels (FWS 2015-TN5218).

Based on the sampling studies and the condition of the living native mussels it is unlikely that either of the protected mussel species would be located in the Clinch River arm of the Watts Bar Reservoir.

During 2011, TVA performed fish sampling studies at two sampling locations downstream between CRM 14 and CRM 15 and upstream between CRM 18 and CRM 19.8 using electrofishing and gillnetting techniques (TVA 2013-TN5167). Surveys were conducted during the months of February, May, July, and October. No Federally protected fish species were identified during the surveys.

M.3.2 Offsite Transmission Line Upgrades

Uplands within the overhead transmission line right-of-ways depicted in Figure M-4 mostly comprise artificially maintained scrub-shrub/herbaceous vegetation similar to that described for the 500-kV transmission line corridor where the new 69-kV line would be buried (Section M.3.1.1). These offsite corridors may also intersect wetlands, streams, rivers, ponds, and reservoirs, as well as possible upland features different from scrub-shrub/herbaceous vegetation. Because TVA's identification of these corridors currently is conceptual and because TVA has not identified where specific upgrades would occur, the locations of relevant wetlands and waterbodies and upland habitats that differ from scrub-shrub/herbaceous, within the offsite transmission line corridors, are not described in this BA.

M.3.3 Possible Future CRN Facilities

The 935-ac CRN Site currently is undeveloped and not used for power-generating activities. Although TVA has not yet selected a specific reactor design, TVA's PPE provides bounding parameters for a "surrogate plant" that a future selected SMR design is expected to fall within. The four SMR technologies used to develop the PPE (Section M.1) all represent pressurized water reactors with below-grade containment, passive containment cooling for the ultimate heat sink, and closed-cycle wet cooling for the cooling-water system (CWS) (TVA 2017-TN4921, TVA 2017-TN4922). The general layout is depicted as part of Figure M-3 and includes the power block, turbine island, switchyard, cooling tower, independent spent fuel storage installation areas, offsite road improvement areas, and the areas that would be permanently or temporarily disturbed on and near the CRN Site.

The paragraphs below briefly describe CRN facilities that would have a major plant-environment interface. Not all proposed facilities are described; many are omitted that do not comprise a major part of the development footprint or have a major interface with the environment.

M.3.3.1 Power Block

Much of the developed portion of the CRN Site would comprise the power block, a densely built area containing the proposed SMRs and containment, auxiliary buildings, and many other operationally connected facilities. TVA's PPE value for the height of the tallest power-block structure is 160 ft above plant grade. The power block would also be where the deepest excavation occurs; the PPE value for the depth of the deepest excavation is 138 ft below plant grade (TVA 2017-TN4922). The power block would be built in the southern portion of the CRN

Site, largely in the area that was previously disturbed for the CRBR. Several large cranes would be needed to install reactors on the CRN Site. The largest would be a 638-ft heavy-lift crane used in the main plant area (TVA 2017-TN4922).

M.3.3.2 Cooling-Water System

Cooling water typically is obtained from a surface-water source; heat in the cooling water is typically rejected to the atmosphere; and blowdown and liquid effluents typically are discharged to the environment. The source of cooling water would be surface water from the Clinch River arm of the Watts Bar Reservoir. A portion of the makeup water would be discharged to the Clinch River, approximately 2.5 mi downstream of the cooling-water intake. The remaining portion of the water would be released to the atmosphere via evaporative cooling through mechanical draft cooling towers (TVA 2017-TN4921, TVA 2016-TN5018).

The location of the intake structure is indicated in Figure M-3 at CRM 17.9, on the east side of the CRN Site. The intake design features are intended to keep the water velocity through the dual-flow traveling screens at less than 0.5 fps to minimize impingement of fish or other aquatic biota (TVA 2017-TN4921).

TVA anticipates that the intake structure would be approximately 50 ft long and 50 ft wide, with four intake channels leading to four pump bays. Bar screens would prevent debris from entering the intake channels and dual-flow traveling screens would prevent smaller debris from reaching the pumps in the pump bays. The vertical height of the structure would be approximately 25 ft with the top deck elevation above the 100-year flood elevation. The riverbed near the shore would need to be deepened slightly to form a forebay between the face of the intake and the main channel of the river so water would enter the intake system below the minimum water level of the reservoir. However, the precise location of the intake and the depth and amount of riverbed excavated would be included in any future CP or COL application (TVA 2017-TN4921).

Liquid effluents from the plant would be transported via pipeline to a holding pond and then to the discharge structure indicated in Figure M-3. The discharge would be built at approximately CRM 15.5 on the west side of the CRN Site. The diffuser pipe would be partially buried, requiring in-water excavation of the river bottom. Installation of the discharge also might require excavation near the shoreline (TVA 2017-TN4921). Installation of the discharge would require placement of two parallel 3-ft-diameter pipes that extend into the river at an elevation of about 720 ft, or 4 ft above the bottom at the offshore end. The conceptual design would have diffuser ports on the downstream side of the last 12 to 15 ft of each pipe in order to effect a discharge velocity of 8 to 10 fps. A vault containing instruments to monitor effluent flow and temperature would be located upstream. Valves installed in each pipe would be used to control discharge flow for mixing or exit velocity or for directing flow to one pipe if needed for maintenance (TVA 2017-TN4921).

Approximately 0.5 mi of new pipeline would be laid to convey water from the intake structure to the main plant area; approximately 0.4 mi of new pipeline would be laid to convey water from the main plant area to the discharge pipe (TVA 2017-TN4920).

TVA's conceptual design calls for a currently unknown number of linear mechanical draft cooling towers to dissipate heat from the CWS. The cooling towers would be located just west of the power block (Figure M-3) and would be 65 ft or less in height.

M.3.3.3 Barge-Unloading Facility

TVA proposes to refurbish an existing but inactive barge terminal (Figure M-3). Materials or equipment shipped by barge to the CRN Site would be offloaded at this terminal. Anticipated refurbishment activities are improvements to the existing retaining wall, and installation of bollards or mooring cells to secure barges at the terminal.

M.3.3.4 Melton Hill Dam Bypass

TVA proposes to add a bypass flow system (conduit) through an existing part of the Melton Hill Dam structure to maintain a minimum flow of 400 cubic feet per second (cfs) independent of the hydroelectric generating system.

M.3.3.5 Onsite Transmission System

Existing transmission lines serving the area of the CRN Site are 161-kV and 500-kV lines. Anticipated changes and additions to the transmission system that would connect a potential 800-MW(e) plant at the CRN Site to the grid that distributes power to the TVA service territory include (1) new onsite switchyards, (2) relocation of an existing 161-kV line within CRN Site boundary, and (3) addition of a new 69-kV underground line within the existing 500-kV corridor that extends from within the CRN Site to the Bethel Valley Substation. Changes 1 and 2 are part of the CRN Site development footprint (Figure M-3). Change 3 would occur partially within the CRN Site development footprint (Figure M-3) and partially offsite (Figure M-2).

M.3.3.6 Support and Laydown Areas

Construction-support and laydown areas (Figure M-3) would be established to support fabrication and installation activities and might be maintained as laydown areas for future maintenance of the plant (TVA 2017-TN4922).

M.3.3.7 Other Facilities

Other facilities would include a concrete batch plant, and radioactive waste management and diesel generator buildings.

M.3.3.8 Offsite Transmission Line Upgrades

TVA has conceptually identified multiple specific segments of existing overhead transmission line in eastern Tennessee and in parts of Kentucky and Georgia that may have to be upgraded to accommodate power delivered to TVA's grid from SMRs at the CRN Site.

In its environmental report (ER), TVA tabulated the total length of transmission line segments to be uprated, reconductored, or rebuilt as approximately 191 mi, 122 mi, and 13 mi, respectively, totaling about 326 mi (TVA 2017-TN4921). However, TVA subsequently provided spatial data that indicated the segment lengths to be uprated or reconductored could be up to 215 and 212 mi, respectively, totaling 440 mi inclusive of the 13-mi line that would be rebuilt (TVA 2017-TN4920) (Table M-3).

The routes for each segment identified for possible upgrade by TVA are shown in Figure M-4. Table M-3 lists each segment and the type of upgrade proposed by TVA. Rebuilds involve building new transmission poles or towers and installing new conductors within an existing right-of-way. Reconductoring involves installing new conductors on existing poles or towers within an existing right-of-way. Uprating a transmission line involves replacing conductors on existing poles or towers within an existing right-of-way with new conductors capable of carrying a higher voltage than the replaced conductors. These and related upgrade activities are described in greater detail in Section M.4.2.

Table M-3. Offsite Transmission Lines where Upgrades (Uprate, Reconductor, Rebuild) Would Occur and Related Information Based on TVA-Provided GIS Files

State	County	Line	Segment(s)	Length (mi)	Engineering Solution
Georgia	Catoosa	L5697	141 - 154	5.92	Reconductor
Kentucky	Bell	L5125	448 - 212	12.09	Reconductor
Kentucky	Whitley	L5125	448 - 212	8.05	Reconductor
Tennessee	Anderson	L5125	448 - 212	1.25	Reconductor
Tennessee	Anderson	L5235	82 - 128	3.54	Reconductor
Tennessee	Anderson	L5235	82 - 128	0.60	Reconductor
Tennessee	Anderson	L5280	86 - 119	1.48	Reconductor
Tennessee	Anderson	L5280	86 - 119	0.60	Reconductor
Tennessee	Anderson	L5659	1 to 55	4.46	Reconductor
Tennessee	Anderson	L5882	298A & 298-310	2.74	Reconductor
Tennessee	Anderson	L5882	298A & 298-310	0.04	Reconductor
Tennessee	Anderson	L5882	298A & 298-310	0.04	Reconductor
Tennessee	Anderson	L5882	298A & 298-310	13.89	Reconductor
			County Total	28.63	
Tennessee	Bledsoe	L5173	1-182A & 182A - 40	16.54	Uprate
Tennessee	Bledsoe	L5173	1-182A & 182A - 40	3.91	Uprate
			County Total	20.45	
Tennessee	Campbell	L5125	448 - 212	12.66	Reconductor
Tennessee	Campbell	L5125	448 - 212	10.83	Reconductor
Tennessee	Campbell	L5125	448 - 212	0.02	Reconductor
Tennessee	Campbell	L5125	448 - 212	3.92	Reconductor
			County Total	27.42	
Tennessee	Claiborne	L5125	448 - 212	2.43	Reconductor
Tennessee	Cocke	L5957	51 - 181 & 1 - 50	4.37	Reconductor
Tennessee	Cocke	L5957	51 - 181 & 1 - 50	7.98	Reconductor
			County Total	12.35	
Tennessee	Cumberland	L5204	198A - 215	6.35	Reconductor
Tennessee	Cumberland	L5204	198A - 215	6.09	Reconductor
Tennessee	Cumberland	L5204	198A - 215	0.04	Reconductor
Tennessee	Cumberland	L5204	198A - 215	3.90	Reconductor
Tennessee	Cumberland	L5205	215-297 & A-G	17.43	Uprate
Tennessee	Cumberland	L5205	215-297 & A-G	2.49	Uprate
			County Total	36.30	

Table M-3. (contd)

State	County	Line	Segment(s)	Length (mi)	Engineering Solution
Tennessee	Franklin	L5167	941B-975	11.70	Uprate
Tennessee	Franklin	L5702	1	9.15	Reconductor
			County Total	20.85	
Tennessee	Grainger	L5186	E1 - E5 & 6 - 234	18.36	Uprate
Tennessee	Greene	L5624	E1 - E39 & 40 & E35 & 192 - 84	8.25	Uprate
Tennessee	Greene	L5624	E1 - E39 & 40 & E35 & 192 - 84	18.11	Uprate
			County Total	26.36	
Tennessee	Grundy	L5167	941B-975	6.78	Uprate
Tennessee	Grundy	L5167	941B-975	17.68	Uprate
Tennessee	Grundy	L5167	941B-975	0.16	Uprate
Tennessee	Grundy	L5167	941B-975	0.06	Uprate
			County Total	24.68	
Tennessee	Hamblen	L5186	E1 - E5 & 6 - 234	1.45	Uprate
Tennessee	Hamblen	L5624	E1 - E39 & 40 & E35 & 192 - 84	8.47	Uprate
Tennessee	Hamblen	L5940	E136 - E120 & 120 - 164 & 164 - 185A	2.18	Uprate
			County Total	12.10	
Tennessee	Hamilton	L5697	141 - 154	0.73	Reconductor
Tennessee	Hawkins	L5186	E1 - E5 & 6 - 234	17.74	Uprate
Tennessee	Hawkins	L5624	E1 - E39 & 40 & E35 & 192 - 84	4.10	Uprate
			County Total	21.85	
Tennessee	Jefferson	L5624	E1 - E39 & 40 & E35 & 192 - 84	1.49	Uprate
Tennessee	Jefferson	L5940	E136 - E120 & 120 - 164 & 164 - 185A	12.79	Uprate
Tennessee	Jefferson	L5957	51 - 181 & 1 - 50	9.97	Reconductor
Tennessee	Jefferson	L5957	51 - 181 & 1 - 50	8.90	Reconductor
Tennessee	Jefferson	L5957	51 - 181 & 1 - 50	4.13	Reconductor
			County Total	37.29	
Tennessee	Knox	L5092	120 - 212	12.57	Rebuild
Tennessee	Knox	L5659	1 to 55	6.48	Reconductor
			County Total	19.05	
Tennessee	Putnam	L5204	198A - 215	1.46	Reconductor
Tennessee	Rhea	L5173	1-182A & 182A - 40	14.15	Uprate
Tennessee	Roane	L5205	215-297 & A-G	1.87	Uprate
Tennessee	Roane	L5235	82 - 128	0.24	Reconductor
Tennessee	Roane	L5235	82 - 128	0.95	Reconductor
Tennessee	Roane	L5280	86 - 119	0.28	Reconductor
Tennessee	Roane	L5280	86 - 119	0.95	Reconductor
Tennessee	Roane	L5743	150-208A	8.41	Reconductor
Tennessee	Roane	L5743	150-208A	7.91	Reconductor
Tennessee	Roane	L5743	150-208A	1.93	Reconductor
Tennessee	Roane	L5743	150-208A	10.86	Reconductor
Tennessee	Roane	L5743	150-208A	1.00	Reconductor
Tennessee	Roane	L5743	150-208A	1.80	Reconductor
Tennessee	Roane	L5743	150-208A	1.07	Reconductor
Tennessee	Roane	L5743	150-208A	1.07	Reconductor

Table M-3. (contd)

State	County	Line	Segment(s)	Length (mi)	Engineering Solution
			County Total	38.34	
Tennessee	Scott	L5882	298A & 298-310	2.68	Reconductor
Tennessee	Scott	L5882	298A & 298-310	17.52	Reconductor
			County Total	20.20	
Tennessee	Sequatchie	L5167	941B-975	7.02	Uprate
Tennessee	Sevier	L5957	51 - 181 & 1 - 50	0.86	Reconductor
Tennessee	Van Buren	L5173	1-182A & 182A - 40	15.71	Uprate
Tennessee	Warren	L5173	1-182A & 182A - 40	1.05	Uprate
Tennessee	White	L5173	1-182A & 182A - 40	5.65	Uprate
			Grand Total	439.35	

M.4 Building Impacts

The discussion in this section provides an overview of potential impacts on terrestrial and aquatic resources that could result from building the facilities discussed in the CRN Site PPE. Section M.5 of this BA provides a complementary overview of potential impacts on terrestrial and aquatic resources from operation of those facilities. Most information presented in these overview sections is drawn from the review team's EIS to support its review of the ESP application. Section M.7 of this BA provides an assessment of the potential effects on individual species and habitats from the alteration of terrestrial and aquatic resources resulting from building and operating the contemplated new facilities.

In a final rule dated October 9, 2007 (72 FR 57416-TN260), the NRC limited the definition of "construction" to the activities that fall within its regulatory authority in 10 CFR Part 51.4 (TN250). Many of the site-preparation activities associated with building a nuclear power plant are not part of the NRC action to license the plant. Activities that are associated with construction, but that are not within the purview of the NRC action, are grouped under the term "preconstruction." Preconstruction activities include clearing and grading, excavating, erecting support buildings and transmission lines, and other associated activities that lack a nexus to nuclear safety. These preconstruction activities may take place before the application for a COL is submitted, during the NRC staff's review of a COL application, or after a COL has been granted. Although preconstruction activities are outside the NRC's regulatory authority, many of the activities are within the regulatory authority of local, State, or other Federal agencies, including the USACE. Because this is a joint BA for both the NRC and the USACE, the distinction between construction and preconstruction is not carried forward in this BA; both are jointly discussed using the term "building."

M.4.1 CRN Site and Vicinity

This section provides information about the impacts on baseline terrestrial and aquatic resources described in Section M.3.1 from site preparation and development activities on the CRN Site, in the BTA, and within the existing 500-kV transmission line corridor where the new 69-kV transmission line would be buried.

M.4.1.1 Upland Habitats

Building activities would start with land clearing and site preparation work on the CRN Site and development of the barge facility and haul road in the BTA. The land-clearing and site preparation phase would continue for about 1 year, during which time most impacts on terrestrial habitats, including wetlands, would have taken place. Activities to further excavate and develop the site and erect structures such as the intake, discharge and the support and safety-related facilities would occur over a subsequent period of 4 to 5 years. (TVA 2017-TN4921).

Approximately 494 ac of the CRN Site and 45 ac of the BTA (approximately 539 ac total) would be disturbed by building activities (Table M-4). The affected areas include approximately 327 ac on the CRN Site and 30 ac in the BTA that would be permanently occupied by facilities over the life of the project (Table M-4). The affected areas also include about 167 ac on the CRN Site and about 15 ac in the BTA that would be only temporarily disturbed (Table M-4) (TVA 2017-TN4920). Figure M-7 is an overlay showing terrestrial habitats permanently and temporarily cleared on the CRN Site and in the BTA. By making the maximum possible use of the existing CRBR footprint, TVA has designed the building-activity footprint to minimize impacts on forest and wetlands. Approximate affected acreages by habitat type/land cover on the CRN Site and BTA are provided in Table M-4.

Table M-4. Habitat Types and Land-Cover Types that Would Be Disturbed by Developing the CRN Site and BTA. Obtained from information provided by TVA (2017-TN4920).

Location/Habitat Types/ Land-Cover Types	Approximate Acreage Permanently Affected	Approximate Acreage Temporarily Affected	Total Acreage Affected
CRN Site			
Herbaceous/Grassland	152	41	193
Mixed Evergreen-Deciduous Forest	106	90	196
Deciduous Forest	53	19	72
Roads/Developed Areas (Existing)	13	--	13
Evergreen Forest	3	17	20
Total	327	167	494
Barge Traffic Area			
Herbaceous/Grassland	1	1	2
Deciduous Forest	9	14	23
Roads/Developed Areas (Existing)	20	--	20
Total	30	15	45

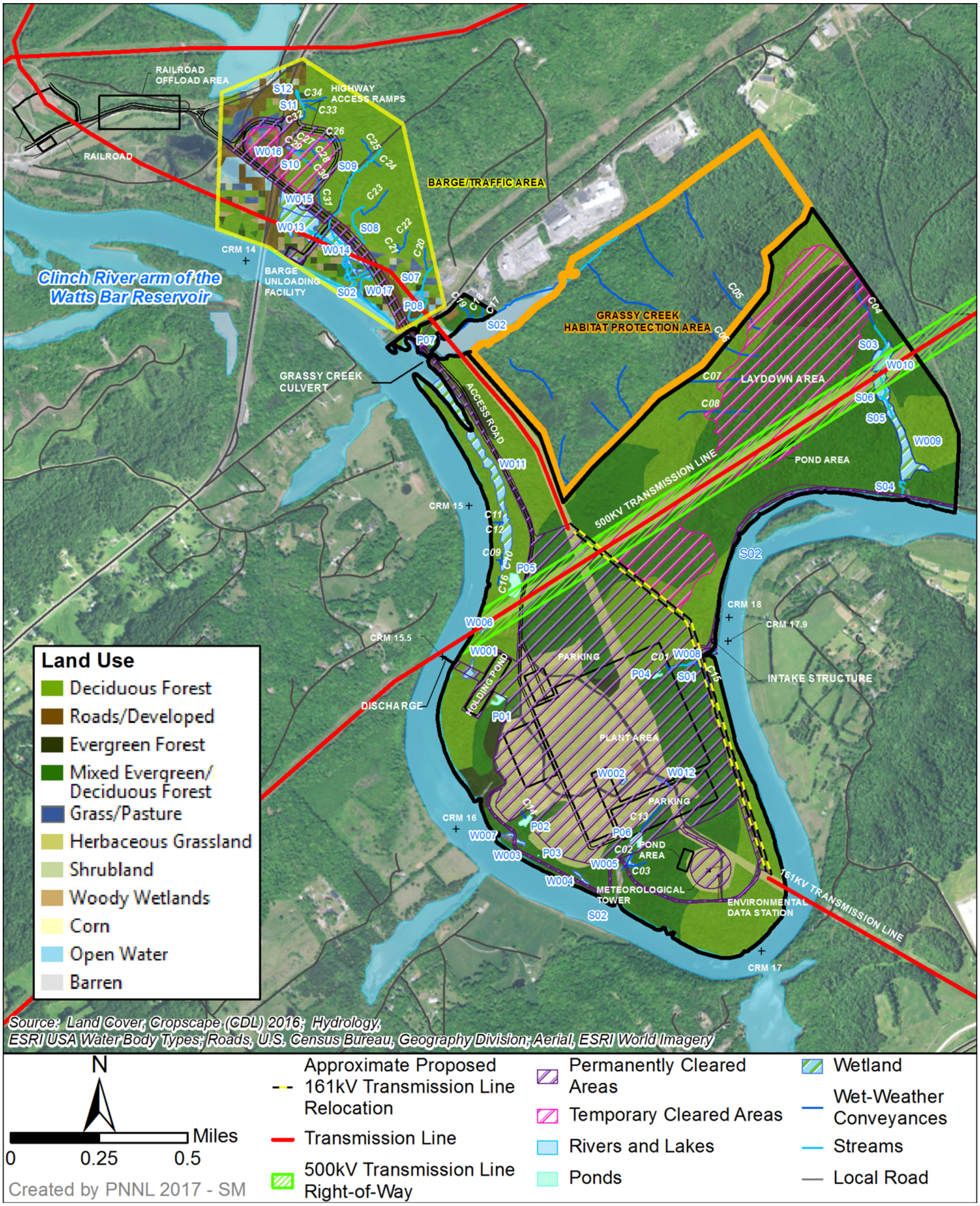


Figure M-7. CRN Site and BTA Development Footprint Overlaid on Terrestrial Habitat Types

M.4.1.1.1 Forest

Clearing would remove about 196 ac of mixed evergreen-deciduous forest on the CRN Site and none in the BTA (Table M-4). Clearing would remove about 72 ac on the CRN Site and about 23 ac of deciduous forest in the BTA (Table M-4). About 20 ac of evergreen forest would be cleared on the CRN Site and none in the BTA (Table M-4). The potentially affected evergreen forest likely consists of remnant pine plantings from when the CRBR footprint was redressed (discussed in Section M.3.1) (DOE 1984-TN5282). Of these impacts, 171 ac would be permanent, and 140 ac would be temporary (Table M-4). Clearing forest would reduce the extent of and fragment forest on the CRN Site and in the BTA. The overall forest impacts of 311 ac represent 0.7 percent of forest occurring in the 6-mi vicinity (Figure M-8).

Building the intake and discharge structures (Figure M-3) along the reservoir shoreline (the Clinch River) would require removal of a relatively small patch of riparian vegetation within the footprint of each structure. No riparian vegetation would be cleared to reactivate the existing barge facility, and improvements to that facility would not require substantial additional clearing of shoreline riparian vegetation.

M.4.1.1.2 Non-Forest Vegetation

Approximately 195 ac of herbaceous/grassland and old-field vegetation on the CRN Site and in the BTA would be disturbed (Table M-4), mostly within the former footprint of the CRBR. Of these disturbances, 153 ac would be permanent impacts, and 42 ac would be temporary impacts (Table M-4). Much of the area that would be permanently affected is currently in a state of early forest succession, and further succession to mature forest would be precluded. This area comprises about 2 percent of the total acreage of similar vegetation within the 6-mi vicinity (Figure M-8).

An additional 210 ac of herbaceous/grassland would be temporarily disturbed east of the CRN Site by installation of the proposed 69-kV underground line within the existing Watts Bar Nuclear Plant–Bull Run Fossil Plant 500-kV corridor, which crosses the CRN Site and ties into the existing Bethel Valley Substation (Figure M-2). This area is currently a maintained right-of-way and would continue to be similarly maintained after installation of the underground transmission line. As part of implementing its proposed best management practices (BMPs), TVA would seed disturbed areas after installation of the underground conductors, and the review team expects that the affected areas would regenerate typical right-of-way vegetation in a few years. An additional 0.33 ac of herbaceous/grassland would be permanently removed by expansion of the Bethel Valley Substation.

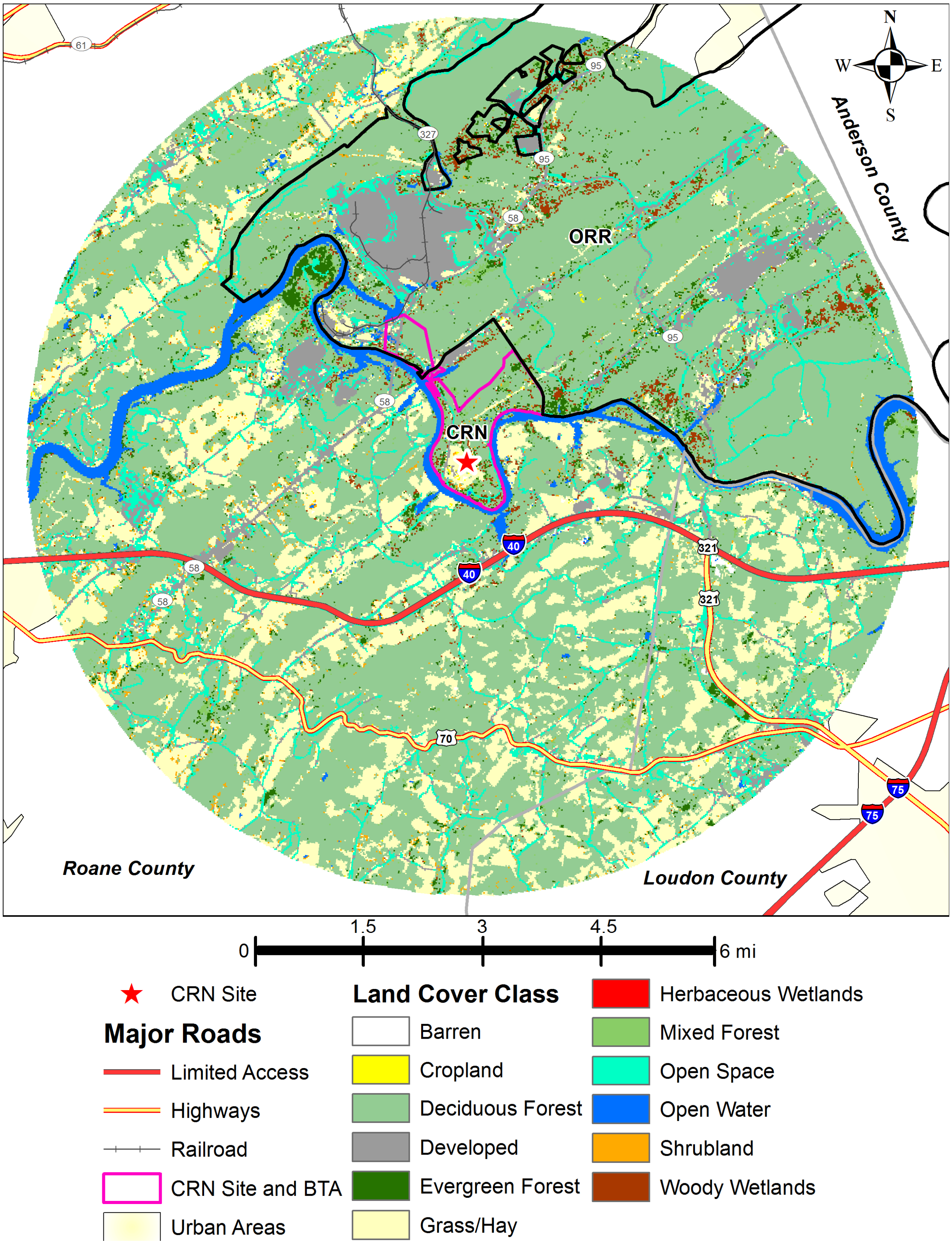


Figure M-8. Land Cover within the 6-Mi Vicinity of the Clinch River Site. (Source: NASS 2017-TN5144)

M.4.1.1.3 Revegetation of Temporarily Disturbed Land

Temporarily disturbed acreage may be revegetated or otherwise restored after clearing and building activities using native or noninvasive herbaceous species. Revegetating using native plant species would reduce competition from invasive species and facilitate forest succession. Other temporarily disturbed areas may be replanted in trees (TVA 2017-TN4921), which would likely further accelerate forest succession. Over several decades, some of these areas likely would gradually transition physically and functionally from herbaceous/grassland to forest habitat (TVA 2017-TN4921). Nevertheless, re-establishment of temporarily disturbed forest, especially mature deciduous forest, could require several decades to more than a century.

In areas of permanent habitat conversion (e.g., forest to herbaceous/grassland or shrubland such as in the relocated 161-kV transmission line onsite or water pipeline corridors for the intake and discharge [Figure M-2]), habitat would be maintained in its converted state and the prior functional value of the former forest communities would not be restored.

M.4.1.2 Wetland Habitats

Four wetlands (W001, W002, W008, and W012) (Figure M-4) with a total area of approximately 1.2 ac would be filled to build the proposed facilities on the CRN Site. The type, location, size, condition, and jurisdictional status of these four wetlands are provided in Table M-5. The condition of the affected wetlands ranges from degraded to moderate (Pilarski-Hall 2015-TN5185). The functions of these wetlands, including any as wildlife habitat, would be lost.

Table M-5. Affected Wetlands on the CRN Site (Source: TVA 2017)

Wetland Number	Wetland Type[(a)]	Location	Impact	TVA Condition Category[(b)]	Size (ac)
W001	PF01E	Water discharge pipeline corridor on a terrace of the Clinch River	Fill	2	0.67
W002	PEM1E	Power-block area	Fill	1	0.13
W008	PF01E	Water intake pipeline corridor	Fill	2	0.23
W012	PEM1E	Power block and parking areas	Fill	1	0.13
				Total	1.16

(a) Classification codes as defined in Cowardin et al. 1979-TN5186: PEM1E = Palustrine emergent, persistent vegetation, seasonally flooded/saturated; PFO1E = Palustrine forested, broad-leaved deciduous vegetation, seasonally flooded/saturated; PSS1E = Palustrine scrub-shrub, broad-leaved deciduous vegetation, seasonally flooded/saturated; PSSHh = Palustrine scrub-shrub, broad-leaved deciduous vegetation, permanently flooded, diked/impounded.
(b) Category 1 = degraded; Category 2 = moderate quality; Category 3 = high quality.

The other wetlands on the CRN Site listed in Table M-2 would be avoided and thus not directly affected by building activities. Indirect effects on downgradient wetlands outside the footprint of development would largely be reduced by the use of BMPs to prevent erosion and sedimentation. These include soil stabilization via revegetation, drainage control measures, and managing discharges in accordance with the CRN Site's future Storm Water Pollution Prevention Plan and National Pollutant Discharge Elimination System (NPDES) permit, etc. (TVA 2017-TN4921).

Dewatering of groundwater within the power-block excavation at the CRN Site would be necessary during development of the below-grade nuclear island structures and foundations described in Section M.3.2. Wetlands on the CRN Site and in the BTA are associated with surface water (streams or the Clinch River), and their association with groundwater is assumed but the extent of the connection is unknown. Because of their surface-water connection and the temporary nature of the power-block excavation, it is anticipated three nearby moderate quality wetlands—W003 (0.18 ac), W004 (0.24 ac), and W007 (0.17 ac) (Figure M-6 and Table M-2) (TVA 2017-TN4921)—could experience temporary dewatering during the power-block excavation.

TVA estimated that a total of approximately 0.5 ac across W013, W014, W015, and W017 (all moderate quality wetlands except W017, which is high quality [Table M-2]) in the BTA would be affected. Partial removal of these wetlands may adversely affect the integrity of the remaining portions of these wetlands (e.g., by providing an inroad for the establishment of invasive species). In addition, 0.11 ac (W016 [a moderate quality wetland (Table M-2)]) may be filled (TVA 2017-TN4921, TVA 2016-TN5145).

Using the FWS National Wetland Inventory database (FWS 2017-TN5327) and assuming fringe wetlands along streams, it is conservatively assumed that up to 2 ac of wetlands may occur within the existing 500-kV transmission line corridor where the proposed new 69-kV underground transmission line would be buried. It is conservatively assumed these 2 ac would be disturbed, although TVA would install the 69-kV line in accordance with its wetland clearing, building activities, and restoration BMPs that are specific to activities in transmission line corridors (TVA 2012-TN4911).

The approximately 1.2 ac of wetland impacts on the CRN Site, 0.6 ac of wetland impacts in the BTA, and the 2 ac of wetlands impacts within the existing 500-kV transmission line corridor total about 3.8 ac, which compose about 0.4 percent of the total acreage of wetlands within a 6-mi radius.

M.4.1.3 Aquatic Habitats

TVA plans to site the proposed facilities and structures to avoid, to the extent possible, impacts on streams and other waterbodies.

M.4.1.3.1 Streams and Ponds

One perennial stream (S01) and six ephemeral streams/wet weather conveyances (C01, C02, C03, C13, C14, C15) lie within TVA's estimated building-activity footprint. Two freshwater ponds (P04 and P06) also lie within the footprint (TVA 2017-TN4921). Five additional ephemeral streams located in the northeast section of the CRN Site (C04, C05, C06, C07, and C08) may be temporarily disturbed and then restored.

Within the BTA, two intermittent streams (S09 and S10) and six ephemeral streams (C26, C27, C28, C29, C30, and C31) would be affected by building improvements to Bear Creek Road, the CRN Site entrances, and development of a new intersection and access ramps on State Route

58 (SR 58). Stream S10 and the six ephemeral streams would be permanently altered through grading and filling as part of the road development (TVA 2017-TN4921).

TVA has stated that they would use BMPs to minimize erosion and transport of sediments in the streams. TVA uses BMPs specifically directed toward avoiding or minimizing adverse impacts on streamside management zones (SMZ) and the waterbodies. TVA also indicated they would follow a stormwater pollution prevention plan that sets controls to manage runoff during clearing and building activities (TVA 2017-TN4921).

The project would also include installing a new right-of-way segment for the 161-kV line on the CRN Site and an underground 69-kV line for the 5-mi segment between the Bethel Valley Substation and the CRN Site as discussed previously. Installation of the buried 69-kV line would take place entirely within an existing right-of-way. However, the installation would cross six streams that flow roughly perpendicularly across the right-of-way., as discussed in Section 2.4.2.1. TVA has indicated that they would attempt to tunnel under the streams where practicable (TVA 2017-TN4921). TVA expects to employ BMPs to reduce the impacts from sediment during the installation of the underground conductors. TVA has committed to restoring any disturbance to streams immediately after work is completed (TVA 2017-TN4921). The review team expects that the USACE would require TVA to restore surface disturbances to jurisdictional streams as part of any Department of the Army permit issued under the Clean Water Act.

M.4.1.3.2 Clinch River Arm of Watts Bar Reservoir

Aquatic habitats and organisms in the Clinch River could be affected by installation of the intake structure, discharge structure, improvements to the barge facility, and installation of a new culvert under the road in the Grassy Creek embayment (that is part of the Clinch River arm of Watts Bar Reservoir).

The proposed cooling-water intake and discharge structures are described in Section M.3.3.

TVA discusses the installation of the intake and discharge and indicates that "… these activities would affect only small areas of the reservoir" (TVA 2017-TN4921). In addition, these activities would require a Department of the Army permit from the USACE, and TVA would need to conduct activities in accordance with the requirements of the permit. TVA has indicated that no in-stream dredging would be required for activities to build the intake or place the discharge although shoreline excavation or underwater excavation would be necessary (TVA 2017-TN4921). TVA anticipates using BMPs to prevent erosion and sediment transport. The review team expects that TVA would use a temporary cofferdam during placement of the intake structure, and TVA may use temporary silt curtains or cofferdams when building the discharge structure (TVA 2017-TN4921).

TVA would install a new culvert in the Grassy Creek embayment of the Clinch River arm of the Watts Bar Reservoir as part of the roadway improvements to the access road as discussed in Section M.3. TVA would use BMPs such as silt curtains and cofferdams to minimize erosion and prevent the transport of sediments into the reservoir (TVA 2017-TN4921).

TVA would refurbish the existing inactive barge terminal at CRM 14.2 near the entrance to the CRN Site and Bear Creek Road. TVA can be expected to repair or enlarge the existing retaining wall and install steel or wooden pilings or mooring posts to secure the barges. Dredging activities are not anticipated; however, piles may be installed during the barge facility improvements. The review team does not anticipate that TVA would disturb much river-bottom area when rebuilding the barge terminal facilities.

TVA would conduct barging activities while building the project. However, TVA indicated that most deliveries of modules and components would occur via road or rail (TVA 2017-TN4921). Thus, the barges arriving at the barge facility are anticipated to be only a few per year.

Other than at the proposed locations for the features noted above, TVA indicates in figures in the ER that a buffer of undisturbed riparian forest vegetation would be left between disturbed lands and the river (TVA 2017-TN4921). This buffer, combined with BMPs to prevent erosion and sedimentation from disturbed soils, would effectively prevent sedimentation of aquatic habitats in the river and would preserve shaded aquatic habitats at the edge of the river.

The bypass that TVA proposes to build at the Melton Hill Dam would be built inside the existing dam; therefore, building it would not affect aquatic life or disturb sediments (TVA 2017-TN4921).

M.4.1.4 Noise Impacts during Building Activities

Building activities are usually performed in a series of steps or phases, and noise associated with different phases can vary greatly depending on the type of equipment used (WSDOT 2017-TN5313). TVA stated that typical noise and vibration would be generated by the operation of machinery and vehicles, including internal combustion engines (e.g., front-end loaders, tractors, scrapers/graders, heavy trucks, cranes, concrete pumps, and generators), impact equipment (e.g., pneumatic equipment, jack hammers, and pile drivers), other equipment (e.g., vibrators, saws, and hydro excavation equipment), and machine backup alarms (TVA 2017-TN4921). These include apparatuses in each of the three categories of typical construction equipment identified by Washington State Department of Transportation (WSDOT) (2017-TN5313), heavy equipment (earth-moving); stationary equipment (pumps, generators, etc.); and impact equipment (pile drivers, etc.). TVA stated that more intense noise would be generated by blasting, demolition, and testing of the emergency warning siren. Use of equipment and blasting activities add noise to background sound levels and cause ground vibration that may affect surface and underground structures (OSMRE 2017-TN5353).

M.4.1.4.1 Typical Construction Equipment

TVA's maximum expected noise level of 101 decibels adjusted (dBA) due to building activities measured at 50 ft from the source (TVA 2017-TN4921) comports with the high end of average maximum noise levels at 50 feet that range from about 73 to 101 dBA for non-impact heavy equipment (WSDOT 2017-TN5313). TVA stated that some infrequent or nighttime construction activities could generate temporary noise levels at or above 60 to 90 dBA at a distance of 100 ft from the source (TVA 2017-TN4921). TVA also noted use of impact equipment (see above) that may generate noise levels from 79 to 110 dBA at 50 ft from the source (WSDOT 2017-TN5313). Stationary equipment (such as that noted above by TVA) generally runs continuously at relatively constant power and speeds, and produces noise levels that can range from 68 to 88 dBA 50 ft from the source (WSDOT 2017-TN5313). TVA has stated that background sound in the project area is about 46 to 48 dBA during the day and between 41 and 49 dBA during the night (TVA 2017-TN4921).

Substrate, topography, vegetation, and atmospheric conditions affect the intensity level of noise as it is propagated over distance. Because vegetation, topography, and atmospheric conditions can vary greatly, these factors are generally not included in a BA (WSDOT 2017-TN5313). The standard attenuation rate for hard site conditions (substrate such as concrete or open water) is 6 dB per doubling of distance for point source noise (WSDOT 2017-TN5313), which includes all the equipment noted above. When ground cover or normal unpacked earth (i.e., a soft site) exists, the ground becomes absorptive of noise energy and can result in an additional 1.5 dB reduction per doubling of distance as it spreads from the source (WSDOT 2017-TN5313). Note that use of this factor alone (without topography, vegetation, and atmospheric conditions) likely predicts noise levels that are higher than actual noise levels (WSDOT 2017-TN5313).

Assuming noise decreases by approximately 7.5 dBA per doubling of distance from the source over soft ground (WSDOT 2017-TN5313), project construction noise could travel as little as 400 ft (starting as 60 dBA at 100 ft from the source) up to 12,800 ft (roughly 2.4 mi) (starting at 110 dBA at 50 ft from the source) before it attenuates to 45 and 50 dBA, respectively, (i.e., approximate background sound levels). These noise intensity levels may represent episodic highs and lows. Heavy construction equipment more typically generates an estimated noise level of approximately 85 decibels adjusted (dBA) at 50 ft from the source (USDOT 2017-TN5383) and would thus travel up to 1,600 ft before it attenuates to 47.5 dBA. This noise intensity level may be more representative of typical bouts of noise. The above noise levels could occur at most locations on the CRN Site and in the BTA, and also along the roughly 5-mi-long underground transmission line between the CRN Site and Bethel Valley Substation, and could thus inject noise at the above levels and distances into the surrounding landscape.

M.4.1.4.2 Noise to Aquatic Ecosystems

Dredging activities are not anticipated; however, piles may be driven during the barge facility improvements. Placement of piles would affect small areas of habitat within the footprint of the piles (TVA 2017-TN4921). In addition, although most fish species would avoid the underwater noise of pile driving, some species could be affected by the noise and the pressure wave generated by the pile driver.

M.4.1.4.3 Blasting and Demolition

Excavation for the power block(s) (Section M.3.2) requires the removal of soil and rock. Periodic blasting during the dayshift would be used to remove rock. Blasting and demolition would occur early in the building activities at intermittent frequencies and only occur during the daylight hours (between 7:00 a.m. and 5:00 p.m.) (TVA 2017-TN4921). Blasting noise can reach 126 dBA (WSDOT 2017-TN5313). Assuming noise decreases by approximately 7.5 dBA per doubling of distance from the source over soft ground (WSDOT 2017-TN5313), blasting-type construction noise could travel 51,200 ft (roughly 9.6 mi) before it attenuates to 51 dBA (i.e., approximate background sound level).

M.4.1.4.4 Combined Noise

Excavation activities for the power block(s) may occur in conjunction with site preparation activities. Thus, blasting may be concurrent with the use of the typical construction equipment described above. Also, the different types of typical construction equipment may be operated at the same time in the absence of blasting.

Although noise from multiple sources at the same location may result in louder levels than a single source alone, the decibel is measured on a logarithmic scale, so noise levels cannot be added by standard addition. For example, two noises of equal level (±1 dB) combine to raise the noise level by 3 dB. However, if two noises differ by more than 10 dB, there is no combined increase in the noise level; the higher output covers any other noise (WSDOT 2017-TN5313).

It is necessary to follow the rules of decibel addition provided by WSDOT (2017-TN5313) to determine the combined noise level of blasting and typical construction equipment operating together. The three loudest noise levels are 126 dBA (blasting), 110 dBA (impact equipment), and 101 dBA (earth-moving equipment). There is a difference of 9 dBA between the lower two noise levels, so 1 dBA is added to 110 dBA. The difference between the resultant combined level of 102 dBA and 126 dBA is greater than 10 dBA; thus, nothing is added to 126 dBA. The 126 dBA blasting noise covers any other noise and there would be no increase due to other concurrent noises at these levels.

Without blasting, the three loudest noise levels would be 110 dBA (impact equipment), 101 dBA (earth-moving equipment), and 88 dBA (stationary equipment). The difference between the lower two levels is greater than 10 dBA so nothing is added to 101 dBA. However, the difference between 110 dBA and 101 dBA is 9 dBA, so 1 dBA is added to 110 dBA to create a combined noise level of 111 dBA, which is a very minor increase.

Consequently, there would be virtually no combined noise levels of any consequence above and beyond the above individual noise levels.

M.4.1.4.5 Noise Reduction

TVA has stated in its application (TVA 2017) that it would attempt noise reduction via the following methods:

- Using noise-reduction devices on heavy equipment (i.e., mufflers)
- Limiting driving speeds, use of “Jake brakes,” and tail-gate slamming
- Building earthen berms
- Placing foliage or ground cover between the noise sources and receptors.

M.4.1.5 Wildlife Collisions with Tall Structures

Tall construction equipment present potential collision obstacles for volant (flying) wildlife that otherwise would not be present. Several large cranes would be used, the largest being 638 ft in height (TVA 2017-TN4922).

M.4.1.6 Herbicide Use

In areas of land clearing that would result in permanent habitat conversion (e.g., forest converted to herbaceous/grassland or shrubland) habitat would be maintained in its converted state using herbicides (as well as mechanical means). Such areas include the relocated 161-kV transmission line on the CRN Site, water pipeline corridors for the intake and discharge, and the 500-kV transmission line corridor where the new 69-kV transmission line would be buried (Figure M-2). Herbicides are used around wetlands and sensitive biological resources as directed by TVA BMPs (TVA 2012-TN4911).

M.4.2 Offsite Transmission Line Upgrades

TVA identified transmission line segments for possible upgrade (Table M-3) based on an initial interconnection system impact study of projected future transmission system conditions. TVA has stated it used available information about transmission and generation additions and upgrades that may subsequently change. TVA also stated that given the dynamic nature of its transmission system and the time lapse between issuance of the ESP and possible COL, the planning assumptions are anticipated to change (depending on the final configuration and additional electrical capacity of the specific reactors ultimately proposed) along with associated changes in the corridor segments and engineering solutions (TVA 2017-TN4921, TVA 2016-TN5145).

TVA has stated that all work associated with the currently identified upgrades would occur within existing corridors and that no new corridors would be developed or widened (TVA 2017-TN4921, TVA 2016-TN5145). The review team estimates that the total length of transmission lines requiring upgrades is approximately 440 mi (Table M-3). TVA estimates that the total land area subject to potential disturbance is about 5,327 ac (TVA 2017-TN4920).

Uprating, reconductoring, and rebuilding activities as currently proposed are described below.

- Removing structures that interfere with clearance (due to increased electrical load increasing line temperature and sag).
- Replacement or modification of existing structures or installation of intermediate structures: This activity would be performed with standard transmission line equipment such as bulldozers, bucket trucks, boom trucks, and forklifts to raise the existing conductor to provide proper ground clearance. Disturbance would typically be limited to a radius of about 100 ft around the work structure.
- Conductor modification: This activity would include conductor slides, cuts, or floating dead-ends to increase ground clearance (described in TVA 2016-TN5145). These improvements require the use of a bucket truck; disturbance would be minimal and confined to the immediate area of the clearance issue.
- Conductor replacement (a.k.a., reconductoring) (described in TVA 2016-TN5145): Bucket trucks would be used for access and stringing equipment. A bulldozer and specialized tensioning equipment would be used to pull conductors to the proper tension. Wire pulls would be limited to a maximum of 5 mi. Pull points would typically be located along the most accessible path on the right-of-way (adjacent to road crossings or existing access roads).

The area of disturbance at each pull point would typically range from 200 to 300 ft along the right-of-way.

- Adding surcharge: This activity would involve adding a stone base and rock or dirt (surcharge) to structure footings. Typical installation of surcharge would be performed with tracked equipment with minimal ground disturbance.
- Modification of local power company transmission lines: If a local utility crossing does not have adequate clearance, TVA would request that the local utility lower or re-route the crossing.
- Rebuild: Installing intermediate structures between existing structures for added structural support and/or clearance, and/or tearing down existing structures and replacing with more robust structures (TVA 2017-TN4921, TVA 2016-TN5145).

Potential impacts to resources within the transmission line corridors would depend on the engineering solution (type of upgrade) selected, which is currently uncertain, and the location and extent of habitat disturbance. The above description of upgrade activities indicates that much less than the full 440 mi or 5,327 ac are likely to be disturbed, and TVA has not yet identified where and to what extent habitat disturbance would take place within the corridors. Lacking this necessary information to perform an assessment, the review team assumes, subject to future confirmation, that TVA would limit ground disturbance to upland areas within the existing bounds of established rights-of-way, and thus would not physically disturb aquatic habitats or wetlands. The review team likewise assumes that TVA would not remove any mature trees or forest cover as part of the transmission line upgrades, including trees from forested wetlands, stream banks, or reservoir shorelines. TVA has committed to using BMPs to avoid impacts on wetlands (Section M.4.1.2) and aquatic habitats (Section M.4.1.3) when possible.

M.5 Operation Impacts

The discussion in this section provides an overview of potential impacts on terrestrial and aquatic resources that could result from operating the facilities discussed in the CRN Site PPE. Section M.4 provides a complementary overview of potential impacts on terrestrial and aquatic resources from building those facilities. Most information presented in these overview sections is drawn from the review team's EIS to support its review of the ESP application. Section M.7 of this BA provides an assessment of the potential effects on individual species and habitats from the alteration of terrestrial and aquatic resources resulting from building and operating the contemplated new facilities.

M.5.1 CRN Site and Vicinity

M.5.1.1 Cooling-Tower Impacts on Vegetation

Two mechanical draft cooling towers (two blocks of 9 cells each, for a total of 18 cells) would be located just west of the reactor buildings (Figure M-3). In each cooling tower, the heat in the CWS water would be transferred to the atmosphere. Operation of the CWS would be based on two cycles of concentration, which means the total dissolved solids (TDS) in the makeup water would be concentrated to approximately two times the ambient concentration in the Clinch River before being released to the atmosphere. Cooled CWS water would be recirculated to complete the closed-cycle cooling loop. Through the process of evaporation, the TDS concentration in the CWS increases. A small percentage of the water in the CWS is released into the atmosphere as fine droplets (i.e., cooling-tower drift) containing elevated TDS levels that can be deposited on nearby vegetation and soil. Vapor plumes and drift may affect vegetation, and the water lost from cooling-tower operation could lower river levels and affect associated shoreline habitat.

Depending on the makeup source waterbody, the TDS concentration in the drift can contain high levels of salts that can stress and damage vegetation, either directly by deposition onto foliage or indirectly from accumulation in the soils. TVA modeled salt-drift deposition using the Electric Power Research Institute’s Seasonal and Annual Cooling Tower Impact model (TVA 2017-TN4921). TVA’s modeling used conservative parameters and addressed all directions from the cooling towers, during all seasons, and annually. Maximum deposition rates took place during summer. Summer deposition rates (TVA 2017-TN4921) were overlaid on the CRN Site vegetation map and development footprint to produce Figure M-9. Deposition rates at or above the threshold of possible vegetation damage stated in NUREG-1555, the Environmental Standard Review Plan (NRC 2000-TN614) (i.e., 1000 $kg/km^2/month$) would affect mostly non-forested early successional vegetation in the CRBR footprint, most of which would be permanently cleared and developed prior to operation of the cooling towers (Figure M-9). However, in the southwest direction, a small parcel of forest would be in the above-threshold salt-deposition footprint; however, this forest parcel lies within the site development footprint (Figure M-9) and would be cleared.

The model analysis also demonstrated that, considering the relatively small size and low height of these cooling towers and the temperature and climate of the area, there would be no hours of fogging or icing (TVA 2017-TN4921) and thus no potential associated impacts on vegetation.

M.5.1.2 Collisions with Cooling Towers

Because the cooling towers would not exceed 65 ft in height (Section M.3.3), they would not present a potential collision hazard for volant (flying) wildlife.

M.5.1.3 Cooling-Tower Noise

The maximum expected noise level produced by the operation of cooling towers measured at 1,000 ft from the source would be <70 dBA (TVA 2017-TN4921). Using the methodology in Section M.4.1.4, cooling-tower noise is expected to attenuate to background levels at around 6,000 ft from the source. Unlike noise generated by construction equipment, which may oft be punctuated by bouts of relative calm, cooling-tower noise would be constant throughout the operating life of the project and, therefore, may be less likely to startle or induce a flushing or avoidance response from wildlife.

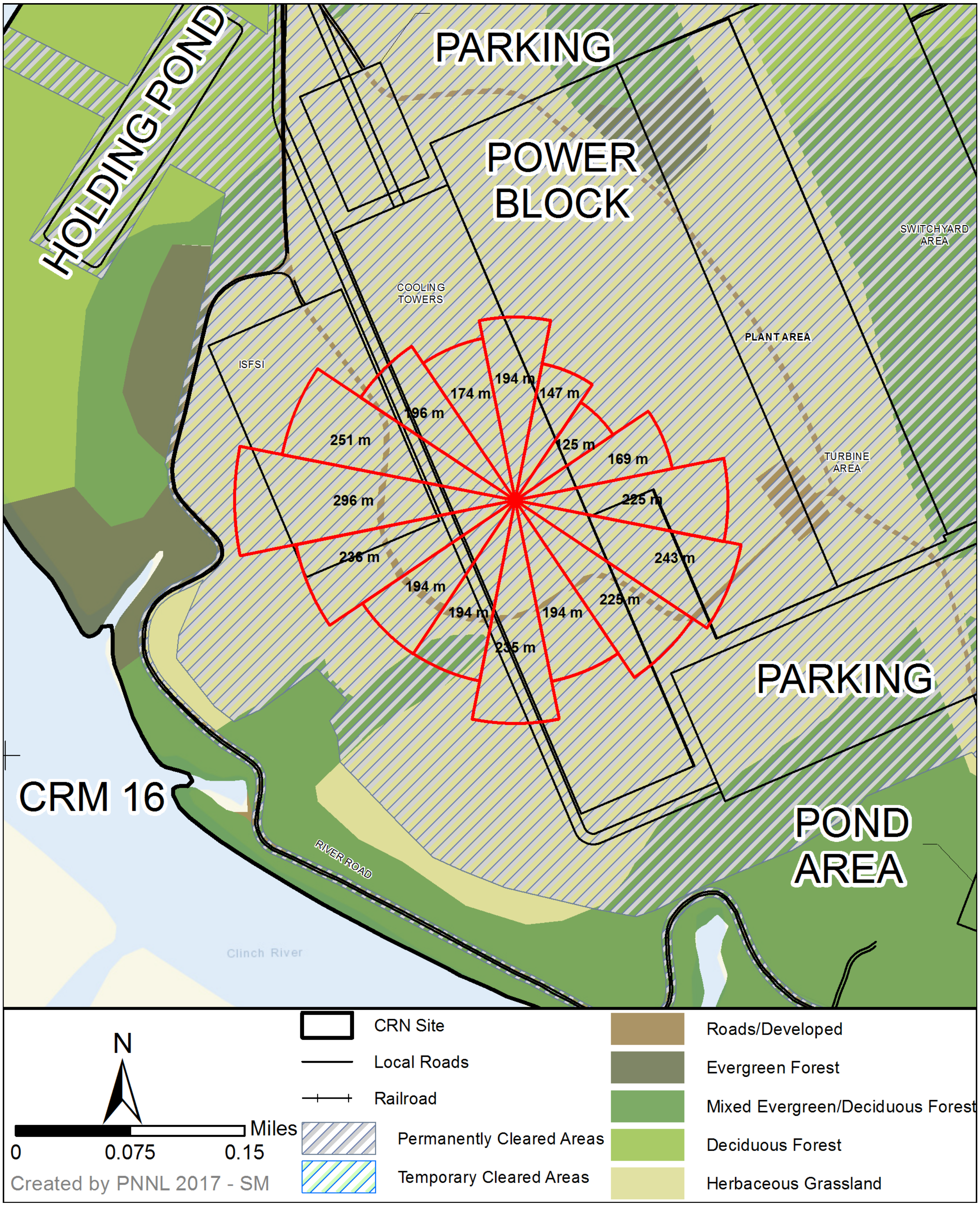


Figure M-9. Salt-Deposition Rates that Exceed 1,000 kg/km^2/mo within Depicted Distances, Overlaid on Terrestrial Vegetation and the Development Footprint on the CRN Site

M.5.1.4 Transmission Line Corridor Maintenance

No new or expanded transmission line corridors would be needed in connection with SMR power generation at the CRN Site (Section M.3.1.3), and thus, no new corridor vegetation maintenance (routine use of herbicides along with mowing and hand-clearing of vegetation) would be required. New transmission line corridor vegetation maintenance only would be required within the relocated section of the 161-kV corridor on the CRN Site (Figure M-3). This would be offset by the cessation of vegetation maintenance practices in the existing section of this corridor on the CRN Site.

M.5.1.5 Water Withdrawal and Consumption

The U.S. Environmental Protection Agency (EPA) has developed regulations that address water withdrawals and intake flow restrictions for new facilities that produce electric power (40 CFR Part 125-TN254). These regulations implement Section 316(b) of the Clean Water Act. These regulations provide limits on the total design intake flow for all cooling-water intake structures. The limits depend on the type of waterbody in which the intake structure is located. For facilities that withdraw from a freshwater river or stream, the regulations limit the total design intake flow to no more than 5 percent of the mean annual flow. For facilities that withdraw water from lakes or reservoirs, the regulations indicate that the withdrawals "… must not disrupt the natural thermal stratification or turnover pattern of the source water," although there is an exception if a Federal or State resource agency indicates that the disruption has a beneficial effect on the management of fisheries (40 CFR Part 125-TN254).

Based on an estimated expected average withdrawal rate of 40 cfs for normal plant operation, on average less than 1 percent of the mean annual discharge from Melton Hill Reservoir to the Clinch River would be withdrawn from the intake located near CRM 17.9. However, although TVA's proposed withdrawal rate using the CRN intake meets the limits for a river, the Clinch River arm of the Watts Bar Reservoir is considered a reservoir. The upstream location in the vicinity of the proposed intake exhibited no stratification during measurements conducted by TVA in February of 2011. However, the downstream location showed a decrease in water temperature with depth during the July 2011 sampling as well as dissolved oxygen levels below the State water-quality criterion, indicating that some stratification may be taking place (TVA 2013-TN5167). There is no indication that the withdrawal of water would disrupt the minimal amounts of stratification occurring downstream of the intake.

TVA estimated the proposed consumptive use of 12,808 gpm (28.5 cfs) to be about 0.6 percent of the average flow rate (TVA 2017-TN4921). This is the percentage of the water withdrawn from the river that is not returned to the river, but instead is evaporated or lost in the form of water droplets from the cooling towers.

TVA has stated that the intake would be designed such that the maximum intake velocity through the inlet, the trash racks, and the water screens would be less than 0.5 ft/s (TVA 2017-TN4921), as required in the EPA regulations that address water withdrawals and intake flow restrictions for new facilities that produce electric power (40 CFR Part 125-TN254). EPA indicated that this approach velocity is recommended based on a fish swimming speed study. The study suggested that the species and life stages evaluated could endure a 1.0 ft/s velocity

(66 FR 65256-TN243). The EPA regulations assume a safety factor of 2 and derive the 0.5 ft/s threshold (66 FR 65256-TN243). These regulations are specified to limit the effects of entrainment and impingement.

Compliance with EPA regulations addressing cooling-water intake structures for new facilities (Subpart I of 40 CFR Part 125 [TN254]) is generally protective of fish and shellfish populations and usually does not result in detectable effects on populations of aquatic organisms from impingement or entrainment.

M.5.1.6 Discharge Analysis

Discharge of heated water back into the Clinch River arm of the Watts Bar Reservoir may affect aquatic habitats and species in several ways. Thermal discharges increase the temperature of the water and can cause adverse effects. Chemically treated water is also a stressor of aquatic biota, as is physical alteration of habitat that may occur through scouring or other sediment transportation processes during cooling-water discharges. Although most of the excess heat in the cooling water transfers to the atmosphere in the cooling tower by evaporation and conductive cooling, some water that does not evaporate or drift from the tower ends up in the cooling-tower basin. A portion of the water in the cooling-tower basin is returned to the river at a higher temperature than when it was originally removed. Thermal discharge would be regulated as part of the NPDES permit administered by Tennessee Department of Environment and Conservation (TDEC) (TVA 2017-TN4921). The applicable temperature-related Tennessee water-quality criteria for the CRN Site discharge are applicable at a depth of 5 ft. and include the following (TNSOS 2017-TN5071): (1) a maximum change in river temperature not to exceed 3°C (5.4°F) relative to an unaffected upstream control location; (2) maximum river temperature not to exceed 30.5°C (86.9°F); and (3) maximum river temperature rate of change not to exceed ±2°C (3.6°F) per hour. These criteria would be required to be met outside the mixing zone, which would be determined by TDEC and stipulated as part of the NPDES permit along with any monitoring requirements. Tennessee's water-quality criteria specify that mixing zones be restricted in area and not prevent the free passage of fish or cause aquatic life mortality, among other requirements (TNSOS 2017-TN5071).

TVA evaluated the extent of the thermal discharge in the mixing zone by assuming the maximum values for withdrawal, discharge, and discharge temperature occurring during extreme summer and winter conditions when the plant was operating at full power. TVA's model suggested that the largest mixing zone occurs during the winter and results in local excursions of high-temperature water beyond a 150-ft-diameter mixing zone. The mixing zone covers about 45 percent of the river width at the discharge at a depth of 5 ft. This mixing zone was the result of a flow reversal that can occur in the reservoir as a result of the timing of water release from Melton Hill Dam. The flow reversal reduces the extent of downstream dispersion of the thermal plume and causes it to occupy a wider area of the reservoir as it moves upstream from the discharge (TVA 2017-TN4921). However, the models show that there is still room for fish to avoid the thermal plume and pass without any obstruction (TVA 2017-TN4921).

Discharge from the cooling towers would contain anti-scaling compounds, corrosion inhibitors, and biocides to eliminate growth of bacteria and algae. The discharge could also contain concentrated minerals, salts, and organic compounds that enter the makeup water system.

TDEC would approve the use and quantities of chemicals for treatment of intake water based on the specifications TVA includes in their future Biocide/Corrosion Treatment Plan. This approval would be requested as part of the NPDES permit application for the facility. The review team expects that, as part of standard practices, the treatment plan would likely include biocides for zebra mussels. TVA would provide the quantities of these chemicals at the COL application stage (TVA 2017-TN4921).

Physical impacts on water quality could occur from increased water velocity or dredging activity that could result in sediment erosion, suspension, and transport. However, the diffuser ports direct effluent upward into the water column such that no physical alteration or scouring occurs that could affect benthic habitat or species (TVA 2017-TN4921, TVA 2016-TN5008). TVA also stated that no dredging to maintain the intake or discharge structures is anticipated during operation, because sediment accumulation is not anticipated (TVA 2017-TN4921).

M.5.2 Offsite Transmission Line Upgrades

M.5.2.1 Terrestrial Resources

As noted in Section M.4.2, work as part of the upgrades would be confined to existing right-of-ways. TVA would manage these right-of-ways in the same manner as at present after the upgrades are completed. Thus, there are no operations impacts on terrestrial resources within the offsite transmission line corridors.

M.5.2.2 Aquatic Resources

The only potential offsite aquatic impacts during operations would be from maintaining the upgraded overhead transmission lines. TVA recognizes SMZs along the border of surface waters including intermittent and perennial streams and other perennial waterbodies such as ponds. TVA guidance for Environmental Protection and BMPs (TVA 2012-TN4911) limits the broadcast application of fertilizers and herbicides in SMZs, including the spraying of herbicides other than those labeled for aquatic use. TVA guidance indicates that these chemicals should not be applied either directly to perennial streams and waterbodies or intermittent ones and that drift should also not be allowed. In addition, application should not be on land surfaces that are adjacent to or where direct washoff into a stream or waterbody could occur. This applies to the surface of drainage canals or streams where direct washoff into a waterbody or stream could occur. Specific herbicides are labeled for use within SMZs but they are only used selectively (TVA 2017-TN4921).

M.6 Species and Critical Habitat Identification

This section describes individual species and critical habitats considered in this BA. Species and critical habitats are treated separately for two different parts of the project area: (1) the CRN Site and vicinity, including the BTA and proposed underground 69-kV transmission line route, and (2) the offsite transmission lines identified for possible upgrading.

M.6.1 CRN Site and Vicinity

The FWS letter of July 2017 requests that three terrestrial species and four aquatic species be considered for the CRN Site and vicinity (FWS 2017-TN5091). In the October conference call with NRC, FWS requested inclusion of two additional bat species. Although these two bat species and the hellbender (*Cryptobranchus alleganiensis*) are not presently listed or otherwise regulated under the ESA, FWS anticipates that they may be listed in the near future (see Sections M.6.1.4, M.6.1.5, and M.6.1.8). Considering the long-term nature of activities envisioned at the CRN Site, BTA, and affected transmission line areas, the NRC and USACE review team agrees that inclusion of these species in the BA could facilitate long-term environmental planning. Each species addressed in the BA for the CRN Site and vicinity are listed in Table M-6.

Table M-6. Species and Critical Habitats Considered in this BA for the CRN Site and Vicinity (including the BTA and buried 68-kV transmission line) in Roane County, Tennessee

Scientific Name[a,b]	Common Name	Federal Status
Terrestrial Species		
Myotis grisescens[a]	Gray Bat	Endangered
Myotis lucifugus[b]	Little Brown Bat	Petitioned for Listing
Myotis sodalis[a]	Indiana bat	Endangered
Myotis septentrionalis[a]	Northern Long-Eared Bat	Threatened
Perimyotis subflavus [b]	Tri-Colored Bat	Petitioned for Listing
Aquatic Species		
Cryptobranchus alleganiensis[a]	Hellbender	Petitioned for Listing
Erimonax monachus[a]	Spotfin chub	Threatened
Lampsilllis abrupta[a]	Pink Mucket	Endangered
Plethobasus cyphus[a]	Sheepnose Mussel	Endangered

(a) Species listed in the FWS July 2017 letter (FWS 2017-TN5091).
(b) Species recommended by FWS in its October 2017 conference call with NRC (PNNL 2017-TN5384).

M.6.1.1 Gray Bat

M.6.1.1.1 Status and Threats

Range-wide, gray bats (*Myotis grisescens*) have been documented in a few hundred caves (FWS 2009-TN5330). Gray bats are endangered largely because 95 percent hibernate in only eight caves making the species extremely vulnerable to disturbance (FWS 1997-TN5194; TNBWG 2017-TN5329). Multiple factors contributed to the initial decline of gray bats, including human disturbance at hibernacula, natural flooding, impoundment of waterways, and contamination from pesticides. Although human disturbance at hibernacula remains the number one reason for the continued decline of some populations of gray bat, natural and manmade flooding remains a secondary threat (FWS 2009-TN5330). Overall, this species is recovering since FWS publication of its recovery plan in 1982 (increased about 104 percent between 1982 and 2007), and numbers have increased significantly in many areas (FWS 2009-TN5330). White nose syndrome (WNS) is an undocumented but possible threat to gray bats (FWS 2009-TN5330).

M.6.1.1.2 Life History

Gray bats occupy a limited geographic range in limestone karst areas of the southeastern United States. They are mainly found in the cave regions of Alabama, northern Arkansas, Kentucky, Missouri, and Tennessee (FWS 1997-TN5194).

Prior to major declines of the species, individual hibernating populations contained from 100,000 to 1.5 million bats. Ninety-five percent of the species hibernated in nine caves, with over more than 50 percent in a single cave. Summer colonies in Tennessee and Alabama contained 5,000 to 250,000 each, with most numbering between 10,000 and 50,000 (FWS 1982-TN929). Overall, gray bat populations have increased and recovered in many areas throughout the species' range. As of 2007, the species was known to occur in 384 caves scattered across 11 states (FWS 2009-TN5330).

With rare exceptions, gray bats live in caves year-round (FWS 1982-TN929, FWS 1997-TN5194; TNBWG 2017-TN5329). The species shows strong philopatry to both summering and wintering sites. Because of their highly specific roost and habitat requirements, only about 5 percent of available caves are suitable for occupancy by gray bats (FWS 2009-TN5330).

During the winter, the species hibernates in deep, vertical caves (FWS 1982-TN929, FWS 1997-TN5194), which act as cold air traps (FWS 1982-TN929). Gray bats regularly migrate from 17 to 437 km (11 to 272 mi) between summer maternity sites and winter hibernacula, and some individuals move as much as 689 to 775 km (428 to 482 mi) (FWS 2009-TN5330). A wide variety of caves are used during the spring and fall transient period (FWS 1982-TN929). In summer, female gray bats form maternity colonies of a few hundred to many thousands of individuals (FWS 2009-TN5330) and roost in caves, which act as warm air traps and are scattered along rivers (FWS 1982-TN929, FWS 1997-TN5194). These caves are in limestone karst areas. They do not use human dwellings (FWS 1997-TN5194). Summer caves, especially maternity caves, are almost always located within 1 km (rarely more than 4 km) of a river or reservoir. A maternity colony may disperse from about 20 km to over several hundred kilometers of shoreline to feed. All bats fly in the protection of forest canopy between caves and foraging areas. Forested areas surrounding caves and between caves and over-water feeding habitat are advantageous for gray bat survival. Gray bat feeding areas have not been found over rivers or reservoirs where adjacent areas of forest have been cleared (FWS 1982-TN929).

Upon arriving at hibernating caves in September and October, adult bats mate and females immediately begin hibernation, followed several weeks thereafter by juveniles of both sexes and adult males, with most in hibernation by early November. Adult females emerge from hibernation in late March or early April, followed by adult males and by juveniles of both sexes from mid-April to mid-May. Mortality is high in late March and April when fat reserves and food supply are low (FWS 1982-TN929).

Maternity colonies each occupy a traditional home range containing several roosting caves along about a 70 km stretch of river or reservoir shoreline (FWS 1982-TN929). Adult females store sperm over winter, become pregnant upon spring emergence, and give birth to a single young in late May or early June (FWS 1982-TN929, FWS 1997-TN5194, FWS 2009-TN5330).

Reproductive females congregate in a single, traditional maternity cave, while males and nonreproductive females roost in peripheral caves. Maternity colonies consist of a few hundred to many thousands of individuals (FWS 2009-TN5330). Most young begin to fly within 20 to 25 days after birth (FWS 1982-TN929).

Although the species may travel up to 35 km between prime feeding areas over lakes or rivers and occupied caves, most maternity colonies are usually located 1 to 4 km from foraging locations (FWS 2009-TN5330). Gray bats are highly dependent on aquatic insects, especially mayflies, caddisflies, and stoneflies, and forage within roughly three meters of the water's surface. The species is an opportunistic forager, however, and also consumes beetles and moths (FWS 2009-TN5330). Foraging territories may be occupied by 15 or more bats and are controlled by reproductive females. Foraging territories are used by the same individual bats from one year to the next. Foraging may focus on a particular insect that may be important to the species survival (FWS 1982-TN929).

M.6.1.1.3 Critical Habitat

Critical habitat has not been designated for the gray bat.

M.6.1.1.4 Site and Vicinity Baseline

One individual gray bat was captured in mist nets in summer on the CRN Site in 2011, and there was a total of 361 to 381 acoustic recordings in spring, summer, and fall on the CRN Site and in the BTA in 2013 and 2015 (Hamrick 2015-TN5187; LeGrand et al. 2015-TN5188). The sex, age, and reproductive condition of the captured individual were not documented (LeGrand et al. 2015-TN5188). No caves are known to be located on the CRN Site or in the BTA; however, Rennies Cave and 2-Batteries Cave are located within the Grassy Creek Habitat Protection Area, and there are three additional caves/karst openings near Grassy Creek (LeGrand et al. 2015-TN5188). Thus, the species likely uses the CRN Site and BTA for foraging but does not roost there. Acoustic recordings during summer indicated the CRN Site and BTA may be part of a foraging territory for bats in a maternity or non-maternity summer roost located somewhere offsite, likely within 1 to 4 km of the Clinch River. Acoustic recordings during spring and fall may indicate the presence of a hibernaculum in the vicinity. The five caves noted above have not been surveyed.

The gray bat was captured in mist nets on the ORR in 1996, 2006, 2011, and 2013, and detected acoustically in areas across the ORR in 2013, 2014, and 2015 (McCracken et al. 2015-TN5287). The species was also detected acoustically in areas across the ORR from April 15 to October 31 in 2013, 2014, and 2015 (TDEC 2014-TN5288; Middleton 2014-TN5347, Middleton 2015-TN5348, Middleton 2016-TN5349), including those closely surrounding the CRN Site (e.g., Grassy Creek in the northwest portion of the Grassy Creek Habitat Protection Area, the junction of Bear Creek Valley Road and Highway 95 located just northeast of the CRN Site, and along the Clinch River between the CRN Site and Jones Island) and in the BTA in 2013 (e.g., Gallaher Cemetery just north of the BTA) (TDEC 2014-TN5288).

From examination of ORNL's and TDEC's 3-year acoustic detection data (McCracken et al. 2015-TN5287; TDEC 2014-TN5288, TDEC 2016-TN5350; Middleton 2014-TN5347, Middleton 2015-TN5348, Middleton 2016-TN5349), no direct comparisons can be made of numbers of gray bat acoustic recordings between sites and or years. However, total acoustic detection data for the gray bat on the ORR over the 3 years reported by ORNL and TDEC appear to provide somewhat of an indication of the relative prevalence of the species compared to the other four bat species considered in this BA (Table M-7). Across the ORR, the gray bat appears to be generally more prevalent than the other two Federally listed species considered in this BA (i.e., Indiana bat and northern long-eared bat).

Table M-7. Number of Acoustic Recordings by Species and Year

Organization/Year Observed	Bat Species[(a)]				
	MYGR	**MYLU**	**MYSE**	**MYSO**	**PESU**
McCracken et al. (2015-TN5287) /2013	7,908	1,427	326	262	23,784
McCracken et al. (2015-TN5287) /2014	4,236	447	426	91	2,958
McCracken et al. (2015-TN5287) /2015	108	139	193	16	60
Total	12,252	2,013	945	369	26,802
Middleton (2014-TN5347)/2013	480	356	47	181	3,423
Middleton (2015-TN5348)/2014	255	424	460	12	1,241
Middleton (2016-TN5349)/2015	1,010	498	49	74	1,230
Total	1,745	1,278	556	267	5,894

(a) Bat species abbreviations: MYGR = *Myotis grisescens* (gray bat), MYLU = *Myotis lucifugus* (little brown bat), MYSE = *Myotis septentrionalis* (northern long-eared bat), MYSO = *Myotis sodalis* (Indiana bat), PESU = *Perimyotis subflavus* (tri-colored bat).

M.6.1.2 Indiana Bat

M.6.1.2.1 Status and Threats

The Indiana bat (*Myotis sodalis*) was originally listed as in danger of extinction under the Endangered Species Preservation Act of 1966 (80 Stat. 926-TN5344) on March 11, 1967 (32 FR 4001-TN2750). It was subsequently listed as endangered under the Act, as amended. Thirteen winter hibernacula in six states were designated as critical habitat for the Indiana bat on September 24, 1976, one of which is in Tennessee—White Oak Blowhole Cave in Blount County (41 FR 41914-TN275).

The historic range of the Indiana bat includes much of the eastern United States in which the species has greatly declined (NatureServe 2017-TN5216). Significant threats to the Indiana bat include human-induced disturbance and alterations at hibernation sites; loss, fragmentation, and isolation of summer and fall swarming/spring staging habitat; contaminants (may affect bat health and decrease prey base); wind power development (collisions with equipment and barotrauma); and WNS (FWS 2007-TN934, FWS 2006-TN4167).

M.6.1.2.2 Life History

Bats enter hibernation by late November when prey are typically no longer available and survive on stored fat until spring (NatureServe 2017-TN5216; FWS 2017-TN5346). Indiana bats roost in caves or mines with configurations that provide suitable temperatures and humid microclimates. Roosts are usually located near cave entrances. Hibernacula often contain large assemblages of several species of bats, including little brown bats (*Myotis lucifugus*), northern long-eared bats (*Myotis septentrionalis*), tri-colored bats (*Perimyotis subflavus*), gray bats, big brown bats (*Eptesicus fuscus*) and silver-haired bats (*Lasionycteris noctivagans*) (FWS 2017-TN5346).

Female Indiana bats emerge first from hibernation by late March or early April, followed by males. Most individuals have completely left their hibernacula by late April. Spring staging for Indiana bats occurs in late March or early April, following hibernation, when most individuals emerge and forage for a few days or weeks near their hibernaculum before migrating to their traditional summer roosting areas. During spring staging, bats exit the hibernacula to feed, but re-enter the same or alternative hibernacula to resume torpor (FWS 2017-TN5346).

Spring migration to summer roosting areas is stressful due to low fat reserves and food supplies. As a result, adult mortality may be highest during late March and April (FWS 2017-TN5346). Fertilization occurs in spring, a single pup is born in June or July, and volancy (i.e., weaning) occurs between mid-July and mid-August (NatureServe 2017-TN5216; FWS 2017-TN5346). Mortality between birth and volancy has been determined to be about 8 percent (FWS 2017-TN5346).

In summer and fall, Indiana bats primarily use wooded or semi-wooded habitats, usually near water, and hunt flying aquatic and terrestrial insects along riparian areas, ponds, and wetlands, but also in upland forests and fields (NatureServe 2017-TN5216). They typically forage in and around tree canopies and within floodplain, riparian, and upland forest openings. Ideal foraging habitat would have 50 to 70 percent canopy closure (FWS 2017-TN5346). The Indiana bat also may persist in highly altered and fragmented forest landscapes. Instances have been documented of bats using forests altered by grazing, swine feedlots, row-crops, hay fields, residential developments, clearcut timber harvests and shelterwood cuts. Roosts have been found near lightly traveled, low-maintenance roads, as well as higher disturbances areas, such as the Indianapolis Airport, Indiana, in the vicinity of Interstate 70 (FWS 2017-TN5346).

Indiana bat maternity colonies most commonly consist of 60 to 100 adult females and typically occupy multiple roosts in riparian bottomland and upland forests. Roost trees have exfoliating bark (which allows the bat to roost between the bark and bole of the tree), a southeast or south-southwest solar exposure, and an open canopy. Roost trees are often located on forest edges or openings with open canopy and open understory. A variety of trees are used for roosts, including both conifers and hardwoods. Roost tree use is primarily related to the local availability of trees with suitable structure rather than a preference for a particular species. Roosts are transient and frequently associated with dead or dying trees. Roost longevity is variable due to many factors such as the bark sloughing off or the tree falling down. Indiana bat maternity sites generally consist of one or more primary maternity roost trees, which are used repeatedly by large numbers of bats, and varying numbers of alternate roosts, which may be used less frequently and by smaller numbers of bats. Primary maternity roosts are often located in openings or at the edge of forests, while alternate roosts can be in either openings or the interior of forests. It is not known how many alternate roosts must be available to assure retention of a colony within a particular area, but large, nearby, forest tracts improve the potential for an area to provide adequate roosting habitat. Trees in excess of 15.7 in. in diameter at breast height (DBH) are considered optimal for maternity colonies. Trees in excess of 8.6 in. DBH are used as alternate roosts by Indiana bats. However, females have also been documented using roost trees as small as 5.5 in. DBH. Distances between roosts can vary from a few yards up to a few miles. Day and night roosts may be different (FWS 2007-TN934, FWS 2017-TN5346). Indiana bats exhibit strong site fidelity to their traditional summer maternity colony areas and foraging habitat and annually return to the same sites in the summer (FWS 2017-TN5346).

Many male Indiana bats appear to remain at or near the hibernacula in summer and some fan out in a broad band around the hibernacula. Males roost singly or in small groups in two to five roost trees, similar to those used by females. Because males typically roost individually or in small groups, the average size of their roost trees tends to be smaller than the roost trees used by female maternity colonies; males have been observed roosting in trees as small as 2.5 in. DBH. Males have shown summer site fidelity and have been recaptured in the same foraging areas as they had used in prior years (FWS 2017-TN5346).

Bats accumulate fat reserves in late summer for fall migration. Most Indiana bats arrive at their traditional hibernacula in August or September and begin to swarm. Swarming assists with mating and foraging (NatureServe 2017-TN5216) until sufficient fat reserves have been deposited to sustain the bats throughout the winter (FWS 2017-TN5346). During swarming, most bats will continue to roost individually in trees during day light hours and forage within 2 to 3 mi of the hibernacula; however, some have been found up to 5 mi or further from hibernacula (FWS 2017-TN5346).

M.6.1.2.3 Critical Habitat

Critical habitat has been designated for the Indiana bat (42 FR 47840-TN5355; FWS 2017-TN5357). The only critical habitat in Tennessee is White Oak Blowhole Cave in Blount County (FWS 2007-TN934, FWS 2009-TN5356), which does not occur in the vicinity of the CRN Site.

M.6.1.2.4 Site and Vicinity Baseline

Indiana bats were surveyed with mist nets and acoustically July 11–21, 2011 at eight locations across the CRN Site (LeGrand et al. 2015-TN5188). The species was surveyed acoustically in fall (October), spring (April), and summer (July) 2013 at six locations across the CRN Site (LeGrand et al. 2015-TN5188). The species was surveyed acoustically at four locations across the BTA in fall (November) 2014 and spring (April) and summer (June) 2015 (Hamrick 2015-TN5187; LeGrand et al. 2015-TN5188). The species was not detected with mist nets or acoustically in 2011 but was detected acoustically in 2013 both on the CRN Site and in the BTA (17 recordings on the CRN Site and four recordings in the BTA [note that multiple recordings may be from one individual]). Recordings from the BTA identified as belonging to the Indiana bat could not be considered definitive (Hamrick 2015-TN5187; LeGrand et al. 2015-TN5188). Because there were no mist-net captures and few acoustic recordings over three seasons, use of the CRN Site and BTA by the species for maternal roosting is unlikely. The closest known Indiana bat maternity roost is in Cherokee National Forest in Blount County, at least 30 mi east of the CRN Site (TWRA 2017-TN5362). The CRN Site and BTA are most likely used for roosting and foraging by males and nonreproductive females, which roost singly or in small groups.

A roost tree study was conducted by TVA in areas of forest cover on the CRN Site in January, April, and May 2011, and the site was found to provide suitable roosting habitat (LeGrand et al. 2015-TN5188). The roost tree study did not include the BTA. Based on general observations of tree size and bark conditions made during the surveys of plant communities on the BTA in May 2015 (Cox et al. 2015-TN5193), TVA has stated that the deciduous forest in the BTA also should be considered suitable Indiana bat roosting habitat.

The Indiana bat was detected acoustically in areas across the ORR in 2013, 2014, and 2015 (McCracken et al. 2015-TN5287). The species also was detected acoustically in areas across the ORR from April 15–October 31 in 2013, 2014, and 2015 (TDEC 2014-TN5288; Middleton 2014-TN5347, Middleton 2015-TN5348, Middleton 2016-TN5349), including those closely surrounding the CRN Site (e.g., Grassy Creek in the northwest portion of the Grassy Creek Habitat Protection Area and the junction of Bear Creek Valley Road and Highway 95 located just northeast of the CRN Site) and in the BTA in 2013 (e.g., Gallaher Cemetery just north of the BTA) (TDEC 2014-TN5288). Across the ORR, the Indiana bat appears to be the least prevalent of the Federally listed species considered in this BA (Table M-8). A male Indiana bat was captured on the ORR during a mist-net survey (at Freels Bend) in June 2013 (TDEC 2014-TN5288; McCracken et al. 2015-TN5287), confirming the species is present on the ORR during the non-hibernating season. This was the first confirmation of an Indiana bat on the ORR since 1950 (TDEC 2014-TN5288).

No known caves are located on the CRN Site or in the BTA, but Rennies Cave and 2-Batteries Cave are located within Grassy Creek Habitat Protection Area, and there are three additional caves/karst openings near Grassy Creek (LeGrand et al. 2015-TN5188). Because the species was detected only in spring and summer but not fall (when swarming in the vicinity of a hibernaculum would occur), either on the CRN Site or in the BTA, a hibernaculum probably is not located in the immediate vicinity at this time. The closest known Indiana bat hibernacula are Grassy Cove Saltpeter (Cumberland County) and White Oak Blowhole (Blount County, Great Smoky Mountains National Park), both more than 30 mi from the CRN Site (TWRA 2017-TN5362).

M.6.1.3 Northern Long-Eared Bat

M.6.1.3.1 Status and Threats

The northern long-eared bat (NLEB; *Myotis septentrionalis*) was listed as a threatened species on May 4, 2015 (80 FR 17974-TN4216), in response to the effects of WNS (78 FR 61046-TN3207), which continues to spread across the remainder of the species' range. The NLEB ranges over the eastern and north-central United States (76 FR 38095-TN1798) and has experienced a 99 percent population reduction across the northeastern portion of its range due to WNS. A final rule under the authority of Section 4(d) of the ESA, providing measures that are necessary and advisable for conservation of the NLEB, also became effective on May 4, 2015 (80 FR 17974-TN4216).

M.6.1.3.2 Life History

NLEBs hibernate in caves or inactive mines (76 FR 38095-TN1798), but they may also overwinter in similar manmade structures (e.g., railroad tunnels, sewers, aqueducts, wells). NLEBs enter hibernation in October and November, and leave the hibernacula in March or April (76 FR 38095-TN1798). Other species that commonly occupy the same hibernacula include little brown bat, big brown bat, eastern small-footed bat, tri-colored bat, and Indiana bat (FWS 2017-TN5346). Breeding occurs when males swarm hibernacula from late summer to early fall (78 FR 61046-TN3207) and may also occur around hibernacula during spring staging (76 FR 38095-TN1798). Fertilization of a single egg occurs in the spring after hibernation (78 FR 61046-TN3207). NLEBs may migrate 35 to 55 mi between hibernacula and summer roosts (FWS 2017-TN5346). Birth of a single pup occurs in May to early June and volancy occurs in 21 days (78 FR 61046-TN3207).

Summer roosting habitat generally consists of late-successional forests with intact interior forest habitat, which typically provide a relatively large number of partially dead or decaying trees that the species uses for breeding, summer day roosting, and gleaning insects (76 FR 38095-TN1798). The species prefers forested hillsides and ridges for foraging, including hawking insects over small ponds and forest clearings under the forest canopy or along streams, and occasionally in forest clearings, over water, and along roads (76 FR 38095-TN1798; 78 FR 61046-TN3207). Summer habitat may also include some adjacent and interspersed non-forested habitats (e.g., old fields) as well as linear features (e.g., riparian forest) (78 FR 61046-TN3207).

During the summer, the species roosts underneath tree bark or in cavities or crevices of both live and dead trees (Johnson et al. 2011-TN1852; 78 FR 61046-TN3207). Females may form small maternity colonies (30 to 60 individuals) behind exfoliating bark (76 FR 38095-TN1798; FWS 2017-TN5346). Males typically roost singly and nonreproductive females roost singly or in small groups (76 FR 38095-TN1798) behind exfoliating bark, and both may also roost in caves and mines (78 FR 61046-TN3207). NLEBs likely are not dependent on certain tree species for roosts, but use trees that form suitable cavities or bark structure opportunistically. NLEBs may switch roosts often, typically every 2 to 3 days (FWS 2017-TN5346).

Suitable summer forest habitat consists of a wide variety of wooded habitats where the species roosts, forages, and travels, and may include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields and pastures (80 FR 17974-TN4216). This includes forests and woodlots containing suitable roost trees (i.e., live trees and/or snags ≥3 in. DBH that have exfoliating bark, cracks, crevices, and/or cavities), as well as linear features such as fencerows, riparian forests, and other wooded corridors with dense or loose aggregates of trees with variable amounts of canopy closure. NLEBs typically occupy summer habitat from mid-May through mid-August (80 FR 17974-TN4216). Spring staging/fall swarming habitat is similar and occurs most typically within 5 mi of a hibernaculum (FWS 2014-TN4162). NLEBs typically occupy their spring staging/fall swarming habitat from between hibernation and migration to summer habitat and after migration from summer habitat to hibernacula but before hibernation (80 FR 17974-TN4216).

M.6.1.3.3 Critical Habitat

Critical habitat has not been designated for the NLEB.

M.6.1.3.4 Site and Vicinity Baseline

One individual was captured in mist nets in the summer of 2011 on the CRN Site, and there was a total of 25 to 32 acoustic recordings in spring, summer, and fall on the CRN Site and in the BTA in 2013 and 2015 (Hamrick 2015-TN5187; LeGrand et al. 2015-TN5188). The sex, age, and reproductive condition of the captured individual were not documented (LeGrand et al. 2015-TN5188). Because there was only one mist-net capture and few acoustic recordings over three seasons, use of the CRN Site and BTA by the species for maternal roosting is unlikely. The closest known NLEB maternity roost is in the Catoosa Wildlife Management Area in Morgan County, at least 20 mi west of the CRN Site (TWRA 2017-TN5362). The CRN Site and BTA are most likely used for roosting and foraging by males and nonreproductive females, which roost singly or in small groups.

The NLEB was captured in mist nets on the ORR in 1997, 2006, 2011, and 2013 (McCracken et al. 2015-TN5287). The species was also detected acoustically in areas across the ORR from April 15 to October 31 in 2013, 2014, and 2015 (TDEC 2014-TN5288; Middleton 2014-TN5347, Middleton 2015-TN5348, Middleton 2016-TN5349), including those closely surrounding the CRN Site in 2013 (e.g., Grassy Creek in the northwest portion of the Grassy Creek Habitat Protection Area and the junction of Bear Creek Valley Road and Highway 95 located just northeast of the CRN Site) (TDEC 2014-TN5288). None was detected in close proximity to the BTA in 2013 (TDEC 2014-TN5288). Across the ORR, the NLEB bat appears to be less prevalent than the gray bat but more prevalent than the Indiana bat (Table M-7).

Thus, suitable habitat for the Indiana bat on the CRN Site and in the BTA (discussed above) is also suitable for the NLEB for summer and fall roosting and foraging. Acoustic recordings during the fall may indicate the presence of a hibernaculum in the vicinity, but this is based on only four fall recordings. A hibernaculum about 8 to 9 mi away was discovered by TVA in January 2014 (LeGrand et al. 2015-TN5188), likely located in Marble Bluff Cave in Roane County (TWRA 2017-TN5362). Suitable habitat on the CRN Site and in the BTA likely also contains NLEB potential roost trees from 3 to 5 in. DBH that are unsuitable for the Indiana bat. There may also be early successional forest parcels on the CRN Site and in the BTA that were not considered in the Indiana bat roost tree study (discussed above) and would not provide suitable habitat for the Indiana bat because of a prevalence of smaller-diameter trees, but may provide suitable roosting habitat for the NLEB.

M.6.1.4 Tri-Colored Bat

M.6.1.4.1 Status and Threats

The tri-colored bat (*Perimyotus subflavus*) ranges across most of eastern North America. The species was petitioned for listing under the ESA in June 2016 (CBD and DoW 2016-TN5360), and in December 2017, FWS found the petitioned action may be warranted (82 FR 60362-TN5416). Threats to the species cited in support of the petition to list include WNS, habitat loss and degradation driven by agricultural and residential development, logging, mining and other resource extractive practices, industrial wind energy, environmental contaminants, and disturbance by vandalism and recreation. WNS has resulted in a dramatic drop in tri-colored bat populations throughout much of its range (greater than 98 percent in the northeastern United States). Prior to WNS, the tri-colored bat was in a state of gradual decline in the eastern United States (by 34 percent in New York, Pennsylvania, West Virginia, and Tennessee). Local declines of tri-colored bat populations began 3 to 7 years prior to the detection of WNS in those populations. The causes for the tri-colored bat's pre-WNS decline are presumably ongoing in the post-WNS environment and likely include loss and disturbance of critical roost and foraging sites; toxicity from agricultural pesticides and other chemical compounds; altered roost microclimates, foraging habitats, and prey communities from climate change; and heightened mortality from inflight collisions with vehicles, buildings, and wind turbines (CBD and DoW 2016-TN5360).

M.6.1.4.2 Life History

The tri-colored bat is an insectivorous bat that is found in a variety of terrestrial habitats, including grasslands, old fields, suburban areas, orchards, urban areas, and woodlands, especially hardwood woodlands. However, they generally avoid deep woods as well as large, open fields (CBD and DoW 2016-TN5360). The species prefers large trees and woodland edges (CBD and DoW 2016-TN5360; NatureServe 2017-TN5216), and often forages over waterways and forest edges (CBD and DoW 2016-TN5360; TNBWG 2017-TN5359).

Summer roosts are mainly in live and dead foliage in both live and dead deciduous and coniferous trees (CBD and DoW 2016-TN5360; TNBWG 2017-TN5359), and occasionally in buildings (NatureServe 2017-TN5216). Forest on the CRN Site and in the BTA likely provides suitable summer roost habitat for the species. Females exhibit a fairly high degree of roost fidelity, returning to the same small roosting area day after day within a single summer and across successive years. However, tri-colored females may switch specific roost sites frequently during the maternity period. Males exhibit a somewhat lesser degree of roost fidelity than females (CBD and DoW 2016-TN5360).

Hibernation sites usually are in caves or mines (NatureServe 2017-TN5216; TNBWG 2017-TN5359). Mating occurs in autumn during swarming around hibernation sites, sperm are stored during winter, and fertilization takes place in early spring. The species usually bears twins in late spring or early summer (CBD and DoW 2016-TN5360; TNBWG 2017-TN5359). In southern portions of their range, females arrive from hibernacula beginning in late April (CBD and DoW 2016-TN5360). Maternity colonies use manmade structures or tree cavities, often in open areas (NatureServe 2017-TN5216). Maternity colonies are small, often consisting of from several individuals to several tens of individuals (CBD and DoW 2016-TN5360). Young grow rapidly and can fly within a month (TNBWG 2017-TN5359).

M.6.1.4.3 Critical Habitat

Critical habitat has not been designated for the tri-colored bat (and cannot be designated, as this species is not yet formally listed as threatened or endangered).

M.6.1.4.4 Site and Vicinity Baseline

Three individuals were caught in mist nets on the CRN Site in 2011 and the species was recorded acoustically (the number of recordings was undocumented) on the CRN Site and in the BTA in spring, summer, and fall in 2013 and 2015 (LeGrand et al. 2015-TN5188). The sex, age, and reproductive condition of the captured individuals were not documented (LeGrand et al. 2015-TN5188). The species was the most prevalent species acoustically recorded in the BTA in 2015 (Hamrick 2015-TN5187). Recordings of the species in the fall may indicate a possible hibernaculum in the vicinity of the CRN Site or BTA. Roosting bats were observed in Rennies Cave by archaeological surveyors in April 2011. One bat was identified from a photo as a tri-colored bat (LeGrand et al. 2015-TN5188).

The species was detected acoustically in areas across the ORR in 2013, 2014, and 2015 (McCracken et al. 2015-TN5287). The species also was detected acoustically in areas across the ORR from April 15 to October 31 in 2013, 2014, and 2015 (TDEC 2014-TN5288; Middleton 2014-TN5347, Middleton 2015-TN5348, Middleton 2016-TN5349), including those closely surrounding the CRN Site in 2013 (e.g., Grassy Creek in the northwest portion of the Grassy Creek Habitat Protection Area, the junction of Bear Creek Valley Road and Highway 95 located just northeast of the CRN Site, and along the Clinch River between the CRN Site and Jones Island) (TDEC 2014-TN5288). None were detected in close proximity to the BTA in 2013 (TDEC 2014-TN5288). Across the ORR, the tri-colored bat appears to be more prevalent than the little brown bat, and more prevalent than the three Federally listed bat species considered in this BA (Table M-7).

M.6.1.5 Little Brown Bat

M.6.1.5.1 Status and Threats

The little brown bat (*Myotis lucifugus*) was petitioned for listing under the ESA in 2010 (Kunz and Reichard 2010-TN5373). The range of the little brown bat extends across North America, from Alaska to central Mexico and from the Pacific to Atlantic coasts. The little brown bat was considered one of the most common and widespread bat species in North America. Its core range is considered the northeastern United States where ideal hibernacula conditions predominate and the vast majority of ideal habitat is found. Numbers substantially decrease southward and westward in this core area. The pre-WNS population of this species—both throughout its range and within its core northeastern range—was viable and did not face imminent risk of extinction. However, extinction is virtually certain to occur in the core range of this species by 2026, and range-wide extinction may very well follow based on the known and predicted infection dynamics of WNS. This conclusion is based on a thorough population viability analysis incorporating extensive empirical data collected before and since the appearance of WNS in the species' core range, including the species' starting population, vital rates, and observed morbidity rates. Other natural and manmade factors that have an adverse impact on the species include climate change (reduced rainfall in late summer in the northeastern United States resulting in reduced insect production and drying up of water sources) and pollutants in waterbodies (Kunz and Reichard 2010-TN5373).

M.6.1.5.2 Life History

Caves and mines serve as swarming sites during the autumn mating period and as hibernacula (NatureServe 2017-TN5216). The little brown bat swarms and mates at hibernacula, and females store sperm during hibernation with fertilization occurring in spring after emergence (Kunz and Reichard 2010-TN5373).

In spring, reproductive female bats form maternity colonies in barns, attics, and tree cavities. Maternity colonies range in size from tens to hundreds of individuals. Fidelity of females to summer roosts tends to be high with adult females typically returning to their natal roosts. Nonreproductive females and adult males usually inhabit separate roosts individually or in small groups. A single pup is born during the late spring/early summer timeframe. Pups are weaned and begin to fly at about 26 days (Kunz and Reichard 2010-TN5373).

The little brown bat feeds on aerial insects over open water (Kunz and Reichard 2010-TN5373) and along the margins of lakes and streams, or in woodlands near water (NatureServe 2017-TN5216). First-year survival of female little brown bat ranges from 23 to 46 percent, and adult survival rate was 63 to 90 percent from 1993 to 2008 (Kunz and Reichard 2010-TN5373).

M.6.1.5.3 Critical Habitat

Critical habitat has not been designated for the little brown bat (and cannot be designated, as this species is not yet formally listed as threatened or endangered).

M.6.1.5.4 Site and Vicinity Baseline

The species was not captured in mist nets on the CRN Site in 2011 (LeGrand et al. 2015-TN5188). It was recorded acoustically (the number of recordings was undocumented) on the CRN Site and in the BTA in spring, summer, and fall in 2013 and 2015 (LeGrand et al. 2015-TN5188; Hamrick 2015-TN5187). Recordings of the species in the fall may indicate a possible hibernaculum in the vicinity of the CRN Site or BTA.

The species was detected acoustically in areas across the ORR in 2013, 2014, and 2015 (McCracken et al. 2015-TN5287). The species also was detected acoustically in areas across the ORR from April 15-October 31 in 2013, 2014, and 2015 (TDEC 2014-TN5288; Middleton 2014-TN5347, Middleton 2015-TN5348, Middleton 2016-TN5349), including those closely surrounding the CRN Site (e.g., Grassy Creek in the northwest portion of the Grassy Creek Habitat Protection Area, the junction of Bear Creek Valley Road and Highway 95 located just northeast of the CRN Site, and along the Clinch River between the CRN Site and Jones Island) and in the BTA in 2013 (e.g., Gallaher Cemetery just north of the BTA) (TDEC 2014-TN5288). Across the ORR, the little brown bat appears to be less prevalent than the tri-colored bat, and less prevalent than the gray bat but more prevalent than the Indiana bat and NLEB (Table M-7).

M.6.1.6 Freshwater Mussels – Pink Mucket (*Lampsilis abrupta*) and Sheepnose Mussel (*Plethobasus cyphyus*)

M.6.1.6.1 Status and Threats

Mussel populations have declined in the last several decades in species diversity and at an individual level. Population declines are caused by habitat destruction and degradation and their inability to move from poor-quality habitat. Habitat destruction includes impoundment by dams, dredging and channelization as well as erosion, siltation, and contamination of the environment. Most habitat destruction and degradation is caused by human activities, but the expansion of populations of nonindigenous mollusks such as the zebra mussel (*Dreissena polymoprha*) and the Asian clam (*Corbicula fluminea*) is negatively affecting the remaining native mussel populations (Williams et al. 1993-TN5369).

The FWS identified two species of unionid mussels from the vicinity of the CRN Site: the pink mucket (*Lampsilis abrupta*) and the sheepnose mussel (*Plethobasus cyphyus*). The FWS designated the pink mucket mussel as endangered in 1976 (41 FR 24062-TN5173). The FWS listed the sheepnose mussel as endangered in the *Federal Register* on March 13, 2012 (77 FR 14914-TN5177).

M.6.1.6.2 Life History of Unionid Mussels

Mussels spend their entire juvenile and adult lives buried either partially or completely in the substrate. Many factors may affect the preferred habitat of mussels, including substrate composition, water depth, water temperature and velocity, turbidity, and bottom roughness (Williams et al. 2008-TN5372). Although mussels are able to change their position and location, they rarely move more than a few hundred yards during their lifetime unless dislodged. Reservoirs have been documented as uninhabitable for the majority of mussel species (Williams et al. 2008-TN5372). Williams et al. (2008-TN5372) reported mussel extirpation from the area downstream of Norris Dam, caused by a decrease in water temperature and dissolved oxygen, as was well as scouring effects from dam discharge.

Native freshwater mussels have an unusual reproductive cycle. Although some species are hermaphroditic, the species discussed in this BA have separate sexes. The eggs of female mussels move from the ovaries to the gills where fertilization occurs. Sperm is released to the water by male mussels and is carried into the female's body through the incurrent aperture. The gills, or a portion of the gills, serve as brood pouches, called marsupia. The fertilized eggs develop into small larvae, called glochidia, which release into the water. At the time of their release from the marsupia, the glochidia possess only the embryonic stages of a mouth, intestines, a foot, and a heart. If the glochidia do not encounter a passing fish and attach to its gills, skin, or fins then they fall to the bottom and die a short time later. The glochidia usually remain on the fish from 1 to 6 weeks (sometimes longer) and then fall off and begin their growth into adulthood. Each mussel species has specific species of fish that serve as a host fish for the glochidia (Parmalee and Bogan 1998-TN5166). The survival of freshwater mussel species depends not only on the environmental conditions for the mussel, but on the survival and health of the host fish populations.

Pink muckets have several species of fishes that reportedly serve as hosts for their glochidia, including three species of bass: smallmouth (*Micropterus dolomieu)*, spotted (*M. punctulatus*), and largemouth bass (*M. salmoides*) as well as freshwater drum (*Aplodinotus grunniens*) and possibly sauger (*Sander canadensis*) (Mirarchi et al. 2004-TN5174). Fish community sampling by TVA in February, May, July, and October of 2011 at stations extending from CRM 14 to 16 and CRM 18 to 19.8 indicated the presence of all five host fish species (TVA 2013-TN5167).

For sheepnose mussel glochidia, the sauger (*Sander canadensis*) is the only known host (Parmalee and Bogan 1998-TN5166). However, Williams et al. (2008-TN5372) reported central stoneroller (*Campostoma anomalum*) as a host for sheepnose glochidia in a laboratory setting. Only the sauger was identified in TVA's fish community sampling from the vicinity of the CRN Site. Sheepnose mussels live nearly 30 years (77 FR 14914-TN5177).

M.6.1.6.3 Critical Habitat

Currently no critical habitat has been designated for either the pink mucket (FWS 2017-TN5370) or the sheepnose mussel (FWS 2017-TN5371).

M.6.1.6.4 Site and Vicinity Baseline

The pink mucket mussels prefer free-flowing reaches of large rivers, typically in gravel substrates with interstitial sand but silt-free. They have also been occasionally reported in large creeks and small rivers (Williams et al. 2008-TN5372). Historically, the pink mucket species was recorded from the Mississippi, Ohio, and Cumberland Rivers and in the Tennessee River up to the lower Clinch River (Parmalee and Bogan 1998-TN5166). Currently, it occurs only in the riverine reaches such as downstream of Wilson Dam in Tennessee and Guntersville Dam in Alabama (Mirarchi et al. 2004-TN5174) and in the Cumberland River in Smith County, Tennessee (Parmalee and Bogan 1998-TN5166). Researchers report specimens younger than 10 years of age as rare in the Wilson and Guntersville Dam tailwaters.

The most recent siting of a pink mucket in the Clinch River was in 1984 at CRM 19.1, slightly above the CRN Site. No pink muckets, either living or as relic shells, were found in the 2011 surveys at the CRN Site. TVA has found the pink mucket mussel more recently elsewhere in the Tennessee River system. A single individual was found as recently as a September 2010 survey (TRC 2010-TN5175) in the tailrace of Watts Bar Dam in Chickamauga Reservoir.

Sheepnose mussels prefer flowing water of medium to large rivers in a sand and gravel substrate mixture (Williams et al. 2008-TN5372; Parmalee and Bogan 1998-TN5166). Further, in unimpounded rivers sheepnose mussels can be found in less than 0.6 m (2 ft) of water and in relatively fast currents. In reservoirs, sheepnose mussels can be found at depths of 3.6 to 4.6 m (12 to 15 ft) (Parmalee and Bogan 1998-TN5166), though they have also been reported at depths exceeding 6 m (20 ft) (77 FR 14914-TN5177).

They occur across the Southeast and the Midwest, but are likely extirpated from two-thirds of streams where they had previously been known to occur. Parmalee and Bogan (1998-TN5166) indicated that the most stable and viable populations of sheepnose mussels in Tennessee were located in the upper Clinch River (Hancock County) and below Pickwick Landing Dam (Harding County) in the Tennessee River. The sheepnose mussel was last observed in 1994 at CRM 21.4 downstream of Melton Hill Dam (TWRA 2017-TN5362). More recent sightings have occurred elsewhere in the Tennessee River system. In September 2010, TVA found a specimen, judged to be approximately 20 years old, during sampling in the tailrace of Watts Bar Dam in Chickamauga Reservoir (TRM 526 to 527) (TRC 2010-TN5175). The sheepnose is known to have existed recently farther upstream in the Clinch River above CRM 168 and the last recorded sightings occurred between 2004 and 2006 (Jones et al. 2014-TN5324).

Neither the pink mucket or the sheepnose mussel were observed in benthic macroinvertebrate sampling in 2011 at either of two locations, CRM 15.0 (slightly downstream from the proposed discharge) and CRM 18.8 (approximately a mile upstream of the proposed intake). As discussed in Section M.3.1.3.2, a total of 74 living native mussels from six different species were collected in 2011 in the Clinch River arm of Watts Barr Reservoir. The mollusk survey observed that zebra mussels were found attached to 71 of the 74 living native mussels. The average area of coverage on an individual mussel was 28 percent and coverage ranged from 5 to 100 percent (TRC 2011-TN5168). It appears that zebra mussels are out-competing native mussels for space and food, interfering with the native mussel's ability to open and close their shells, impairing movement of the native mussels, and depositing metabolic wastes on the native mussels (FWS 2015-TN5218). Based on the sampling studies and the condition of the living native mussels it is unlikely that either the pink mucket or the sheepnose mussel species would be located in the Clinch River arm of the Watts Bar Reservoir.

M.6.1.7 Spotfin Chub (Erimonax monachus)

M.6.1.7.1 Status and Threats

The FWS listed the spotfin chub (*Erimonax monachus) (= Cyprinella monacha = Hybopsis monacha*) as threatened in 1977 (42 FR 45526-TN5178). Threats to the spotfin chub include habitat destruction and degradation such as from siltation, and runoff from coal mining, operations, and municipal and industrial wastes (42 FR 45526-TN5178).

M.6.1.7.2 Life History

The estimated age of maturity for spotfin chub is 2 years. Spotfin chubs are estimated to live for 3 or 4 years, and adults may spawn in consecutive years. They are crevice spawners—their eggs are deposited in rock crevices on the bottom of the stream, and they prefer the lowermost crevices (adjacent to the substrate) (Rakes et al. 1999-TN5367). There is no parental care of the eggs or guarding of the nest after spawning. Spotfin chub larvae and juveniles are benthic after hatching and do not shift to the middle of the water column until their total length is 1.8 to 2.3 cm (0.71 to 0.91 in.). Once large enough, the spotfin chub is typically a mid-water schooling minnow (Shute et al. 2005-TN5366). As adults, spotfin chub are small fish, less than 12.1 cm (4.75 in.) long.

Spotfin Chub inhabit clear upland rivers and are typically found in habitats with boulders in swift currents. Their diet is primarily aquatic insects such as midges, mayflies, and caddisfly larvae (Etnier and Starnes 1993-TN5054).

M.6.1.7.3 Critical Habitat

Critical habitat for the spotfin chub exists in Tennessee in portions of the Emory River in Morgan County and the Obed River, Clear Creek, and Daddys Creek in Morgan and Cumberland Counties. Critical habitat in Tennessee also exists in the North Fork of the Holston from the junction with the South Fork Holston River to the Tennessee- Virginia State line in Hawkins and Sullivan Counties. No critical habitat exists in Roane County near the CRN Site.

M.6.1.7.4 Site and Vicinity Baseline

The spotfin chub were historically found in Alabama, Georgia, North Carolina, Virginia, and Tennessee inhabiting streams in upper and middle Tennessee River Basin (FWS 2017-TN5219; Holliman et al. 2003-TN5364). Experimental populations are now found in three river systems including the Tennessee portions of Tellico River, Shoal Creek, French Broad River, and Holston River (FWS 2017-TN5219).

It is unlikely that spotfin chub still inhabit the Clinch River arm of the Watts Bar Reservoir because of siltation and changes in the river-bottom substrate that would prevent them from spawning. The Clinch River arm of the Watts Bar Reservoir adjacent to the CRN Site lacks the appropriate habitat features for spotfin chub. Furthermore, the spotfin chub was not identified in the sampling that occurred Clinch River or the streams on the CRN Site or in the transmission corridor within the vicinity of the CRN Site during electrofishing studies between CRM 14 and 15 and CRM 18 and 19.8 (TVA 2013-TN5167). It is unlikely that the spotfin chub is present in the vicinity of the site.

M.6.1.8 Hellbender

M.6.1.8.1 Status and Threats

The status of the hellbender (*Cryptobranchus alleganiensis*), an aquatic salamander, is currently under review by the FWS (2017-TN5365). Threats to the hellbender may include habitat alterations such as siltation, water impoundment, and degradation of water quality (Mayasich et al. 2003-TN5179).

M.6.1.8.2 Life History

The hellbender, also called the mudpuppy or waterdog grows from 30 to 74 cm (12 to 29 in.) long. Hellbenders are a unique salamander because they are completely aquatic throughout their life history. They tend to be nocturnal in nature, exhibiting positive thigmotaxis (i.e., seeking contact with other objects such as rocks) and negative phototaxis (avoiding light). Hellbenders have a well-developed dermal sense of light, particularly in their tail, which may serve as an initial light exposure receptor (Nickerson et al. 2003-TN5368). Hellbenders are also cannibalistic in nature, consuming its eggs and smaller hellbenders (Nickerson et al. 2003-TN5368).

The hellbender prefers habitats with swift running, fairly shallow, highly oxygenated waters that are cool in temperature (Humphries and Pauley 2004-TN5363) and tend to be more alkaline (Nickerson et al. 2003-TN5368). This species finds flat rocks, logs, or other cover in the vicinity of riffle areas, essential for hiding/shelter, feeding, and breeding (Mayasich et al. 2003-TN5179; Humphries and Pauley 2004-TN5363). Its habitat is generally medium to large clear, fast-flowing streams with rocky bottoms, especially riffle areas and upper pool reaches. Larvae are typically found under small rocks, juveniles under rock piles or gravel beds, and adults under larger rocks, all in riffles (Nickerson et al. 2003-TN5368). Their diet primarily consists of crayfish (Humphries and Pauley 2004-TN5363).

M.6.1.8.3 Critical Habitat

No critical habitat is designated by the FWS for the hellbender.

M.6.1.8.4 Site and Vicinity Baseline

Hellbenders are found distributed from southern New York, west to Missouri and Arkansas, and south to Alabama and Mississippi (Humphries and Pauley 2004-TN5363). The Clinch River arm of the Watts Bar Reservoir adjacent to the CRN Site lacks the appropriate habitat for the hellbender because it is now impounded and lacks the fast-flowing water over rocky bottoms and riffle areas. But potentially this species could still exist in the area upstream of the site immediately below Melton Hill Dam because the faster moving water in the tailrace provides more suitable habitat. A hellbender was most recently observed in 1989 in the Clinch River downstream of Jones Island within the tailrace below Melton Hill Dam (TNHP 2017-TN5361). This location, however, it is upstream of the CRN Site and would be unaffected by the building or operation of the CRN Site.

M.6.2 Offsite Transmission Lines

The FWS July 2017 letter (FWS 2017-TN5091) suggested what species to consider in this BA for the offsite transmission lines, based on visual comparison of Figure M-4, a county map of Tennessee, and species known to occur in those counties according to the FWS Information for Planning and Consultation (IPaC) database (FWS 2017-TN5328). In November 2017, the review team generated a more definitive list by overlaying the offsite transmission layer on layers of the counties in Tennessee, Kentucky, and Georgia in ArcGIS (version 10.4) to derive a list of the counties in each state in which the offsite transmission lines occur (Table M-3). The review team then queried IPaC (FWS 2017-TN5328) and the TDEC rare species by county database (TDEC 2017-TN5217) to identify those Federally threatened and endangered species known to occur in each county (Table M-8). As directed in the FWS July 2017 letter (FWS 2017-TN5091), the IPaC (FWS 2017-TN5328) was also queried to identify which of the species also have designated critical habitat in these counties, including counties in which the species are not known to occur (Table M-8).

Table M-9 identifies Federally listed species with known occurrences within 0.125 mi of the transmission line segments identified for upgrading in Tennessee (Table M-3), and notes whether the locations lie within the bounds of the existing corridors. Table M-9 was developed using data obtained from the Tennessee Natural Heritage Program (TNHP 2017-TN5361). This table provides a description of the known occurrences as well as the date of most recent observation. Data obtained from the Kentucky and Georgia Natural Heritage Programs (KNSPC 2017-TN5400; GDNR 2017-TN5397) did not identify Federally listed terrestrial or aquatic species with known occurrences within 0.125 mi of the transmission line segments that occur in those states (Table M-9).

Habitat preferences for the species identified in Table M-8 are provided in (Table M-10). Table M-10 also indicates the possible presence of suitable habitat for the species within the transmission line corridors in counties where the species are known to occur.

Table M-8. Federally Listed Species (not including experimental populations) in the Counties where Upgrades (Uprate, Reconductor, Rebuild) of Offsite Transmission Lines May Occur (FWS 2017-TN5091; TDEC 2017-TN5217). X = species present in county based on IPaC (FWS 2017-TN5328) and TDEC Rare Species by County Database (TDEC 2017-TN5217); Y = critical habitat present in the county; N = no critical habitat designated for the species or critical habitat designated but does not occur in the county. All cells where IPaC indicates the presence of critical habitat in the indicated county are highlighted blue; orange highlighted cells indicate critical habitat in proximity to offsite transmission lines that is depicted in figures provided later in Section M.6.2

			State																											
			GA	KY		TN																								
Scientific Name	Common Name	Status[a]	Catoosa	Bell	Whitley	Anderson	Bledsoe	Campbell	Claiborne	Cocke	Cumberland	Franklin	Grainger	Greene	Grundy	Hamblen	Hamilton	Hawkins	Jefferson	Knox	Putnam	Rhea	Roane	Scott	Sequatchie	Sevier	Van Buren	Warren	White
Mammals																														
Corynorhinus (=Plecotus) townsendii virginianus	Virginia big-eared bat	E			X N																									
Glaucomys sabrinus coloratus	Carolina northern flying squirrel	E																								X N			
Myotis grisescens	Gray bat	E	XN	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N
Myotis septentrionalis	Northern long-eared bat	T	XN	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N	X N
Myotis sodalis	Indiana bat	E	XN	X N	X N	X N	X N	X N	X N	X Y	X N	X N	X N	X N	X N	X N	X N	X N	X Y	X Y	X N	X N	X N	X N	X N	X Y	X N	X N	X N
Amphibians																														
Gyrinophilus gulolineatus	Berry cave salamander	C																		X N			X N						
Fishes																														
Chrosomus saylori	Laurel dace	E					X Y				X N						X N					X Y		X N	X Y				
Erimystax cahni	Slender chub	T				X N			Y c				Y			X N		X N											
Erimonax monachus	Spotfin chub	T				X N	X N	X N	X N		X Y		X N	X N				X Y			X N	X N	X Y	X N					
Etheostoma akatulo	Bluemask (Jewel) darter	E					X N				X N				X N						X N				X N		X N	X N	X N
Etheostoma lemniscatum	Tuxedo darter	E																						X N					

Table M-8. (contd)

Scientific Name	Common Name	Status[a]	State: GA	KY		TN																								
			Catoosa	Bell	Whitley	Anderson	Bledsoe	Campbell	Claiborne	Cocke	Cumberland	Franklin	Grainger	Greene	Grundy	Hamblen	Hamilton	Hawkins	Jefferson	Knox	Putnam	Rhea	Roane	Scott	Sequatchie	Sevier	Van Buren	Warren	White
Etheostoma percnurum	Duskytail darter	E											X N											X N					
Etheostoma spilotum	Kentucky arrow darter	T		X N																									
Etheostoma susanae	Cumberland darter	E			X N			X N																X N					
Etheostoma wapiti	Boulder darter	E										X N																	
Notropis albizonatus	Palezone shiner	E						X N																					
Noturus crypticus	Chucky madtom	E								X N				X Y		X N		X N	X N										
Noturus flavipinnis	Yellowfin madtom	T				X N			Y											X N									
Noturus stanauli	Pygmy madtom	E											X N					X N											
Percina tanasi	Snail darter	T	XN				X N			X N			X N	X N	X N	X N	X N	X N	X N	X N		X N	X N		X N	X N			
Phoxinus cumberlandensis	Blackside dace	T		X N	X N	X N		X N	X N															X N					
Mollusks																													
Alasmidonta atropurpurea	Cumberland elktoe	E		X N	X Y	X N		X Y	Y						X N									X Y	X N		X N	X N	
Alasmidonta raveneliana	Appalachian elktoe	E								X N				X N		X N			X N							X N			
Cumberlandia monodonta	Spectaclecase (mussel)	E			X N	X N		X N	X N	X N			X N	X N	X N	X N		X N	X N	X N	X N		X N		X N	X N			
Cyprogenia stegaria	Fanshell	E				X N	X N	X N	X N				X N				X N	X N	X N	X N	X N	X N	X N		X N	X N			
Dromus dromas	Dromedary pearlymussel	E				X N	X N	X N	X N		X N		X N			X N	X N	X N	X N	X N	X N	X N	X N		X N	X N			
Epioblasma brevidens	Cumberlandian combshell	E			X N			X N	X Y	Y		X N	X Y			Y		X N	X N		X N			X Y					

Table M-8. (contd)

Scientific Name	Common Name	Status[a]	State																										
			GA	KY		TN																							
			Catoosa	Bell	Whitley	Anderson	Bledsoe	Campbell	Claiborne	Cocke	Cumberland	Franklin	Grainger	Greene	Grundy	Hamblen	Hamilton	Hawkins	Jefferson	Knox	Putnam	Rhea	Roane	Scott	Sequatchie	Sevier	Van Buren	Warren	White
Epioblasma capsaeformis	Oyster mussel	E					X N	X N	X Y	X Y	X N		X Y	X N		X Y		X N	X N	X N	X N			Y	X N	X N	X N		
Epioblasma florentina walkeri (=E. walkeri)	Tan riffleshell	E			X N																			X N					
Epioblasma obliquata	Catspaw	E																			X N								
Epioblasma torulosa	Tubercled blossom (pearlymussel)	E										X N					X N		X N	X N					X N	X N			
Epioblasma triquetra	Snuffbox mussel	E		X N	X N				X N					X N							X N								
Epioblasma turgidula	Turgid blossom (pearlymussel)	E				X N					X N	X N	X N			X N		X N	X N	X N			X N	X N		X N			
Fusconaia cor	Shiny pigtoe	E				X N		X N	X N			X N	X N					X N	X N	X N			X N			X N			
Fusconaia cuneolus	Finerayed pigtoe	E				X N		X N	X N	X N	X N	X N	X N	X N	X N	X N		X N	X N	X N			X N	X N	X N	X N			
Hemistena lata	Cracking pearlymussel	E				X N		X N	X N			X N	X N					X N		X N			X N						
Lampsilis abrupta	Pink mucket (pearlymussel)	E				X N	X N	X N	X N	X N			X N	X N			X N	X N	X N	X N	X N	X N	X N		X N	X N			
Lampsilis virescens	Alabama lampmussel	E				X N		X N			X N	X N								X N			X N	X N					
Lemiox rimosa	Birdwing pearlymussel	E				X N			X N				X N					X N		X N									
Obovaria retusa	Ring pink (mussel)	E			X N	X N		X N											X N	X N			X N			X N			
Pegias fabula	Littlewing pearlymussel	E			X N		X N					X N		X N	X N			X N						X N	X N		X N	X N	X N
Plethobasus cooperianus	Orangefoot pimpleback (pearlymussel)	E				X N	X N	X N	X N								X N		X N	X N		X N	X N		X N	X N			
Plethobasus cicatricosus	White wartyback (pearlymussel)	E				X N		X N	X N				X N						X N	X N	X N		X N			X N			
Plethobasus cyphyus	Sheepnose mussel	E				X N		X N	X N				X N					X N	X N	X N	X N		X N			X N			

Table M-8. (contd)

Scientific Name	Common Name	Status[a]	GA: Catoosa	KY: Bell	KY: Whitley	TN: Anderson	TN: Bledsoe	TN: Campbell	TN: Claiborne	TN: Cocke	TN: Cumberland	TN: Franklin	TN: Grainger	TN: Greene	TN: Grundy	TN: Hamblen	TN: Hamilton	TN: Hawkins	TN: Jefferson	TN: Knox	TN: Putnam	TN: Rhea	TN: Roane	TN: Scott	TN: Sequatchie	TN: Sevier	TN: Van Buren	TN: Warren	TN: White
Pleurobema clava	Clubshell	E																			X N								
Pleuronaia gibberum	Cumberland pigtoe	E					X N				X N	X N			X N						X N				X N		X N	X N	X N
Pleurobema plenum	Rough pigtoe	E				X N	X N	X N									X N	X N	X N	X N		X N	X N		X N	X N			
Pleuronaia dolabelloides	Slabside pearlymussel	E					X Y		X Y	X Y	X N	X Y	Y	X Y	X N	Y		X N			X N				X Y		X N		
Ptychobranchus subtentum	Fluted kidneyshell	E			X N			X N	X Y	X Y		X Y	X Y	X Y		X Y		X N	X Y	Y	X N			Y		Y			
Quadrula cylindrica	Rabbitsfoot	T			X N																X N					X N			
Quadrula cylindrica strigillata	Rough rabbitsfoot	E				X N		X N	X Y				X Y	X N		X N		X N		X N			X N						
Quadrula intermedia	Cumberland monkeyface	E							X N			X N					X N	X N		X N									
Quadrula sparsa	Appalachian monkeyface	E							X N				X N																
Toxolasma cylindrellus	Pale lilliput (pearlymussel)	E										X N			X N														
Villosa fabalis	Rayed bean	E								X N		X N		X N															
Villosa perpurpurea	Purple bean	E							Y		X Y		Y					X Y					X N	X N					
Villosa trabalis	Cumberland bean (pearlymussel)	E			X N	X N	X N	X N		X N	X N		X N	X N		X N	X N	X N	X N	X N	X N		X N	X N	X N	X N	X N	X N	X N
Arachnids																													
Microhexura montivaga	Spruce-fir moss spider	E																								X Y			
Insects																													
Bombus affinis	Rusty-patched bumble bee	E												X N						X N						X N			
Snails																													

Table M-8. (contd)

Scientific Name	Common Name	Status[a]	State																										
			GA	KY		TN																							
			Catoosa	Bell	Whitley	Anderson	Bledsoe	Campbell	Claiborne	Cocke	Cumberland	Franklin	Grainger	Greene	Grundy	Hamblen	Hamilton	Hawkins	Jefferson	Knox	Putnam	Rhea	Roane	Scott	Sequatchie	Sevier	Van Buren	Warren	White
Anguispira picta	Painted tigersnail	T										X N																	
Athearnia anthonyi	Anthony's riversnail	E				X N		X N							X N					X N			X N		X N				
Plants																													
Apios priceana	Price's potato-bean	T										X N																	
Arenaria cumberlandensis	Cumberland sandwort	E																						X N					
Asplenium scolopendrium var. americanum	Hart's-tongue fern	T																					X N						
Clematis morefieldii	Morefield's leather flower	E										X N			X N														
Conradina verticillata	Cumberland rosemary	T									X N													X N					X N
Geum radiatum	Spreading avens	E																								X N			
Isotria medeoloides	Small whorled pogonia	T															X N												
Platanthera integrilabia	White fringeless orchid	T			X N		X N				X N	X N			X N		X N						X N	X N	X N		X N	X N	
Scutellaria montana	Large-flowered skullcap	T	XN				X N										X N								X N				
Spiraea virginiana	Virginia spiraea	T			X N		X N				X N						X N					X N	X N	X N	X N		X N		X N
Fungus																													
Gymnoderma lineare	Rock gnome lichen	E																								X N			

(a) E = endangered; T = threatened; C = candidate.
(b) "Y" for the Indiana bat indicates the spatial extent of the population associated with White Oak Blowhole Cave hibernation site in Blount County (FWS 2017-TN5357, FWS 2017-TN5328), the only critical habitat designated for the species in Tennessee (FWS 2007-TN934, FWS 2009-TN5356).
(c) "Y" alone = only critical habitat present.

1

Table M-9. Tennessee Natural Heritage Program Locations of Federally Listed Species within 0.125 Mi of the Transmission Line Segments Identified for Upgrade in Tennessee (TNHP 2017-TN5361**)**

County	Transmission Line	Scientific Name	Common Name	Federal Status	Comments	Last Observed
Fish						
Van Buren (TN)	L5173	*Etheostoma akatulo*	Bluemask (Jewel) Darter	E	In Caney Creek near transmission line but outside of corridor.	1972
Campbell (TN)	L5125	*Chrosomus cumberlandensis*	Blackside Dace	T	In Sandlick Branch near transmission line but outside of corridor.	2008
Mollusks						
Anderson (TN)	L5125	*Cyprogenia stegaria*	Fanshell	E	In Clinch River by Norris Dam and near transmission line but outside of corridor.	1936
Anderson (TN); Campbell (TN)	L5125	*Athearnia anthonyi*	Anthony's Riversnail	E	In Clinch River by Norris Dam and near transmission line but outside of corridor.	1985
Anderson (TN); Campbell (TN)	L5125	*Dromus dromas*	Dromedary Pearlymussel	E	In Clinch River by Norris Dam and near transmission line but outside of corridor.	1936
Franklin (TN); Coffee (TN); Grundy (TN)	L5167	*Toxolasma cylindrellus*	Pale Lilliput	E	In Elk River near transmission line but outside of corridor.	1954
Plants						
Rhea (TN)	L5173	*Spiraea virginiana*	Virginia Spiraea	T	Near Piney Creek near transmission line but outside of corridor.	2015
Bats						
Campbell (TN)	L5125	*Myotis grisescens*	Gray bat	E	Reports from various authors in various years from 1968 to 2002 indicate Norris Dam cave (Figure M-10) used by gray bats as a maternity, swarming, and hibernation site, Cave located near the Clinch River within the transmission line corridor.	2002
Campbell (TN)	L5125	*Myotis septentrionalis*	Northern long-eared bat	E	Norris Dam cave (Figure M-10) used as a hibernation site. Cave located in the transmission line corridor and near the Clinch River.	No date

Table M-9. (contd)

County	Transmission Line	Scientific Name	Common Name	Federal Status	Comments	Last Observed
Campbell (TN)	L5125	*Myotis sodalis*	Indiana Bat	E	Conflicting reports from various authors indicate Norris Dam cave (Figure M-10) was and was not used as a hibernation site. To be conservative occurrence in the cave is assumed. Cave located in the transmission line corridor near the Clinch River.	2002
Anderson (TN)	L5235	*Myotis grisescens*	Gray Bat	E	One dead individual in the U.S. Department of Energy Y-12 facility on the ORR. Facility near but outside the transmission line corridor.	1994
Franklin (TN)	L5702	*Myotis grisescens*	Gray Bat	E	One juvenile gray bat observed on Arnold Airforce Base. Site near Roland Creek near but outside transmission line corridor (Figure M-13).	1998
Scott (TN)	L5882	*Myotis grisescens*	Gray Bat	E	One dead individual in a Y-12 facility on the ORR. Facility near but outside the transmission line corridor.	1994

Table M-10. Habitat Preferences for the Species Known to Occur in the Counties Containing the Transmission Lines Identified by TVA for Possible Upgrade (Table M-8). Habitat description from TDEC (2017-TN5217) unless otherwise indicated. NA = not applicable for the species and any associated critical habitat noted in Table M-8 because (1) the species and critical habitat occur in waterbodies or wetlands which the review team has assumed would not be affected by transmission line upgrades (see Section M.4.2), or (2) suitable habitat for the species based on habitat preferences is unlikely to be present in the upland part of transmission line corridors (i.e., in scrub-shrub/herbaceous vegetation) to which it is assumed habitat disturbance would be limited (see Section M.4.2).

Scientific Name	Common Name	Status	Habitat Preferences	Transmission Lines and Segments by County with Potentially Suitable Habitat
Mammals				
Corynorhinus (= Plecotus) townsendii virginianus	Virginia big-eared bat	E	Caves typically in limestone karst regions dominated by mature hardwood forests. Prefers cool, well-ventilated caves for hibernation. Maternity colonies deep within caves.	Possible occurrence in transmission line L5125 in Whitley County, Kentucky (No figure), if suitable cave habitat were to occur in this corridor.
Glaucomys sabrinus coloratus	Carolina northern flying squirrel	E	Spruce-fir or mature hardwood forest with snags; in tree cavities or leaf nests; higher elevations of the Appalachians.	NA
Myotis grisescens	Gray bat	E	Cave obligate year-round; frequents forested areas; migratory.	Known occurrence in Norris Dam cave, located within the corridor of L5125 in Campbell County, Tennessee (Figure M-10), has been used by gray bats as a maternity, swarming, and hibernation site (Table M-8). One individual captured near Roland Creek at Arnold Airforce Base along transmission line L5702 in Franklin County, TN (Figure M-13). Possible occurrence in all transmission line corridors in all three states if suitable cave habitat were to occur in these corridors, since the species is present in all counties.

Table M-10. (contd)

Scientific Name	Common Name	Status	Habitat Preferences	Transmission Lines and Segments by County with Potentially Suitable Habitat
Myotis septentrionalis	NLEB	T	A forest bat whose summer roosts may include caves, mines, live trees and snags; hibernates in caves and mines, often using small cracks and fissures. Notably susceptible to WNS.	Known occurrence in Norris Dam cave, located within the corridor of L5125 in Campbell County, Tennessee (Figure M-10), is reported to be used by NLEBs as a hibernation site (Table M-8). Possible occurrence in all transmission line corridors in all three states if suitable cave habitat were to occur in these corridors, since the species is present in all counties (Table M-8).
Myotis sodalis	Indiana bat	E	Hibernates in caves; spring/summer maternity roosts are normally under the bark of standing trees.	Conflicting data as to presence (Table M-8) so assumed occurrence in Norris Dam cave, located within the corridor of L5125 in Campbell County, Tennessee (Figure M-10). Possible occurrence in all transmission line corridors in all three states if suitable cave habitat were to occur in these corridors, since the species is present in all counties (Table M-8).
Amphibians				
Gyrinophilus gulolineatus	Berry cave salamander	C	Aquatic cave obligate; Ridge and Valley Ecoregion; formerly included with *G. palleucus*.	Possible occurrence in L5092 and L5659 in Knox County, and L5205, L5235, L5280, and L5743 in Roane County, Tennessee (No figure), if suitable cave habitat were to occur in these corridors.
Fishes				
Chrosomus saylori	Laurel dace	E	Cool 1st–2nd order streams with slabrock and rubble substrate; Walden Ridge of the Cumberland Plateau; Tennessee River watershed.	Critical habitat as shown in Figure M-11 in Bledsoe and Rhea Counties, Tennessee, is in the vicinity of, but does not cross transmission corridor L5173.
Erimystax cahni	Slender chub	T	Major headwater tributaries to the Tennessee River with small gravel substrates and swift-moderate currents.	NA

Table M-10. (contd)

Scientific Name	Common Name	Status	Habitat Preferences	Transmission Lines and Segments by County with Potentially Suitable Habitat
Erimonax monachus	Spotfin chub	T	Clear upland rivers with swift currents and boulder substrates; portions of the Tennessee River watershed.	Critical habitat as shown in Figure M-14 in Cumberland County, Tennessee, crossing transmission line corridor L5204 in the Gum Branch of the Clear Creek and the Obed River and crossing transmission line L5205 in Daddy's Creek.
Etheostoma akatulo	Bluemask (Jewel) darter	E	Streams with slow to moderate current over clean sand and fine gravel; Caney Fork River system (above Great Falls Reservoir).	Occurrence in vicinity of transmission line corridor L5173 in Caney Creek in Van Buren County, Tennessee, as shown in Figure M-11. Last observed in 1972.
Etheostoma lemniscatum	Tuxedo darter	E	Gently flowing, silt-free pools or runs immediately upstream of riffles with cobble, boulders, and slabrock; Big South Fork Cumberland River.	NA
Etheostoma percnurum	Duskytail darter	E	Gravel, rubble, and slabrock pools and runs of small to medium rivers (NatureServe 2017-TN5216).	NA
Etheostoma spilotum	Cumberland Plateau darter	T	Upland creeks and streams, generally in headwaters, sometimes in larger streams; generally in slow to moderate current in cool, sluggish pools or areas above and below riffles over bedrock, rubble, cobble, and pebble, often interspersed with sandy areas. Common only in intermittently flowing first- or second-order creeks, preferring protective stones near the bank, or ledges and recesses at stream margins (NatureServe 2017-TN5216).	NA
Etheostoma susanae	Cumberland darter	E	Creeks in the upper Cumberland River watershed of the Cumberland Mountains; extremely rare.	NA
Etheostoma wapiti	Boulder darter	E	Fast rocky riffles of small to medium rivers and large creeks; Elk River watershed.	NA
Notropis albizonatus	Palezone shiner	E	Large upland creeks and small rivers in quiet waters and flowing pools; possibly extirpated from Tennessee.	NA
Noturus crypticus	Chucky madtom	E	Stream runs with slow to moderate current over pea gravel, cobble, or slabrock; Little Chucky Creek; Nolichucky River system.	Critical habitat as shown in Figure M-15 in Greene County, Tennessee, is within a mile of transmission line corridor L5624 in Little Chucky Creek.

Table M-10. (contd)

Scientific Name	Common Name	Status	Habitat Preferences	Transmission Lines and Segments by County with Potentially Suitable Habitat
Noturus flavipinnis	Yellowfin madtom	T	Medium-size to large creeks and small rivers that are unpolluted and relatively unsilted; upper Tennessee River watershed.	NA
Noturus stanauli	Pygmy madtom	E	Medium to large rivers with moderate to strong current over gravel substrates; Tennessee River watershed.	NA
Percina tanasi	Snail darter	T	Sand and gravel shoals of moderately flowing, vegetated, large creeks; upper Tennessee River watershed.	Occurrence within 0.4 mi SE of transmission line corridor L5697 in South Chickamauga Creek in Georgia (no figure). Last observed date is unknown.
Phoxinus cumberlandensis	Blackside dace	T	Small upland tributaries with sand, sandstone, and shale substrates in unsilted conditions; upper Cumberland River watershed.	Occurrence in the vicinity of line L5125 in Sandlick Branch of Davis Creek in Campbell County, Tennessee, as shown in Figure M-12. Last observed 3/21/2008. A second species occurrence is within 0.3 mi. of transmission line corridor L5125 in Buffalo Creek in Whitley County, Kentucky, as shown in Figure M-19. Most recent observation in September of 2015.
Mussels				
Alasmidonta atropurpurea	Cumberland elktoe	E	Small creeks to medium-size rivers with slow current, sand substrates, and large cobble; upper Cumberland River watershed.	Critical habitat as shown in Figure M-15 within 0.5 mi in the Nolichucky River on the border of Green and Hamblen Counties, Tennessee, in the vicinity of transmission corridor L5624. Critical habitat as shown in Figure M-17 in the New River in Scott County, Tennessee, is approximately 0.5 mi from transmission line corridor L5882. Critical habitat for the Cumberland elktoe as shown in Figure M-19 in the Laurel Fork of the Clear Fork River in Whitley County, Kentucky, less than 1 mi from transmission line corridor L5125.
Alasmidonta raveneliana	Appalachian elktoe	E	Large creeks/small rivers with stable coarse sand and gravel substrates with cobble and boulders; upper Tennessee River watershed.	NA

Table M-10. (contd)

Scientific Name	Common Name	Status	Habitat Preferences	Transmission Lines and Segments by County with Potentially Suitable Habitat
Cumberlandia monodonta	Spectaclecase (mussel)	E	Medium to large rivers; in substrates from mud and sand to gravel, cobble, and boulders; Cumberland and Tennessee River systems.	NA
Cyprogenia stegaria	Fanshell	E	Medium to large streams and rivers with coarse sand and gravel substrates; Cumberland and Tennessee River systems.	NA
Dromus dromas	Dromedary pearlymussel	E	Medium to large rivers with riffles and shoals with relatively firm rubble, gravel, and stable substrates; Tennessee and Cumberland river systems.	Species located in the vicinity of transmission line corridor L5125 in Clinch River in Campbell County, Tennessee, L5125 as shown in Figure M-10. Last observed in 1936.
Epioblasma brevidens	Cumberlandian combshell	E	Large creeks to large rivers, in coarse sand or mixtures of gravel, cobble, or rocks; Tennessee and Cumberland river systems.	Critical habitat as shown in Figure M-15 in the Nolichucky River within 0.5 mi of transmission corridor L5624 on the border of Green and Hamblen Counties, Tennessee. Critical habitat as shown in Figure M-17 along the New River in Scott County, Tennessee, is approximately 0.5 mi from transmission line corridor L5882.
Epioblasma capsaeformis	Oyster mussel	E	Shallow riffles in mod-swift current of small-medium rivers with coarse sand and gravel; Tennessee and Cumberland river systems excluding the Duck River.	Critical habitat as shown in Figure M-15 along the Nolichucky River in Greene and Hamblen Counties, Tennessee, is within 0.5 mi of transmission line corridor L5624. Critical habitat as shown in Figure M-17 along the New River in Scott County, Tennessee, is within approximately 0.5 mi of transmission line corridor L5882.
Epioblasma florentina walkeri (=E. walkeri)	Tan riffleshell	E	River headwaters, in riffles and shoals in sand and gravel substrates; Tennessee and Cumberland river systems.	NA
Epioblasma obliquata	Catspaw	E	Medium to large rivers, in sand and gravel substrates in runs and riffles; Tennessee and Cumberland river systems.	NA

Table M-10. (contd)

Scientific Name	Common Name	Status	Habitat Preferences	Transmission Lines and Segments by County with Potentially Suitable Habitat
Epioblasma torulosa	Tubercled blossom (pearlymussel)	E	High-gradient creeks, riffles of medium-size rivers. Riffles or shoals in shallow water with sandy gravel substrate and rapid currents (NatureServe 2017-TN5216).	NA
Epioblasma triquetra	Snuffbox mussel	E	Riffles of medium-large rivers with stony or sandy bottoms, in swift currents, usually deeply buried; Tennessee and Cumberland river systems.	NA
Epioblasma turgidula	Turgid blossom (pearlymussel)	E	Riffles of creeks and medium-size rivers. Requires clear, unpolluted water; typically found buried in sand and gravel substrates of shallow, fast-flowing streams (NatureServe 2017-TN5216).	NA
Fusconaia cor	Shiny pigtoe	E	Shoals and riffles of small- to medium-size rivers with moderate to fast current over sand-cobble substrates; upper Tennessee River watershed.	NA
Fusconaia cuneolus	Finerayed pigtoe	E	Riffles of fords and shoals of mod gradient streams in firm cobble and gravel substrates; middle and upper Tennessee River watershed.	NA
Hemistena lata	Cracking pearlymussel	E	Medium-size rivers of moderate current, deeply buried in mud, sand, gravel, and cobble substrates; Tennessee and Cumberland river systems.	NA
Lampsilis abrupta	Pink mucket (pearlymussel)	E	Generally a large river species, preferring sand-gravel or rocky substrates with moderate to strong currents; Tennessee and Cumberland river systems.	NA
Lampsilis virescens	Alabama lampmussel	E	Found in sand and gravel substrates in shoal areas of small- to medium-size rivers; middle and upper Tennessee River system; recently rediscovered in Emory River.	NA
Lemiox rimosa	Birdwing pearlymussel	E	Small- to medium-size rivers in riffle areas with sand and gravel substrates in moderate to fast currents; Tennessee River system.	NA
Obovaria retusa	Ring pink (mussel)	E	Large rivers in gravel and sand bars; Tennessee and Cumberland river watersheds; many historic locations currently inundated.	NA

Table M-10. (contd)

Scientific Name	Common Name	Status	Habitat Preferences	Transmission Lines and Segments by County with Potentially Suitable Habitat
Pegias fabula	Littlewing pearlymussel	E	Cool, clear, high-gradient streams in sand, gravel, and cobble substrates, riffles; portions of Cumberland and upper Tennessee River systems.	NA
Plethobasus cooperianus	Orangefoot pimpleback (pearlymussel)	E	Large rivers in sand-gravel-cobble substrates in riffles and shoals in deep flowing water; Cumberland and Tennessee River systems.	NA
Plethobasus cicatricosus	White wartyback (pearlymussel)	E	Presumed to inhabit shoals and riffles in large rivers; Tennessee and Cumberland river systems. Very rare and possibly extirpated in Tennessee.	NA
Plethobasus cyphyus	Sheepnose mussel	E	Large- to medium-size rivers, in riffles and coarse sand/gravel substrate; Tennessee and Cumberland river systems including Kentucky Reservoir; Uplands, and Rim.	NA
Pleurobema clava	Clubshell	E	Small- to medium-size rivers and streams; deeply buried in sand/fine gravel or in clean, coarse sand/gravel runs; lower Cumberland and Tennessee rivers.	NA
Pleurobema gibberum	Cumberland pigtoe	E	Shallow areas in small- to medium-size rivers in riffles with sand and gravel substrates; tributaries of Cumberland River and possibly Tennessee River in middle Tennessee.	NA
Pleurobema plenum	Rough pigtoe	E	Medium- to large-size rivers in sand, gravel, and cobble substrates of shoals; Tennessee and Cumberland river systems.	NA
Pleuronaia dolabelloides	Slabside pearlymussel	E	Large creeks to moderate size rivers, in riffles/shoals of sand, fine gravel, and cobble substrates with moderate current; Tennessee River watershed.	Critical habitat as shown in Figure M-11 in the Sequatchie River crossing transmission line corridor L5173 in Bledsoe County, Tennessee. Critical habitat as shown in Figure M-15 in the Nolichucky River within 0.5 mi of transmission corridor L5624 on the border of Green and Hamblen Counties, Tennessee.

Table M-10. (contd)

Scientific Name	Common Name	Status	Habitat Preferences	Transmission Lines and Segments by County with Potentially Suitable Habitat
Ptychobranchus subtentum	Fluted kidneyshell	E	Small- to medium-size rivers in swift current or riffles, in sand, gravel, and cobble substrates; Tennessee and Cumberland river systems.	Critical habitat as shown in Figure M-15 along the Nolichucky River in Greene and Hamblen Counties, Tennessee, is within 0.5 mi of transmission line corridor L5624. Critical habitat as shown in Figure M-16 along the Holston River in Jefferson County, Tennessee, is adjacent to transmission line corridor L5186. Critical habitat as shown in Figure M-17 along the New River in Scott County, Tennessee, is approximately 0.5 mi from transmission line corridor L5882. Critical habitat as shown in Figure M-18 in the French Broad River in Sevier County, Tennessee, is within less than 0.25 mi of transmission line corridor L5957.
Quadrula cylindrica	Rabbitsfoot	T	Large rivers in sand and gravel; Tennessee and Cumberland systems. Big river form of *Q. cylindrica*.	NA
Quadrula cylindrica strigillata	Rough rabbitsfoot	E	Small- to medium-size rivers, in clear, shallow riffles with sand-gravel substrates; Tennessee and Cumberland river systems.	NA
Quadrula intermedia	Cumberland monkeyface	E	Shallow riffle and shoal areas of headwater streams and bigger rivers, in coarse sand/gravel substrates; Tennessee River system.	NA
Quadrula sparsa	Appalachian monkeyface	E	Headwater sections of rivers in shallow riffles/runs with sand-gravel substrate and moderate current; upper Tennessee River drainage.	NA
Toxolasma cylindrellus	Pale lilliput (pearlymussel)	E	Small tributary rivers and streams, in firm rubble, gravel, and sand substrates in shallow riffles and shoals; lower Tennessee River system.	Species located in the vicinity of transmission line corridor L5167 on the Elk River in Frankllin County, Tennessee, as shown in Figure M-13. Last observed October 13, 1954.
Villosa fabalis	Rayed bean	E	Riffles of medium to small rivers and creeks, in gravel and sand substrates associated with *Justicia americana*; Tennessee River watershed.	NA

Table M-10. (contd)

Scientific Name	Common Name	Status	Habitat Preferences	Transmission Lines and Segments by County with Potentially Suitable Habitat
Villosa perpurpurea	Purple bean	E	Creeks to medium-size rivers, headwaters, in riffles with coarse sand and gravel and some silt; upper Tennessee River watershed.	Critical habitat as shown in Figure M-14 in the Obed River in Morgan and Cumberland Counties, Tennessee, is in the vicinity of, but does not cross, transmission corridor L5204 and L5205.
Villosa trabalis	Cumberland bean (pearlymussel)	E	Riffle areas of small rivers and streams in sand, gravel, and cobble substrates with swift current; upper Cumberland and upper Tennessee River systems.	NA
Arachnids				
Microhexura montivaga	Spruce-fir moss spider	E	Moss mats in high-elevation spruce-fir forests; Southern Appalachians.	NA
Insects				
Bombus affinis	Rusty-patched bumble bee	E	Once occupied grasslands and tallgrass prairies of the Upper Midwest and Northeast, but most have been lost, degraded, or fragmented by conversion to other uses. Bumble bees need areas that provide nectar and pollen from flowers, nesting sites (underground and abandoned rodent cavities or clumps of grasses), and overwintering sites for hibernating queens (undisturbed soil) (FWS 2017-TN5376).	NA
Snails				
Anguispira picta	Painted tigersnail	T	A calciphile; limestone outcrops and cliff faces of karstic woods; South Cumberland Mountains; Sherwood community of upper Crow Creek valley (TDEC 2017-TN5217). Not found in habitats no longer having forest cover (43 FR 28932-TN5374).	NA
Athearnia anthonyi	Anthony's riversnail	E	Larger rivers and downstream stretches of large creeks, on cobble/boulder substrates adjacent to riffles; portions of upper Tennessee River basin.	Species located in the vicinity of transmission line corridor L5125 in the Clinch River, Campbell County, Tennessee, as shown in Figure M-10. Last observed 1985.

Table M-10. (contd)

Scientific Name	Common Name	Status	Habitat Preferences	Transmission Lines and Segments by County with Potentially Suitable Habitat
Plants				
Apios priceana	Price's potato-bean	T	Lightly disturbed areas, such as forest openings, woodland edges, where bluffs descend to streams, and highway right-of-way and powerline corridors (FWS 2015-TN5375)	Possible occurrence in L5167 and L5702 in Franklin County, Tennessee depending on whether the species is present in the uplands of these corridors.
Arenaria cumberlandensis	Cumberland sandwort	E	Restricted to sandstone rock houses, ledges, and solution pockets on sandstone rock faces. Habitat requirements include shade, moisture, relatively constant cool temperatures, and high humidity (McKerrow 1996-TN5302).	NA
Asplenium scolopendrium var. americanum	Hart's-tongue fern	T	Southern populations (e.g., Tennessee) are found only within limestone pits that trap cold air, have high humidity, and are well shaded. At all known locations, the species appears to require high humidity, shaded conditions, a moist substrate, and the presence of dolomitic limestone (Currie 1993-TN5306).	NA
Clematis morefieldii	Morefield's leather flower	E	Seeps/springs in rocky limestone woods (TDEC 2017-TN5217; Norquist 1994-TN939; FWS 2017-TN5411).	NA
Conradina verticillata	Cumberland rosemary	T	Grows in full to moderate sunlight in the floodplain of major streams flowing over sandstone bedrock. Occurs on boulder bars, bouldery gravel bars, sandy gravel bars, and terraces of sand on gradually sloped riverbanks and islands, and sandy pockets between boulders. Essential habitat requirements include periodic flooding to maintain openness, topographic features to enhance sand deposition, and periods of inundation of at least 2 weeks (Shea and Roulston 1996-TN5303).	Possible occurrence in L5204 and L5205 in Cumberland County and L5882 in Scott County and L5173 in White County, Tennessee, depending on the presence of the species along major streams within these corridors.

Table M-10. (contd)

Scientific Name	Common Name	Status	Habitat Preferences	Transmission Lines and Segments by County with Potentially Suitable Habitat
Geum radiatum	Spreading avens	E	Grows in pioneer perennial herb communities at high-elevation rocky sites where it is exposed to direct sunlight for at least part of the day. Populations occur at altitudes ranging from 1,400 to 1,911 m (Murdock 1993-TN5377).	NA (Elevation of L5957 in Sevier County (located just north of Douglas Lake Dam), Tennessee, does not exceed about 400 m).
Isotria medeoloides	Small whorled pogonia	T	Forests in second- or third-growth successional stages, both in young forests and in maturing stands, including near logging roads, streams,or other features that create long persisting breaks in the forest canopy (von Oettingen 1992-TN5307).	NA (However, note that the species may occur on corridor fringes along L5697 in Hamilton County, Tennessee.
Platanthera integrilabia	White fringeless orchid	T	Acidic seeps and stream heads (TDEC 2017-TN5217). TVA has stated that nearly 20 percent of extant white fringeless orchid occurrences are located in transportation or utility right-of-ways, illustrating that the species occurs in these settings at a disproportionately high rate when compared to its overall prevalence on the landscape (81 FR 62826-TN5378).	Possible occurrence in the transmission line corridors in Whitely County, Kentucky, and Bledsoe, Cumberland, Franklin, Grundy, Hamilton, Roane, Scott, Sequatchie, Van Buren, and Warren Counties, Tennessee, (depending on whether suitable habitat and the species are present in these corridors.
Scutellaria montana	Large-flowered skullcap	T	Rocky, submesic to xeric, well-drained, slightly acidic slope, ravine and stream bottom forests. Recruitment into disturbed sites is not likely (McKerrow 1996-TN5304).	NA
Spiraea virginiana	Virginia spiraea	T	Banks of high-gradient sections of second- and third-order streams, or on meander scrolls and point bars, natural levees, and other braided features of lower reaches (often near the stream mouth) in oft-disturbed early successional areas (Ogle 1992-TN5379).	Known occurrence near Piney Creek just outside the corridor of L5173 in Rhea County, Tennessee, (Table M-8) (Figure M-11). Last observed 2015 (Table M-8). Thus, possible occurrence in L5173 in Rhea County, and within the transmission line corridors in Whitely County, Kentucky, and Bledsoe, Cumberland, Hamilton, Roane, Scott, Sequatchie, Van Buren, and White Counties, Tennessee, depending on whether suitable habitat and the species are present in these corridors.

Table M-10. (contd)

Scientific Name	Common Name	Status	Habitat Preferences	Transmission Lines and Segments by County with Potentially Suitable Habitat
Fungus				
Gymnoderma lineare	Rock gnome lichen	E	Primarily limited to vertical rock faces with seepage water. Thrives on moist, generally open sites with northern exposures, but needs partial canopy coverage on southern or western exposures. Common associates include spreading avens (discussed above in this table). Most populations occur above 1,524 m elevation (Murdock and Langdon 1997-TN5380).	NA (Elevation of L5957 in Sevier County [located just north of Douglas Lake dam], Tennessee, does not exceed about 400 m).

Figure M-10 through Figure M-19 show species and critical habitat locations that are within or in close proximity to the transmission line corridors. Table M-10 provides the callouts for these figures as identified in the last column of the table.

Note that, in addition to the notations for Norris Dam cave for Federally listed bat species in Table M-10, this cave (first described in Table M-9) has also been used by little brown bats (described in Section M.6.1.5) as a hibernation site (Figure M-10) (TNHP 2017-TN5361). This species, as well as the tri-colored bat (described in Section M.6.1.4), could potentially occur in all transmission line corridors in all three states if suitable cave habitat were to occur in these corridors.

Notes on Critical Habitat for Terrestrial Species Near Transmission Line Upgrades: The critical habitat noted in Table M-8 for the spruce-fir moss spider (*Microhexura montivaga*) in Sevier County, Tennessee (FWS 2017-TN5328; 66 FR 35547-TN5381), does not overlap and is not located in proximity to L5957, the only transmission line identified for upgrade in Sevier County (Table M-10). The critical habitat noted in Table M-8 for the Indiana bat in Cocke, Jefferson, Knox, and Sevier Counties actually concerns the spatial extent of populations associated with White Oak Blowhole Cave in neighboring Blount County (FWS 2017-TN5357, FWS 2017-TN5328), the only actual critical habitat for the species designated in Tennessee (FWS 2007-TN934, FWS 2009-TN5356). The hibernation site in Blount County is not located in proximity to any of the transmission lines in the counties for which critical habitat is listed for the species in Table M-8. Therefore, critical habitat for the spruce-fir moss spider and Indiana bat will not be carried forward for potential impact evaluation in Section M.7.8.

Notes on critical habitat for aquatic species near transmission line upgrades: critical habitat noted in Table M-7 for aquatic species follow:

- Critical habitat for the slabside pearly mussel (*Pleuronaia dolabelloides*) that intersects transmission line corridor L5173 in Bledsoe County, Tennessee, as shown in Figure M-11. Critical habitat in Bledsoe and Rhea Counties, Tennessee, for the Laurel Dace (*Chrosomus saylori*) also shown in Figure M-11 is not crossed by a transmission line corridor L5173.
- Critical habitat for the spotfin chub (*Erimonax monachus*) intersects transmission line corridor L5204 on the Gum Branch of the Clear Creek, the Obed River and transmission corridor L5205 in Daddy's Creek in Cumberland County, Tennessee as shown in Figure M-14. Critical habitat for the purple bean (*Villosa perpurpurea)* is also shown in Morgan and Cumberland Counties, Tennessee, but it is several miles from the transmission line corridors.
- Critical habitat less than a mile from transmission corridor L5624 is shown in Figure M-15 for the chucky madtom (*Noturus crypticus)* in Little Chucky Creek in Greene County, Tennessee. Critical habitat for the fluted kidneyshell (*Ptychobranchus subtentum),* slabside pearly mussel, Cumberlandian combshell (*Epioblasma brevidens*), Cumberland elktoe (*Alasmidonta atropurpurea)* and the oyster mussel (*Epioblasma capsaeformis*) in the Nolichucky River in Greene County and Hamblen County, Tennessee, is shown within 0.5 mi of the transmission corridor.
- Critical habitat for the fluted kidneyshell mussel in the Holston River in Jefferson County on the border with Grainger County, Tennessee, is adjacent to, but not within, transmission line corridor L5186 as shown in Figure M-16.

- Critical habitat for the fluted kidneyshell mussel, the oyster mussel, the Cumberlandian combshell and the Cumberland elktoe in the New River in Scott County, Tennessee is approximately 0.5 mi from transmission line corridor L5882 as shown in Figure M-17.
- Critical habitat for the fluted kidneyshell mussel in the French Broad River in Sevier County, Tennessee, is within less than 0.25 mi of transmission line corridor L5957 as shown in Figure M-18.
- Critical habitat for the Cumberland elktoe in the Laurel Fork of the Clear Fork River in Whitley County, Kentucky, is less than 1 mi from transmission line corridor L5125 as shown in Figure M-19.

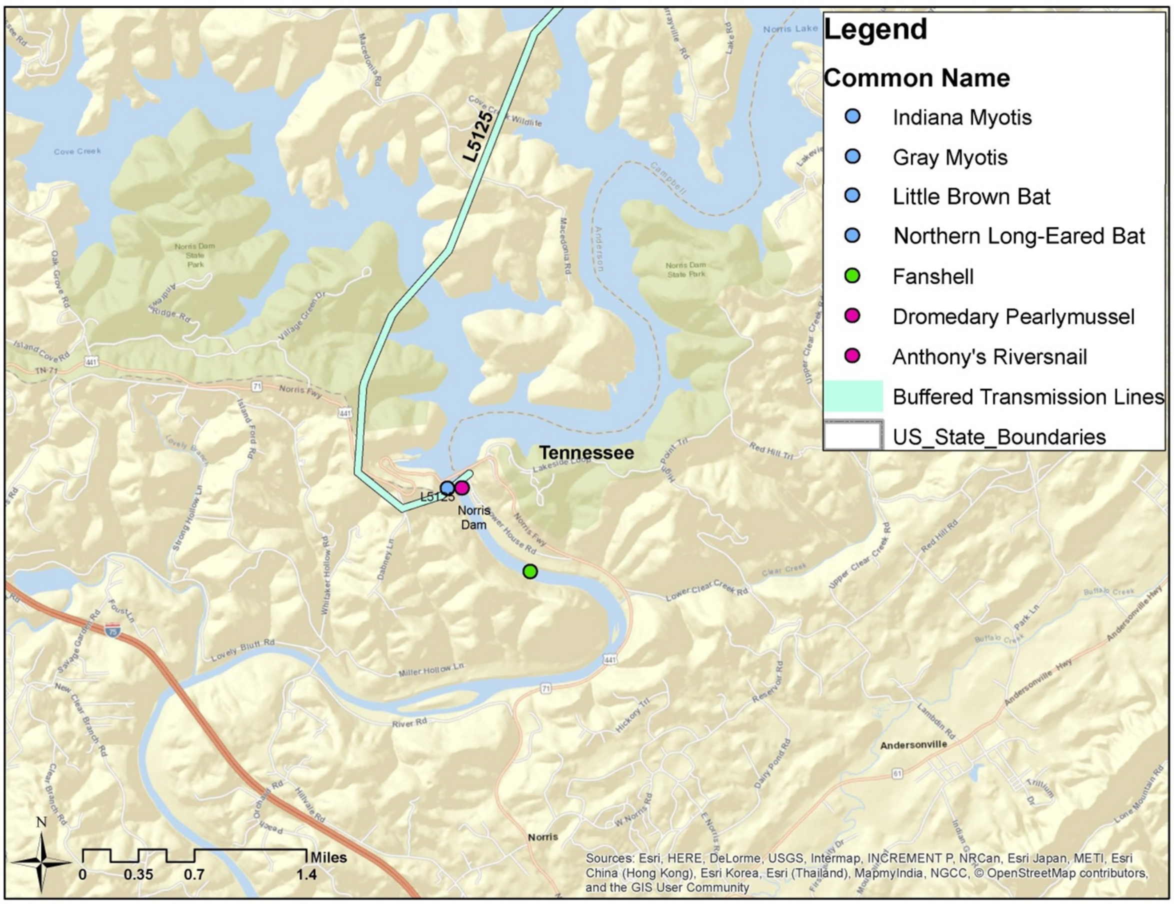


Figure M-10. Location of Norris Dam Cave along the Clinch River within Transmission Line Corridor L5125 in Campbell County, Tennessee. Records of prior cave use by various bat species, and records of various mussel species in the river.

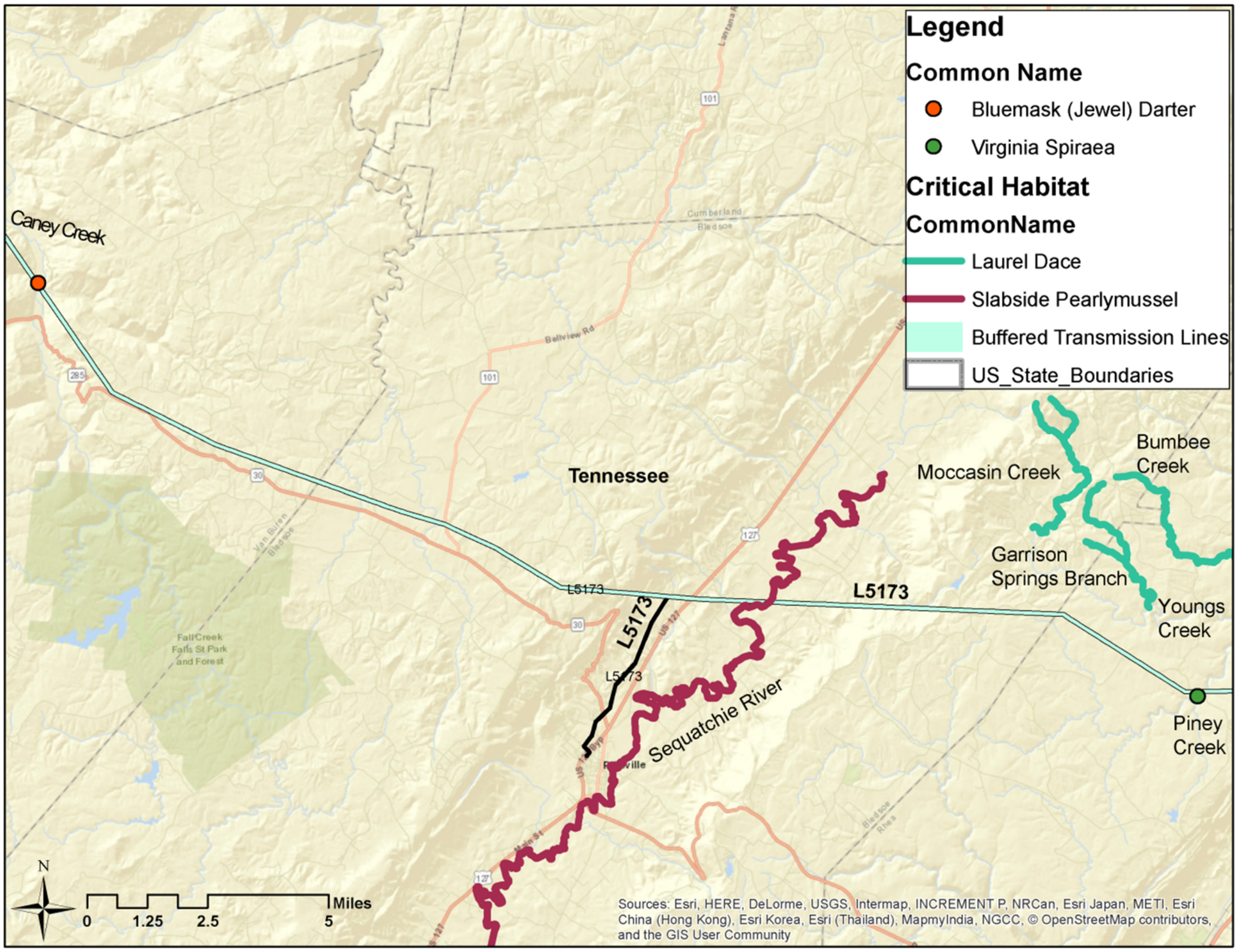


Figure M-11. Occurrence of Virginia Spiraea (*Spiraea virginiana*) near Piney Creek and bluemask (jewel) darter (*Etheostoma akatulo*) in Caney Creek, as well as critical habitat for the laurel dace (*Chrosomus saylori*) and slabside pearlymussel (*Pleuronaia dolabelloides*) along Transmission Line Corridor L5173 in Tennessee.

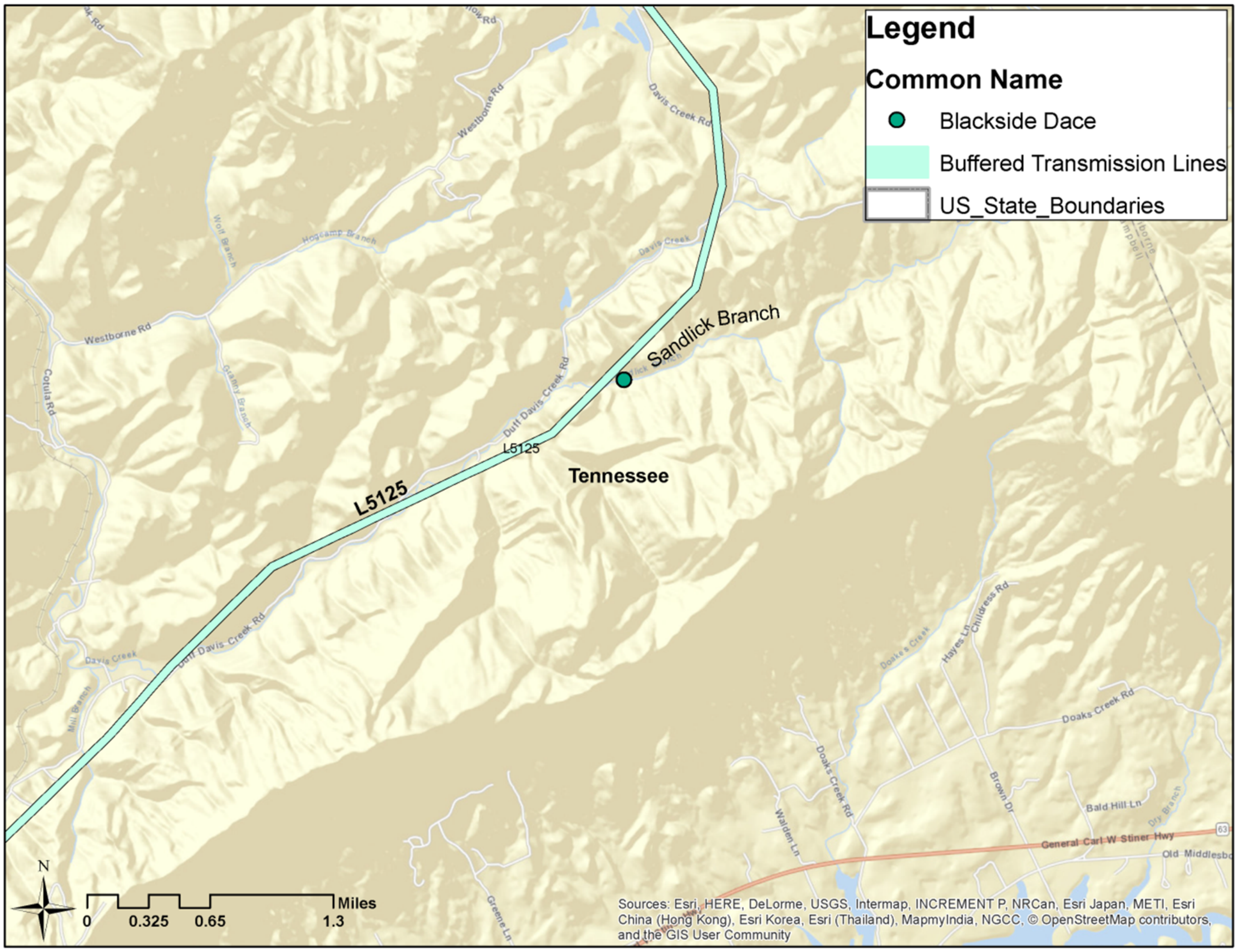


Figure M-12. Occurrence of blackside dace (*Phoxinus cumberlandensis*) in Sandlick Branch along Transmission Line Corridor L5125 in Tennessee.

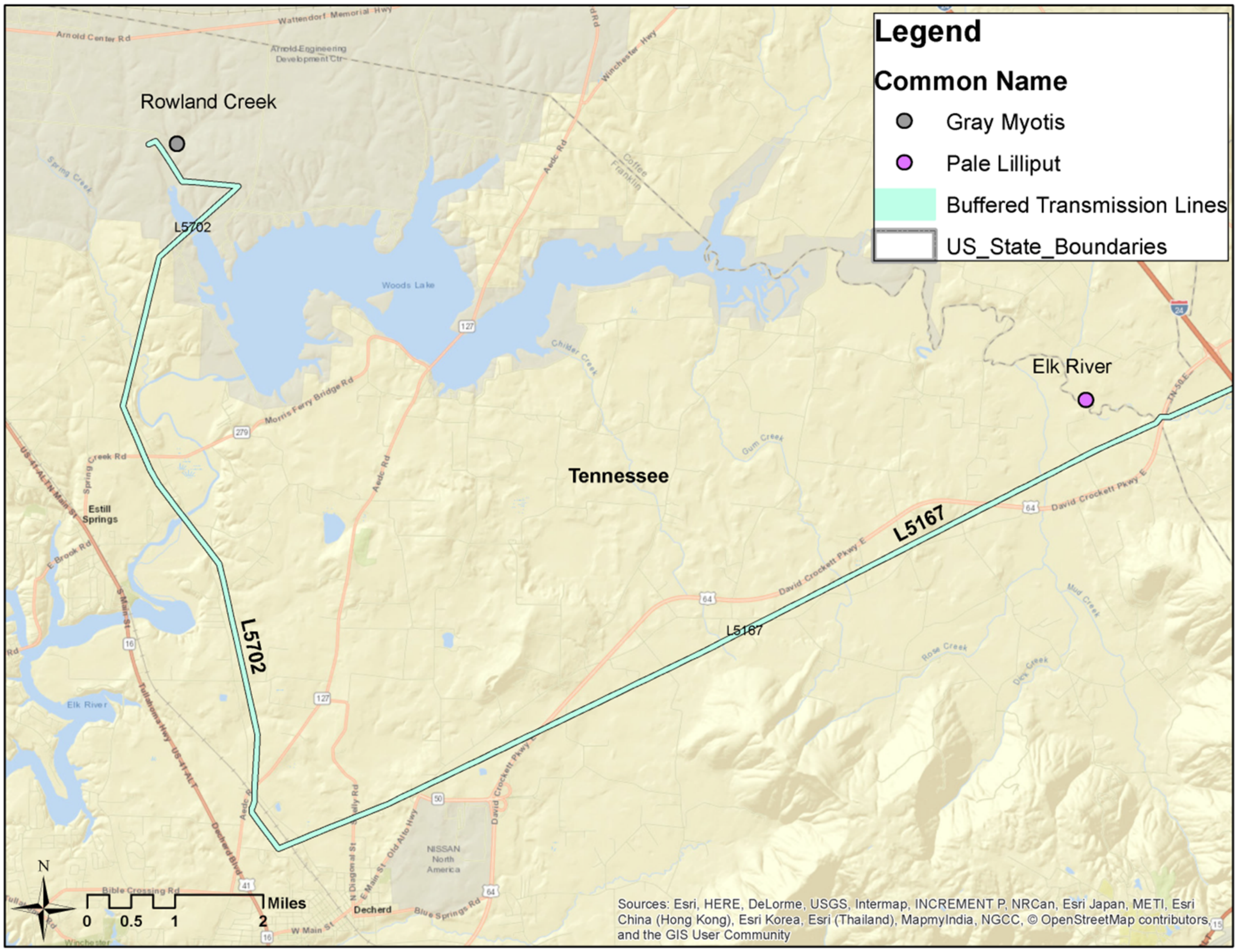


Figure M-13. Occurrence of gray bat (*Myotis grisescens*) near Rowland Creek on Arnold Airforce Base along Transmission Line Corridor L5702 in Tennessee. Occurrence of pale lilliput (*Toxolasma cylindrellus*) along Transmission Line Corridor L5167, in Tennessee.

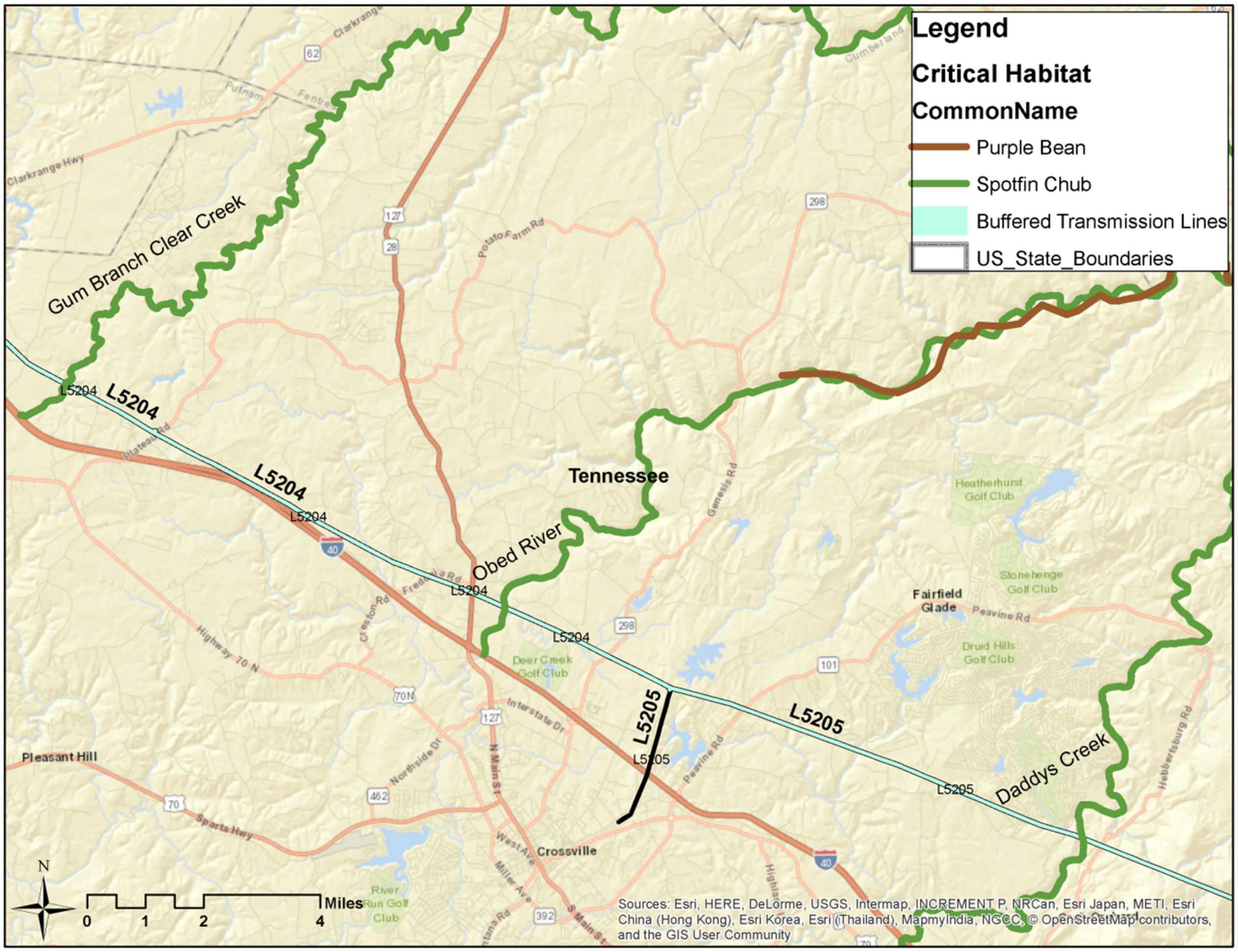


Figure M-14. Critical habitats for the purple bean (*Villosa perpurpurea*) and spotfin chub (*Erimonax monachus*) along Transmission Corridors L5204 and L5205 in Tennessee.

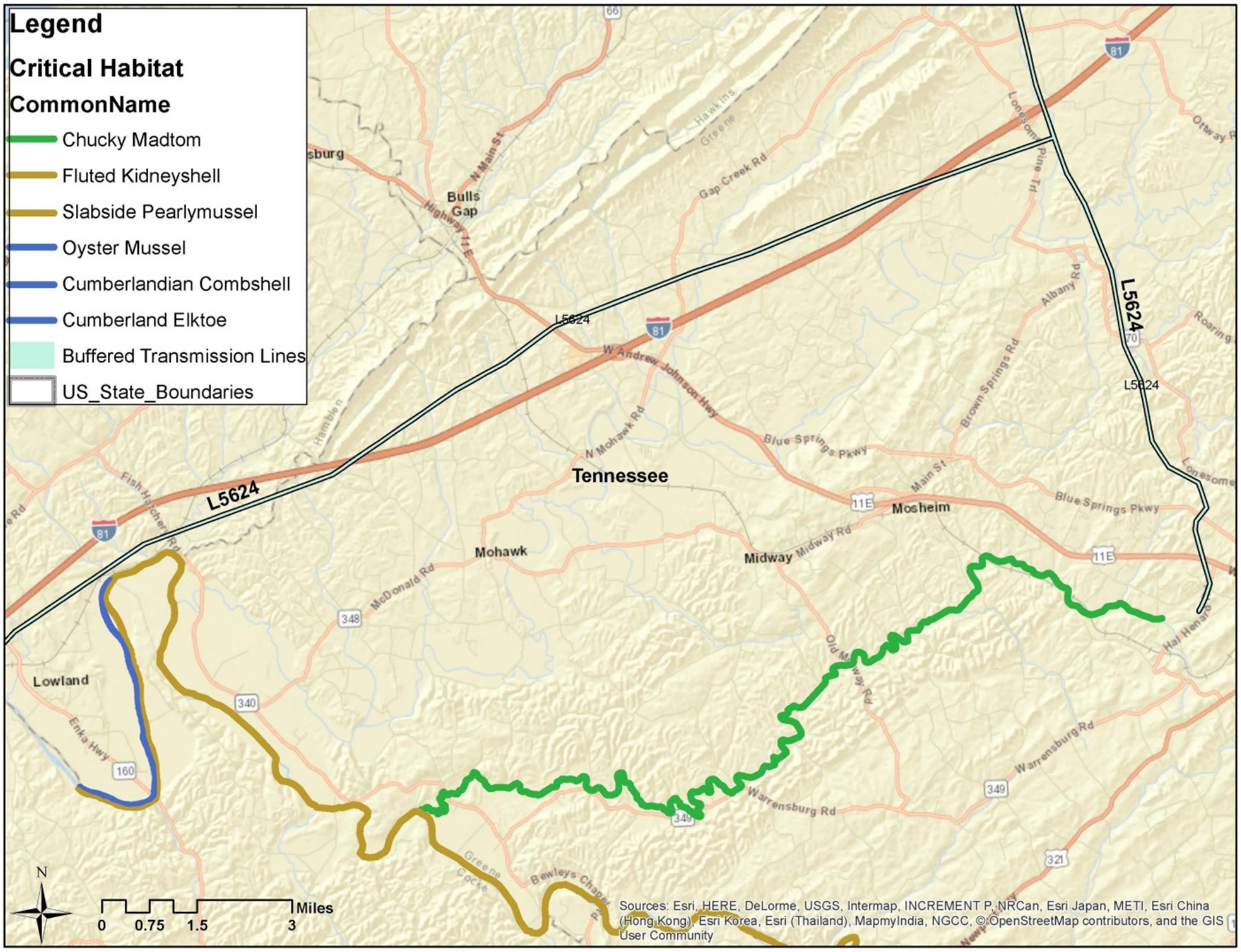


Figure M-15. Critical habitats for various aquatic species along Transmission Corridor L5624 in Tennessee.

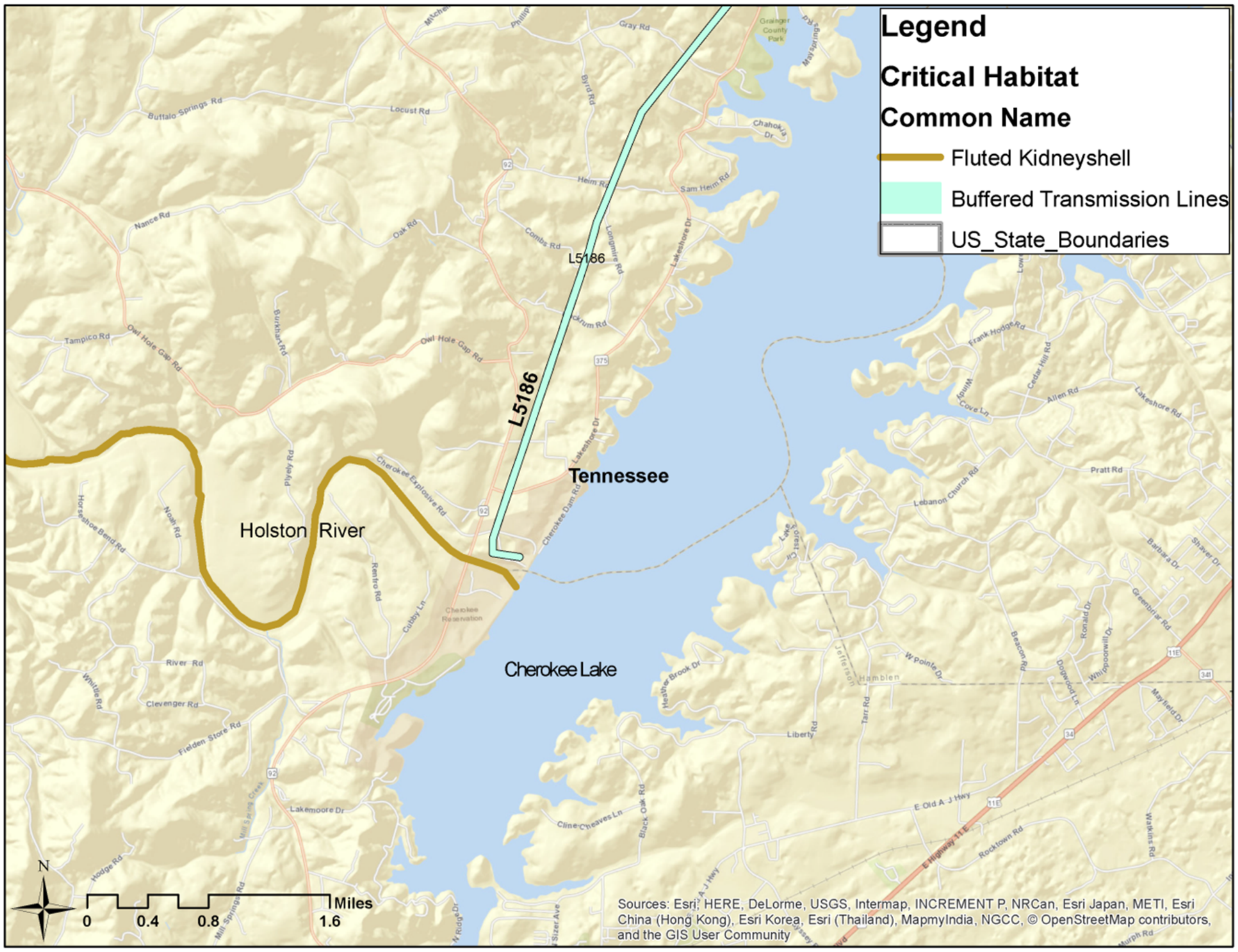


Figure M-16. Critical habitat for the fluted kidneyshell (*Ptychobranchus subtentum*) along Transmission Corridor L5186 in Tennessee..

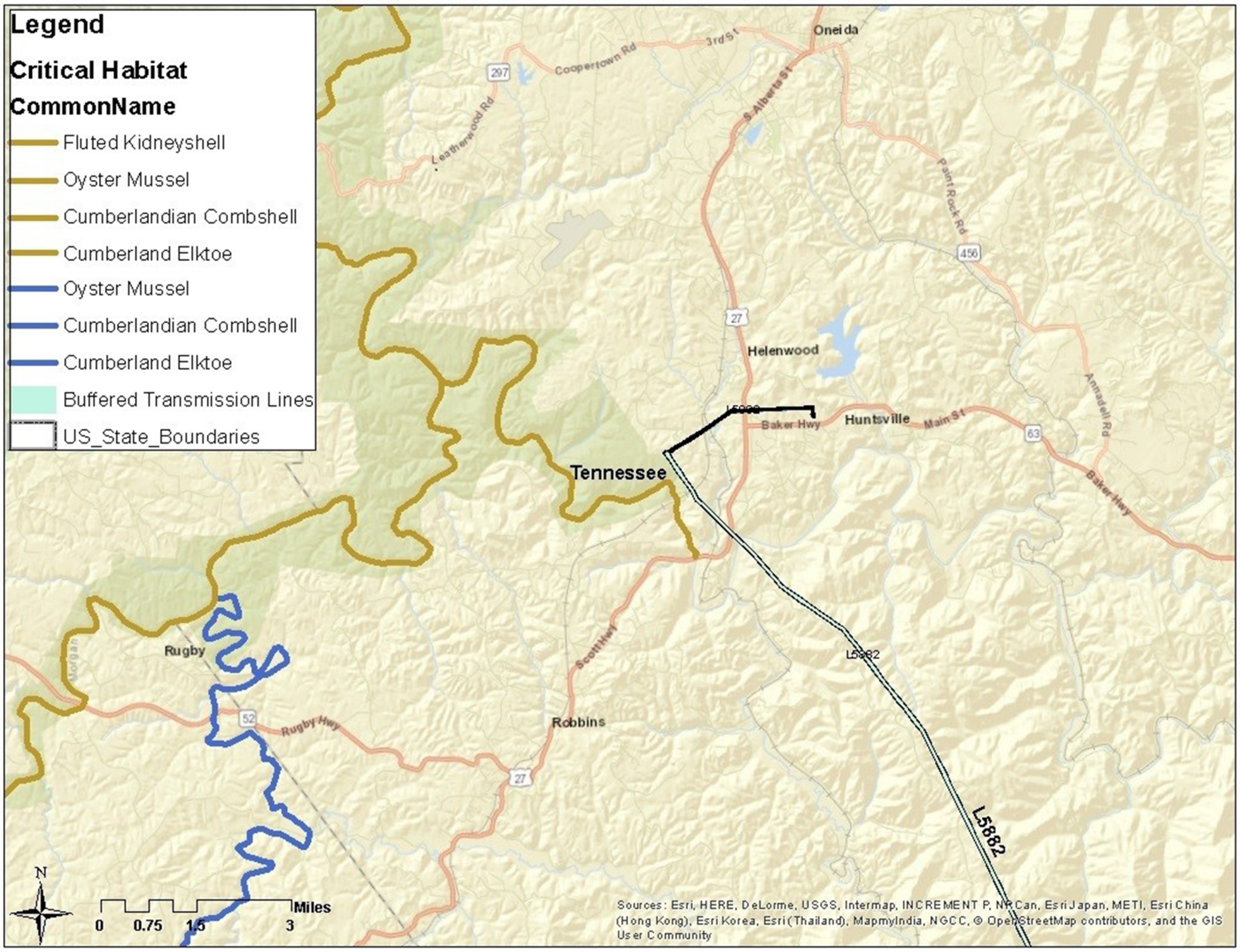


Figure M-17. Critical habitats for various aquatic species along Transmission Corridor L5882 in Tennessee.

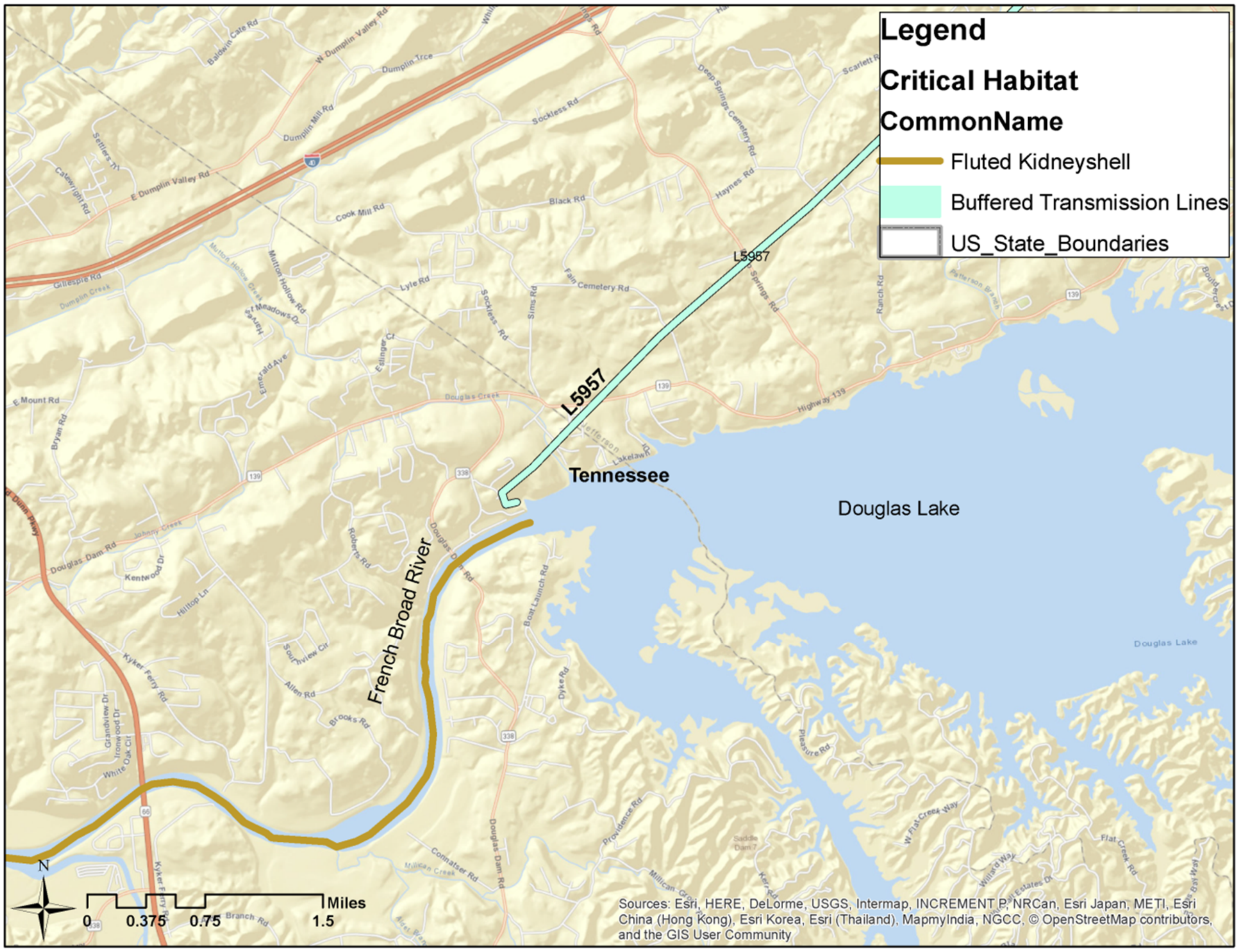


Figure M-18. Critical habitat for the fluted kidneyshell (*Ptychobranchus subtentum*) along Transmission Corridor L5957 in Tennessee.

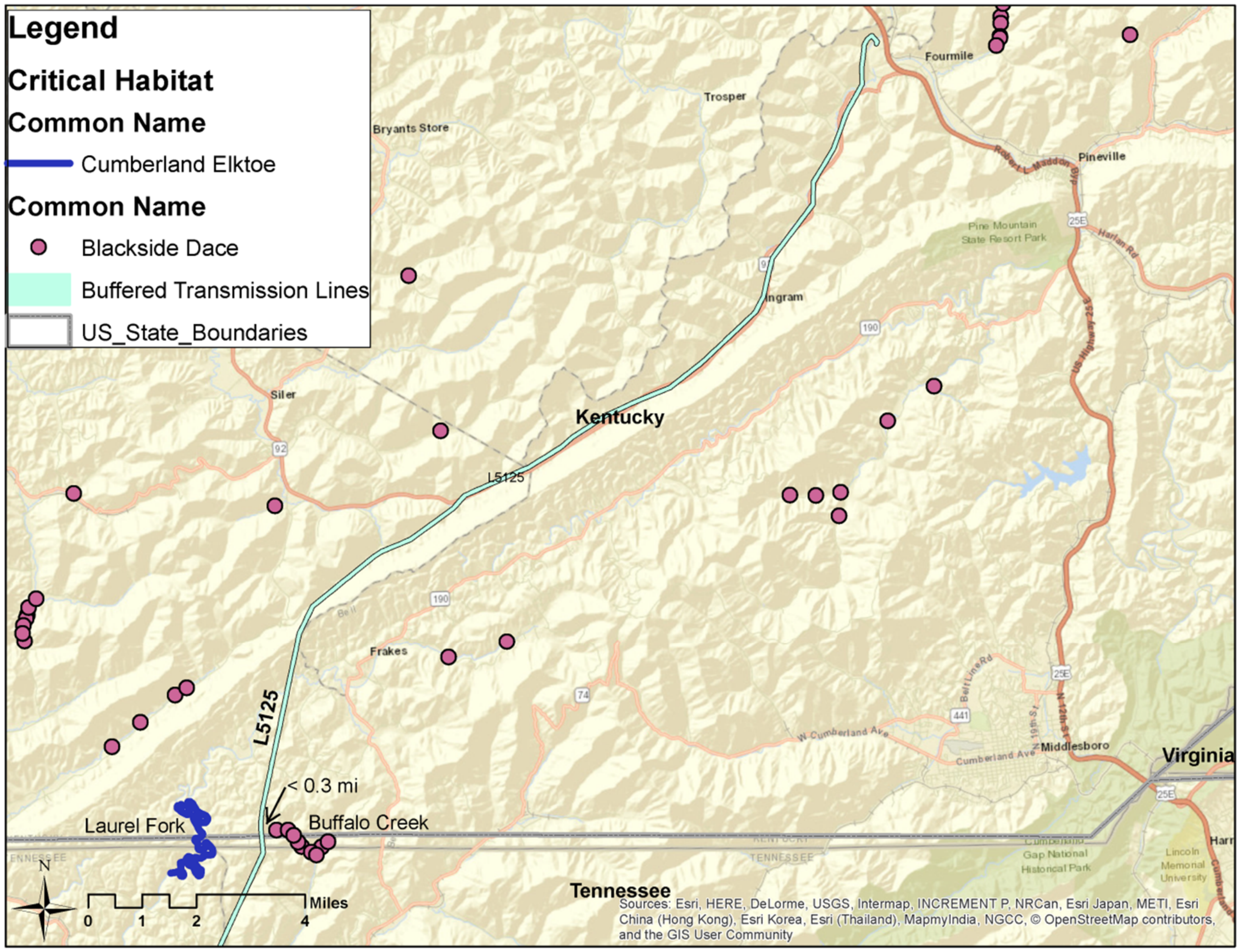


Figure M-19. Occurrences of blackside dace (*Phoxinus cumberlandensis*) and location of critical habitat for the Cumberland elktoe (*Alasmidonta atropurpurea*) along Transmission Corridor L5125 in Kentucky.

M.7 Potential Effects on Species and Habitats

This section describes the potential direct and indirect impacts on the species and critical habitats discussed in Section M.6 from changes in baseline terrestrial and aquatic resources (Section M.3) due to building (Section M.4) and operating (Section M.5) a reactor at the CRN Site. This section also describes various areas where the species described in Section M.6.1 may be affected in the CRN Site vicinity.

Sections M.7.1 through M.7.6 address the bat species covered in this BA. Section M.7.1 provides an overview of possible effects of building and operating SMRs at the CRN Site on bats, while Sections M.7.2 through M.7.6 individually address the gray bat, Indiana bat, NLEB, tri-colored bat, and little brown bat. Section M.7.7 addresses the aquatic species covered in this BA, specifically, the pink mucket mussel, sheepnose mussel, spotfin chub (a fish), and the hellbender (an amphibian). Section M.7.8 separately addresses the potential effects of the proposed transmission line upgrades on listed species and habitats.

M.7.1 Bat Species

M.7.1.1 CRN Site and Vicinity

As is evident from the descriptive characterizations provided in Section M.6.1 of this BA, the Indiana bat, NLEB, little brown bat, and tri-colored bat have similar (although not identical) life histories and habitat requirements in that they roost in trees during the non-hibernation season; forage in riparian areas, ponds, and wetlands, and in upland forest, forest openings, and fields; and use caves and mines as hibernacula. These four species are thus addressed together for effects due to potential loss of roosting and foraging habitat. The gray bat roosts in caves year-round and forages over waterbodies, and so is addressed individually for effects due to potential loss of forest cover providing access to foraging habitat. Noise impacts (Section M.7.1.4) are addressed for all five bat species collectively, and are used to describe the Action Area for bats. The analysis methods provided in FWS (2017-TN5346) are followed for the major impact activities of habitat removal and noise. Other minimal impact activities are addressed more succinctly for all five bat species collectively. Hypothetical blasting and demolition impacts to bats potentially using the five caves along Grassy Creek are discussed in Section M.7.1.4 because some use of the caves appears probable but is unknown. Separate summaries and conclusions are provided for each species but do not include as a basis the hypothetical blasting and demolition impacts to bats potentially using the caves along Grassy Creek discussed in Section M.7.1.4.

M.7.1.2 Activity − Vegetation Clearing (Forest and Non-Forest)

As noted in Section M.4.1 of this BA, about 311 ac of forest and about 195 ac of non-forested vegetation would be removed on the CRN Site and in the BTA to build the proposed facilities. An additional 210 ac of non-forested vegetation would be temporarily removed within an approximate 5-mi length of the 500-kV transmission line corridor (where the 69-kV buried line would be installed) between the perimeter of the CRN Site and the Bethel Valley Substation.

Potential cooling-tower salt deposition during project operations (Section M.5.1.1) would affect forest and non-forest vegetation that would already be cleared for building as described above, and thus would not add to the effects of vegetation clearing.

M.7.1.2.1 Stressor

Removing forest vegetation would remove non-hibernating roosting habitat potentially used by Indiana, northern long-eared, little brown, and tri-colored bats, but not gray bats which roost in caves. Removing forest vegetation would remove potential travel corridors for gray bats between summer cave roosts and foraging habitat over the Clinch River and associated wetlands, ponds, and streams. Removing non-forest vegetation would remove foraging habitat potentially used by Indiana, northern long-eared, little brown, and tri-colored bats, but not gray bats which forage over waterbodies.

M.7.1.2.2 Exposure (Time and Space)

Removal of the forested habitats potentially used by Indiana, northern long-eared, little brown, and tri-colored bats for non-hibernation roosting, and by gray bats as commuting corridors (to foraging habitat over the Clinch River and associated wetlands, ponds, and streams), would affect these species during the non-hibernating season (April 1–October 15). The permanent removal of forest vegetation (171 ac) (Section M.4.1.1.1) would permanently affect these species within the development footprint (Figure M-7). The temporary removal of forest vegetation (140 ac) (Section M.4.1.1.1) would affect these species until re-establishment of forests with trees sufficiently large to provide suitable roost sites and commuting corridors. The amount of time required to re-establish forest habitats that could provide roost sites and commuting corridors could vary from about 40 to 100 years, depending on the bat species. This time span may be reduced somewhat by replanting trees in temporarily disturbed areas (Section M.4.1.1.3).

Removal of the non-forested habitats potentially used by Indiana, northern long-eared, little brown, and tri-colored bats for foraging would affect these species during the non-hibernating season (April 1 to October 15). The permanent removal of non-forest vegetation (153 ac) (Section M.4.1.1.2) would permanently affect these species within the development footprint (Figure M-7). The temporary removal of non-forest vegetation (42 ac) (Section M.4.1.1.2) would affect these species until re-establishment of scrub-shrub/herbaceous vegetation sufficient to produce an insect prey base. The amount of time required to re-establish early successional habitats that would provide a prey base could be 10 years. This time may be reduced somewhat by revegetating temporarily disturbed areas (Section M.4.1.1.3).

M.7.1.2.3 Individual Response

Indiana, northern long-eared, little brown, and tri-colored bats using the forested portion of the development footprint for roosting when TVA fells trees for site preparation would be directly affected by being displaced and possibly experiencing injury or death. Displaced individuals would have to find alternate roost trees, and in doing so, could experience increased competition with other bats for remaining suitable roosts. Gray bats using forested areas on the CRN Site to commute nocturnally from cave roosts to foraging areas would not be directly affected during daytime tree removal, but may be indirectly affected by having to establish new nighttime commuting patterns to the same or to new foraging areas.

M.7.1.2.4 Interpretation

Removal of forested areas potentially used by Indiana, northern long-eared, little brown, and tri-colored bats during the non-hibernating season could reduce fitness for individuals that were disturbed or flushed because they would need to expend energy to find other appropriate roost trees in the vicinity, or because they may incur injury or mortality. Removal of forest cover used by gray bats as commuting corridors to the Clinch River and associated wetlands, ponds, and streams could reduce fitness for individuals required to find other forest commuting habitat in the vicinity. Removal of non-forested habitat used by Indiana, northern long-eared, little brown, and tri-colored bats as foraging habitat could reduce fitness for individuals required to find other foraging habitat in the vicinity. These impacts would last for the duration of vegetation removal activities, which TVA has estimated would continue for about 1 year (Section M.4.1.1).

Considering the abundance of forest and other terrestrial habitat in the region, as evident from Figure M-8, the losses of forest in the development footprint are unlikely to materially reduce the availability of suitable roosting, commuting, or foraging habitat for any of the subject bat species. This is especially true in the landscape north of the CRN site, which consists mostly of broad blocks of mature deciduous forest that are part of the ORR.

M.7.1.3 Activity − Wetland and Waterbody Removal

As noted in Section M.4.1.2 and Figure M-7, wetland loss on the CRN Site would total about 1.2 ac. Wetland loss in the BTA would total about 0.6 ac (Section M.4.1.2). Wetland loss within the existing 500-kV transmission line corridor where the 69-kV transmission line would be buried could total up to 2 ac (Section M.4.1.2). This constitutes a potential maximal permanent loss of less than 4 ac of wetland.

Wetland dewatering (Section M.4.1.2) is uncertain and would be temporary if it were to occur, and thus would not substantively add to the effects of wetland removal on bats.

One perennial stream, six ephemeral streams/wet weather conveyances, and two freshwater ponds lie within TVA's estimated building-activity footprint and would be permanently removed (Section M.4.1.3 and Figure M-7) (TVA 2017-TN4921). Five additional ephemeral streams located in the northeast section of the CRN Site (C04, C05, C06, C07, and C08) would be temporarily disturbed and then restored (Section M.4.1.3).

M.7.1.3.1 Stressor

Loss of wetlands, ponds, and perennial and ephemeral streams would remove foraging habitat potentially used by Indiana, northern long-eared, little brown, tri-colored, and gray bats.

M.7.1.3.2 Exposure (Time and Space)

Removal of the 4 ac of wetland habitats, and ponds and perennial and ephemeral streams potentially used by Indiana, northern long-eared, little brown, tri-colored, and gray bats for foraging would affect the species during the non-hibernating season (April 1 to October 15). The permanent removal of wetland, ponds, and perennial and ephemeral streams would permanently affect these species within the development footprint (Figure M-7). The temporary removal of ephemeral streams would affect these species until restoration of the ephemeral streams (Section M.4.1.3) and recolonization of an insect prey base. The amount of time required to restore ephemeral streams that would provide a prey base could be 10 years.

M.7.1.3.3 Individual Response

Bats using the wetlands, ponds, and perennial and ephemeral streams in the development footprint would not be directly affected by removal of these resources, because foraging takes place at night. However, removal of these resources could indirectly affect bats by causing them to need to find alternate foraging habitat.

M.7.1.3.4 Interpretation

Removal of wetlands, ponds, and perennial and ephemeral streams potentially used by Indiana, northern long-eared, little brown, tri-colored, and gray bats could reduce fitness for individuals required to expend energy to find other appropriate foraging habitat elsewhere in the vicinity. This impact would last for the duration of wetland and waterbody removal activities, which TVA has estimated would continue for about 1 year (Section M.4.1.1).

Considering the abundance of other wetlands, ponds, and streams in the region, as evident from Figure M-8, the loss of these resources from building and operating activities at the CRN Site, BTA, and underground transmission line areas are unlikely to materially reduce the availability of such foraging habitat for any of the subject bat species in the surrounding landscape.

M.7.1.4 Activity – Noise Generation (Building and Operation)

Daytime episodic construction noise produced by blasting and demolition would likely originate in the power-block area of the southern part of the CRN Site (Figure M-3) and may travel roughly 9 to 10 mi from the site before it attenuates to background levels (Section M.4.1.4). Vibrations from blasting may result in damage to structures as far away as 0.7 mi (FWS 2005-TN5382). Daytime noise from heavy construction equipment would be more regular, could originate from anywhere on the CRN Site, in the BTA, or along the 69-kV transmission line during burial, and may travel from about 1,600 ft (general noise levels from non-blasting, non-impact equipment) to about 2.5 mi (maximum noise levels from non-blasting impact equipment) before it attenuates to background levels (Section M.4.1.4). Nighttime noise from construction equipment may travel up to 3,200 ft before attenuating to background (Section M.4.1.4). In addition, human activity may also occur day and night during building activities, along with increased light levels during nighttime. Daytime and nighttime noise from the operation of cooling towers would originate from the southern part of the CRN Site (Figure M-3) and may travel about 6,000 ft before attenuating to background levels (Section M.4.1.4). Human activity may also occur day and night during the operation period, along with increased light levels during nighttime.

As noted in Section M.4.1.4, the sound attenuation rates used by the review team account only for distance and the soft site factor and do not consider other factors contributing to attenuation such as topography, vegetation, and atmospheric conditions. The review team estimates that effects of construction noise on the five bat species may be experienced up to about 0.5 mi from development activities. In developing this estimate, the review team considered the disparate locations of contributing noise sources, the conservatism inherent in the review team's projections of noise attenuation, and mitigative noise reduction methods proposed by TVA in their application. The review team also assumes that noise from the operation of cooling-towers could affect bats as far as 0.5 mi away.

Note that 0.5 mi from the CRN Site, the BTA, and the 69-kV transmission line constitutes the Action Area for bats, because it encompasses the area of direct and indirect effects of habitat loss (the above two activities described in Sections M.7.1.2 and M.7.1.3) and the indirect effects of noise.

M.7.1.4.1 Stressor

Daytime building noise (including ground vibrations from blasting and demolition that would occur only during daytime [Section M.4.1.4]), operation noise (cooling towers), and increased human activity could disturb tree-roosting bats (Indiana, northern long-eared, little brown, and tri-colored bats) during the non-hibernating season (April 1 to October 15). Nighttime building noise, operation noise (cooling towers), and increased human activity and lighting could disturb foraging Indiana, northern long-eared, little brown, tri-colored, and gray bats during the non-hibernating season.

Daytime ground vibrations and noise from blasting and demolition could potentially disturb gray bats if they were roosting in any of the five caves located on the Grassy Creek Habitat Protection Area during the non-hibernating season, and any of the five bat species if they were to use the caves for hibernation (October 15 to April 1). The risk of disturbance may be decreased by Chestnut Ridge, which lies between Grassy Creek and the CRN Site. However, the locations of the surface openings of the caves have not been mapped, nor have the underground portions been mapped, which may lie closer to the source of blasting on the CRN Site.

M.7.1.4.2 Exposure (Time and Space)

Building noise (including ground vibrations from blasting and demolition) and increased human presence and lighting could disturb the tree-roosting bat species day and night and during the non-hibernation season, as indicated in Section M.7.1.4.1, up to 0.5 mi from the CRN Site boundary, BTA, and the route of the 69-kV transmission line over a period of several years. Operation noise and increased human presence and lighting could disturb the subject bat species day and night during the non-hibernation period, as indicated in Section M.7.1.4.1, up to 0.5 mi from the CRN Site boundary over a period of 20 years.

The effects of daytime ground vibrations due blasting and demolition on bats potentially occupying the five caves located on the Grassy Creek Habitat Protection Area, as described in Section M.7.1.4.1, could occur over a period of several years.

M.7.1.4.3 Individual Response

Tree-roosting bats disturbed by day-time noise (including ground vibrations from blasting and demolition) and increased human activity could flush from roost trees, requiring them to expend energy finding other appropriate roost trees. Foraging bats disturbed by night-time noise and increased human activity and lighting may expend energy finding other alternative foraging areas.

Gray bats potentially roosting in the five caves in the Grassy Creek Habitat Protection Area during the non-hibernating season may be disturbed by ground vibrations and noise due to blasting and demolition and need to find alternate cave roost sites. Any of the subject bat species potentially hibernating in these caves may be aroused from torpor by this disturbance.

M.7.1.4.4 Interpretation

Tree-roosting bats that flush to find other roost trees or that avoid traditional foraging areas in search of foraging habitat elsewhere, because of noise, human activity, and light, would expend energy that could reduce fitness.

Gray bats potentially roosting in the five caves in the Grassy Creek Habitat Protection Area during the non-hibernating season may be disturbed and could expend energy finding alternate cave roost sites, which could reduce fitness. Arousal from torpor of any of the five bat species potentially hibernating in these caves could result in depletion of fat reserves needed for the duration of hibernation and spring migration.

M.7.1.5 Activity – Collision with Tall Structures

Notwithstanding bats' ability to echo-locate, they may infrequently suffer mortality from collisions with tall, stationary structures. For example, studies of bat mortality attributable to collision with the Susquehanna Steam Electric Station tall (540 ft) natural draft cooling towers between 1984 and 1986 found eight dead bats of three species (little brown bat, eastern red bat [*Lasiurus borealis*], and big brown bat [*Eptesicus fuscus*]) (NRC 1996-TN288). TVA proposes to use low stature (65 ft) mechanical draft cooling towers at the CRN Site, which would pose virtually no risk of collision mortality for the subject bat species. Lower structures pose less collision risk to flying animals. The risk of collision mortality posed by stationary tall construction equipment (e.g., cranes) would be low and temporary, reducing the risk even further. Thus, potential effects on the subject bat species due to collision mortality are considered minimal.

M.7.1.6 Activity – Changes in Surface-Water Quality

Changes in surface-water quality may be caused by sediment (Section M.4.1.3), herbicides (Section M.4.1.6), and other contaminants through erosion and accidental spills during building and operation. Because insects associated with wetland and aquatic habitats make up part of the diet of the Indiana, northern long-eared, little brown, and tri-colored bats (diet also includes terrestrial insects), and the complete diet of gray bats, a change in water quality could affect the local prey base. Decreases in water quality may reduce the availability of aquatic insects and reduce the availability of or quality of drinking water (FWS 2015-TN5312). It is expected that such water-quality impacts would be negligible and temporary because of TVA's use of BMPs (TVA 2012-TN4911) for controlling erosion and in its use of pesticides and herbicides, as well as its intention to implement a pollution prevention plan (Section M.4.1.3). It is therefore anticipated that any minor, temporary reductions in water quality and effects on associated prey (e.g., bioaccumulation of contaminants or prey reduction) would not cause a decrease in the fitness of bats.

M.7.1.7 Activity – Transmission Line Corridor Maintenance

Transmission line corridor vegetation maintenance (routine use of herbicides along with mowing and hand-clearing of vegetation) would only take place within the relocated section of the 161-kV corridor on the CRN Site (Figure M-3) (Section M.5.1.4). Maintenance of this corridor may be beneficial by providing long-term foraging habitat and a potential travel route along the Clinch River for Indiana, northern long-eared, little brown, and tri-colored bats.

M.7.2 Gray Bat

As discussed in Section M.6.1.1.4, one gray bat was captured in mist nets in summer on the CRN Site in 2011, and there was a total of 361–381 acoustic recordings (note that multiple recordings may be from one individual) in spring, summer, and fall on the CRN Site and in the BTA in 2013 and 2015 (Hamrick 2015-TN5187; LeGrand et al. 2015-TN5188). No caves are known to be located on the CRN Site or in the BTA. Thus, the species likely uses the CRN Site and BTA for foraging, but does not likely roost there. Rennies Cave and 2-Batteries Cave are located within the Grassy Creek Habitat Protection Area, and there are three additional caves/karst openings near Grassy Creek (LeGrand et al. 2015-TN5188). The five caves noted above have not been surveyed for bats. The CRN Site and BTA may be part of a foraging territory for bats in a maternity or non-maternity cave located somewhere offsite within 1 km of the Clinch River (FWS 1982-TN929), possibly in the caves noted above (Section M.6.1.1.4).

There would be no direct effects on gray bats from the activities discussed in Section M.7.1. Indirect effects are discussed below.

M.7.2.1 Indirect Adverse Effects

All gray bats fly in the protection of forest canopy between caves and foraging areas. Forested areas surrounding caves and between caves and over-water feeding habitat are advantageous for gray bat survival. Gray bat feeding areas have not been found over rivers or reservoirs where adjacent areas of forest have been cleared (FWS 1982-TN929). It is unknown whether and where any maternity or non-maternity caves are located near the proposed site. Thus, routes taken by gray bats in the area of building on the CRN Site to forage along the river and associated wetlands ponds, and streams are unknown. However, notwithstanding the lack of forest in the CRBR footprint, gray bats currently use the nearby river and wetland environment. It is uncertain whether removal of more forest in the northern part of the CRN Site and in the BTA (Figure M-7) would disrupt existing commuting routes to the river and associated wetlands and/or use of these as a foraging area. This could require gray bats to find alternative forested commuting corridors to the same or a more distant foraging area along the river. One factor that may facilitate possible continued use of the river environment in the project area for foraging is that a strip of forest would remain along the river after development of the CRN Site and the BTA (Figure M-7). However, it is uncertain whether this strip of forest is currently used to access the river and wetlands and whether it would be used after building, especially because it would become much narrower in places after site development (Figure M-7).

Potential indirect adverse effects on gray bats also include increased noise, human activity, and light levels during nighttime. It is difficult to predict the degree to which bats would be disturbed by noise. Some studies suggest that bats may be able to tolerate loud noises while other studies suggest that bats avoid noisy areas (FWS 2005-TN5382). There is evidence to suggest that increased levels of noise and light may have a negative effect on foraging bats (FWS 2017-TN5346). These factors could reduce the quality of remaining forested areas on and around the CRN Site and in the BTA for use as commuting corridors, and/or reduce the quality of the existing foraging areas along the Clinch River and associated wetlands, ponds, and streams. Avoidance could disrupt use of existing commuting routes to the river and associated wetlands and/or use of these as a foraging area, and necessitate finding alternative forested commuting corridors to the same or a more distant foraging area along the river. Depending on the energy expended to find new commuting corridors and/or foraging areas, and the increase in distance between caves and foraging areas, these activities could result in reduced fitness.

M.7.2.2 Summary

The review team concludes that loss of forest habitat and increased nighttime noise, human activity, and lighting on the CRN Site and in the BTA necessary to build the proposed facilities may adversely affect the gray bat. However, the review team does not believe that these effects could jeopardize the gray bat, because they are not expected to disturb hibernacula or enhance the spread of WNS.

M.7.3 Indiana Bat

As noted in Section M.6.1.2.4, Indiana bats were not captured with mist nets or detected acoustically in 2011 but were detected acoustically in 2013 both on the CRN Site and in the BTA (17 recordings on the CRN Site and 4 recordings in the BTA) in spring and summer (Hamrick 2015-TN5187; LeGrand et al. 2015-TN5188). The low number of acoustic recordings indicates the CRN Site and BTA are most likely used by males and/or nonreproductive females for spring and summer roosting and foraging. Because the species was only detected in spring and summer but not fall (when swarming in the vicinity of a hibernaculum would occur), either on the CRN Site or in the BTA, a hibernaculum is likely not located in the immediate vicinity (including the five caves in the Grassy Creek area). This assessment is not definitive due to the small size of the acoustic recording data set (note that multiple recordings may be from one individual). Based on the results of the potential roost tree study, forest habitat on the CRN Site and in the BTA provides suitable roosting habitat for the Indiana bat. The species is also known to occur on the ORR, but the nearest known maternity colony and hibernation site are 30 mi from the CRN Site (Section M.6.1.2.4.

M.7.3.1 Direct Adverse Effects

Potential direct adverse effects on roosting bats by tree removal could include (1) harm (injury or death) if occupied roost trees are felled (there are currently no seasonal tree harvest restrictions) and (2) harassment from tree felling noise resulting in displacement (FWS 2017-TN5346). Displaced bats may alter normal behavior patterns (FWS 2017-TN5346) and be forced to locate new roosts in the spring when they are stressed from hibernation and migration, or in the summer or fall, depending on the timing of tree harvest. Depending on the distance bats are required to fly to find suitable alternate roost tree habitats, their energy expenditure could result in reduced fitness. Bats could also encounter increased intra-specific or inter-specific competition (e.g., with the NLEB) in locating and establishing alternative roost sites, which could also result in reduced fitness. The roost availability in these areas may be limited by the habitat itself, as well as by competition. The displaced bats may need to increase energy expenditures because new roosting habitat may be more distant from traditional foraging areas. Alternatively, displaced bats may first seek new foraging areas and then new roost trees in association with them, also increasing energy expenditure (addressed in Section M.7.3.2).

Increased energy expenditure is anticipated to affect fitness and nutrition (FWS 2005-TN5382). Reduced fitness could result in reduced survivorship and decline in local population abundance and viability.

M.7.3.2 Indirect Adverse Effects

Potential indirect adverse effects on bats could include (1) removal of foraging habitat and (2) increased noise, human activity, and light levels. Both of these indirect adverse effects may result in a need to find alternative foraging areas.

The Indiana bat is dependent upon aquatic and terrestrial insects for forage. Much of the Indiana bat terrestrial prey base (e.g., moths, beetles, wasps, flying ants, leafhoppers, tree hoppers, etc.) are dependent upon a forested environment (FWS 2005-TN5382). Intermittent streams and riparian areas are often preferred foraging habitats for the bat (FWS 2005-TN5382). One of the primary effects on the Indiana bat would be the loss of foraging habitat (Section M.7.1.3). The loss of stream habitats, coupled with the loss of associated riparian forested habitats, would possibly eliminate some preferred foraging areas, as well as bat flyways and watering areas. In addition, the loss of riparian forest may greatly reduce the foraging efficiency because riparian forests have been shown to provide a much higher volume of insects (FWS 2005-TN5382). The forested habitat remaining in the Action Area would become more isolated (Figure M-7) and perhaps less suitable to support the Indiana bat.

Because Indiana bats likely locate their roost trees within foraging areas or along commuting corridors, any large-scale modification of habitat that includes destruction of foraging areas may be particularly detrimental (FWS 2005-TN5382). Indiana bats may also experience higher rates of predation when searching for new foraging and roosting areas due to loss of the benefits of site familiarity, which include more profitable exploitation of local food resources, and greater awareness of resident predators. Even if there is an ability to relocate, the I increased energy expenditure associated with loss and degradation of terrestrial foraging (and any associated roosting) habitat, riparian foraging habitat, and water sources may result in overall decreased fitness of individuals. Decreased fitness can result in death or injury through predation and starvation. In addition, the feeding habits of Indiana bats are similar to those of the little brown bat, the NLEB, and to a lesser extent the tri-colored bat (FWS 2005-TN5382). Indiana bats could thus also encounter increased intra-specific or inter-specific competition in locating and establishing alternative foraging areas. This could also result in reduced fitness, which may lead to reduced survivorship and decline in local population abundance and viability.

Noise (as well as increased human activity and light levels) would result in a decrease in the quality of the remaining habitat on the CRN Site and in the BTA (M.7.2.1). Because noise would be generated day and night, roosting and foraging bats may frequently be disturbed. It is conservative and reasonable to conclude that noise and vibrations related to building and operation activities could result in bats abandoning roosts. Limited data are available about how far away from noise tree-roosting bats need to be for these effects to be avoided (FWS 2005-TN5382). In the absence of these data, the review team relies on the standards noted in the introduction to the subsection on noise in Section M.7.1.1. Thus, the review team assumes noise and ground vibrations may affect bats up to 0.5 mi from the CRN Site, BTA, and buried 69-kV transmission line. Depending on the distance bats are required to fly to find new habitat in which they could resume roosting or foraging activities in calm conditions, their energy expenditure could result in reduced fitness. This reduced fitness could then result in reduced survivorship and reproduction and a decline in local population abundance.

M.7.3.3 Summary

The review team concludes that removal of roosting and foraging habitat and project-related noise generation, increased human activity, and lighting on the CRN Site and in the BTA necessary to build the proposed facilities may adversely affect the Indiana bat. However, the review team does not believe that these effects could jeopardize the Indiana bat, because they are not expected to disturb hibernacula or enhance the spread of WNS.

M.7.4 Northern Long-Eared Bat

As noted in Section M.6.1.3.4, one individual NLEB was captured in mist nets in summer on the CRN Site in 2011 and there was a total of 25 to 32 acoustic recordings (note that multiple recordings may be from one individual) in spring, summer, and fall on the CRN Site and in the BTA in 2013 and 2015 (Hamrick 2015-TN5187; LeGrand et al. 2015-TN5188). Given the low number of captures and acoustic recordings, the CRN Site and BTA are most likely used by males and/or nonreproductive females for spring, summer, and fall roosting and foraging. Roost sites have been documented to occur about 0.04 to 3.0 mi from foraging areas (80 FR 17974 - TN4216). Thus, roost sites may or may not occur on the CRN Site and in the BTA but should be assumed to occur there because of the presence of suitable habitat. The suitable habitat for the Indiana bat on the CRN Site and in the BTA is also suitable for the NLEB for spring, summer, and fall roosting and foraging. Acoustic recordings during fall indicate the possible presence of a hibernaculum in the vicinity (i.e., within about 5 mi). Rennies Cave and 2-Batteries Cave located within the Grassy Creek Habitat Protection Area, and the three additional caves/karst openings near Grassy Creek (LeGrand et al. 2015-TN5188) have not been surveyed for bats. A NLEB hibernaculum about 9 mi away was discovered by TVA in January 2014 (LeGrand et al. 2015-TN5188).

M.7.4.1 Direct Adverse Effects

Potential direct adverse effects on roosting bats by tree removal could include (1) harm (injury or death) if occupied roost trees are felled (there are currently no seasonal tree harvest restrictions) and (2) harassment from tree felling noise resulting in displacement.

Habitat loss and fragmentation increases the proportion of forest edge habitat, which correlates with reduced NLEB occupancy. Displaced bats may be forced to locate new roosts in the spring when they are stressed from hibernation and migration, or in the summer or fall, depending on the timing of tree harvest. Depending on the distance bats are required to fly to find suitable alternate roost tree habitats, their energy expenditure could result in reduced fitness. Bats could also encounter increased intra-specific or inter-specific competition (e.g., with the Indiana bat) in locating and establishing alternative roost sites, which could also result in reduced fitness. The roost availability in these areas may be limited by the habitat itself, as well as by competition. However, because NLEBs may roost in younger roost trees (down to 3 in. in DBH), the species may have greater roost tree availability, which could lessen the effects of locating and establishing alternative roost sites relative to the Indiana bat. Timber harvest alone has not to date had significant, population-level effects on the NLEB (80 FR 17974 -TN4216); this has not been the case for the Indiana bat. Thus, unlike the Indiana bat, effects on the fitness, including reproductive fitness or survivorship, of individual bats likely would not rise to the level of affecting population abundance and viability except when overlaid on the effects of WNS (Section M.6.1.3.1).

M.7.4.2 Indirect Adverse Effects

Potential indirect adverse effects on bats could include (1) removal of foraging habitat and (2) increased noise, human activity, and light levels. Both of these indirect adverse effects may result in a need to find alternative foraging areas.

Unlike the Indiana bat, NLEB foraging habitat is largely confined to under the forest canopy. Thus, mature forest habitat not only provides suitable roosting habitat, but is also an important habitat type for foraging NLEBs, because it provides prey that accommodate the gleaning part of the species' foraging lifestyle (e.g., snags and downed logs that provide insects) (80 FR 17974 -TN4216). Mature forest habitat would remain elsewhere on the CRN Site and in the BTA after building. It also exists offsite, more on the ORR than south of the Clinch River (Parr et al. 2015-TN5151). NLEBs whose foraging areas occur within an affected area of suitable habitat onsite or whose foraging areas would be disconnected (i.e., loss of a suitable travel corridor), may expend an increased amount of energy to establish new commuting patterns to alternate foraging areas, which could decrease fitness. NLEBs may also be subject to increases in inter- and intra-specific competition (Indiana bat, little brown bat, and to a lesser extent the tri-colored bat) if available foraging habitat is limited, which could also result in decreased fitness. Because the foraging habitat preferred by the NLEB is more specialized than that preferred by the Indiana bat, the effects of foraging habitat removal may affect the NLEB more.

The indirect impacts of noise (as well as increased human activity and light levels) on the NLEB would be similar to those of the Indiana bat and are thus not repeated here.

M.7.4.3 Summary

The review team concludes that removal of roosting and foraging habitat as well as project-related increase in noise generation, human activity, and lighting on the CRN Site and in the BTA necessary to build the proposed facilities may adversely affect the NLEB. However, the review team does not believe that these effects could jeopardize the NLEB, because they are not expected to disturb hibernacula or enhance the spread of WNS.

M.7.5 Tri-Colored Bat

As noted in Section M.6.1.4.4, three tri-colored bats were caught in mist nets on the CRN Site in 2011 and the species was recorded acoustically on the CRN Site and in the BTA in spring, summer, and fall in 2013 and 2015 (LeGrand et al. 2015-TN5188). The species was the most prevalent species acoustically recorded in the BTA in 2015 (Hamrick 2015-TN5187). The species uses manmade structures or tree cavities for maternity colonies. Non-maternity summer roosts are mainly in tree foliage and occasionally in buildings (NatureServe 2017-TN5216). It is possible that the species uses the CRN Site and BTA for roosting and foraging. Recordings of the species in the fall may indicate a possible hibernaculum in the vicinity of the CRN Site or BTA. One tri-colored bat was observed in Rennies Cave in the Grassy Creek Habitat Protection Area by archaeologists in April 2011 (Section M.6.1.4.4).

The same general direct and indirect adverse impacts described above for the Indiana bat and NLEB would also apply to the tri-colored bat.

The review team concludes that removal of roosting and foraging habitat and project-related noise generation and increased human activity and lighting on the CRN Site and in the BTA necessary to build the proposed facilities may adversely affect the tri-colored bat. However, the review team does not believe that these effects could jeopardize the tri-colored bat, because they are not expected to disturb hibernacula or enhance the spread of WNS.

M.7.6 Little Brown Bat

As noted in Section M.6.1.5.4, the little brown bat was not captured in mist nets on the CRN Site in 2011 (LeGrand et al. 2015-TN5188), but was recorded acoustically on the CRN Site and in the BTA in spring, summer, and fall in 2013 and 2015 (LeGrand et al. 2015-TN5188; Hamrick 2015-TN5187). Maternity colonies and non-maternity summer roosts are human-made structures or tree cavities (NatureServe 2017-TN5216). Recordings of the species in the fall may indicate a possible hibernaculum in the vicinity of the CRN Site or BTA.

The same general direct and indirect adverse impacts described above for the Indiana bat and NLEB would also apply to the little brown bat.

The review team concludes that removal of roosting and foraging habitat and project-related noise generation and increased human activity and lighting on the CRN Site and in the BTA necessary to build the proposed facilities may adversely affect the little brown bat. However, the review team does not believe that these effects could jeopardize the little brown bat, because they are not expected to disturb hibernacula or enhance the spread of WNS.

M.7.7 Aquatic Species

The aquatic species in the Tennessee River system (including Clinch River) have changed considerably as a result of human activities (e.g., impoundment of the river and introduction of invasive non-native species). Historical impoundment of the river below and above the CRN Site has greatly altered the dynamics of river flow. For example, spring floods that once occurred along the river no longer occur, and the expansive rocky or gravel shoal areas that once abounded in the Tennessee River system no longer exist (Etnier and Starnes 1993-TN5054). In particular, mussel populations have declined dramatically or have even been extirpated. Similarly, fish species richness and diversity have declined since the introduction of the impoundments on the Clinch River.

M.7.7.1 CRN Site and Vicinity

The Action Area for aquatic habitats in the CRN Site and vicinity is the same as the project area described in Section M.3.1 and shown in Figure M-3. Aquatic habitats in the project area of the CRN Site and vicinity include streams and ponds on the CRN Site and in the BTA (TVA 2017-TN4921). They also include the streams crossed by the proposed route for the 69-kV underground transmission line and the Clinch River arm of the Watts Bar Reservoir from above the location of the intake at approximately CRM 17.9, on the east side of the CRN Site to approximately CRM 14 just downstream of the barge-unloading facility and approximately 1.5 mi downstream of the discharge (located at approximately CRM 15.5 on the west side of the CRN Site).

M.7.7.2 Freshwater Mussels

Between September 21 and 26, 2011, TVA conducted a mollusk and habitat survey using semi-quantitative and qualitative sampling methods (TRC 2011-TN5168). A total of 74 living native mussels were collected from six different species (TRC 2011-TN5168). Neither the pink mucket nor the sheepnose mussel was found during these surveys. Zebra mussels have invaded the area and were found to be attached to 71 of the 74 living native mussels with an average area coverage of 28 percent (TRC 2011-TN5168). As discussed previously the presence of zebra mussels is detrimental to the survival of native mussels. Zebra mussels affect the growth and reproduction of native mussels by competing for space and food, interfering with the native mussel's ability to open and close their shells, impairing movement of the native mussels, and depositing metabolic wastes on the native mussels (FWS 2015-TN5218).

The most recent siting of a pink mucket in the Clinch River was in 1984 at CRM 19.1, slightly above the CRN Site. The sheepnose mussel was last observed in 1994 at CRM 21.4 downstream of Melton Hill Dam (TWRA 2017-TN5362). No pink muckets or sheepnose mussels either living or as relic shells, were found in the 2011 surveys at the CRN Site.

Based on the lack of observed sightings of the pink mucket and sheepnose mussels during surveys within the Action Area, either living or as relic shells, and the degree to which invasive zebra mussels have affected the existing native mussel population, the review team concludes that the endangered pink mucket and sheepnose mussels are unlikely to be present and therefore building and operating the CRN Site may affect but are not likely to adversely affect.

M.7.7.3 Spotfin Chub

TVA performed sampling studies in 2011 at two sampling locations downstream between CRM 14 and 15 and upstream between CRM 18 and 19.8 using electrofishing and gillnetting techniques. Surveys were conducted during the months of February, May, July, and October. The spotfin chub was not found during these surveys, either upstream or downstream.

During March 2015, TVA conducted biological surveys on streams inside the CRN Site and the BTA focusing on aquatic communities in pools, riffles, and runs appearing likely to support communities of aquatic biota. The spotfin chub was not identified in any of the surveys (TVA 2017-TN4921).

Based on the lack of observed sightings of the spotfin chub during surveys within the Action Area, the review team concludes that the spotfin chub is unlikely to be present and therefore building and operating the CRN Site may affect but is not likely to adversely affect.

M.7.7.4 Hellbender

The hellbender prefers habitats with swift running, fairly shallow, highly oxygenated waters. This species finds flat rocks, logs, or other cover in the vicinity of riffle areas, essential for feeding and breeding (Mayasich et al. 2003-TN5179). Its habitat is generally medium to large clear, fast-flowing streams with rocky bottoms, especially riffle areas and upper pool reaches. A hellbender was most recently observed in 1989 in the Clinch River downstream of Jones Island below Melton Hill Dam (TNHP 2017-TN5361). The Clinch River arm of the Watts Bar Reservoir adjacent to the CRN Site lacks the appropriate habitat for the hellbender. However, this species could still exist in the shallower water upstream of the site below Melton Hill Dam.

Based on the lack of appropriate habitat (fast-flowing water over rocky bottom with riffle areas) in the Action Area, the review team concludes that the hellbender is unlikely to be present and therefore building and operating the CRN Site may affect but is not likely to adversely affect it.

M.7.7.5 Summary of Effects

It is unlikely that Federally listed species (specifically the pink mucket, sheepnose mussel and spotfin chub) or the hellbender are present in the Clinch River arm of the Watts Bar Reservoir in the area of the CRN Site or in the streams and ponds on the site and in the BTA. The review team has determined that Federally listed species and the hellbender are not present in the Action Area and that building and operating the proposed project facilities at the CRN Site may affect but is not likely to adversely affect Federally listed species or the hellbender.

M.7.8 Transmission Line Upgrades

The transmission lines identified by TVA for upgrades are listed in Table M-3 and depicted in Figure M-4, and the descriptions of TVA's upgrade activities are provided in Section M.4.2. The uncertainties surrounding TVA's identification of these transmission lines, the upgrade engineering solutions, and locations and extent of habitat disturbance are described in Section M.4.2. The review team expects, based on the nature of how transmission lines are upgraded, that TVA would limit ground disturbance to upland areas within the existing bounds of established right-of-ways, and thus would not physically disturb aquatic habitats or wetlands or remove mature trees or forest cover (including trees from forested wetlands, stream banks, or reservoir shorelines). Under this assumption, there could be no impacts on fish and mollusk species in Table M-8, Table M-9, and Table M-10 (for all of which NA is accordingly noted), as well as any critical habitat for these species, If TVA submits a project design in a future COL or CP application that reveals potential impacts to aquatic, wetland, or forest area, then it would be necessary at that time to evaluate possible adverse effects to species using those habitats.

Note that there is no Action Area for the offsite transmission lines, because the location and extent of habitat disturbance within the upland portions of the 430 mi of corridors is unknown and would likely constitute only a small percentage of their land area (5,327 ac). The bat species, Berry cave salamander, and several plant species listed in Table M-10 could occur in upland areas within the bounds of corridors of transmission lines identified for upgrade (Table M-3) in the counties where the species are known to occur (Table M-8 and Table M-10). The mammals that potentially could be affected include the Virginia big-eared bat (*Corynorhinus [=Plecotus] townsendii virginianus*), gray bat, NLEB, little brown bat, and Indiana bat. The gray bat, NLEB, little brown bat, and Indiana bat could be affected by reconductoring activities in the corridor of transmission line L5125 in Campbell County, Tennessee. Potential effects would be possible if such activities are actually conducted within this corridor and near Norris Dam cave (Figure M-10) (which occurs in the corridor and is known or assumed to have been used by these species in the past [Table M-9 and Table M-10]) and if the species use Norris Dam cave during the duration of work activities, all of which are currently unknown. The Virginia big-eared bat could possibly be affected by reconductoring activities in the corridor of transmission line L5125 in Whitley County, Kentucky (Table M-10). Potential effects would be possible if suitable cave habitat occurs in this corridor and is inhabited by the species, and if such activities are actually conducted within this corridor and near an inhabited cave during its season of use by the species, all of which are currently unknown.

The Berry cave salamander (*Gyrinophilus gulolineatus*) could possibly be affected by upgrade activities in the corridors of transmission lines L5092 and L5659 in Knox County and L5205, L5235, L5280, and L5743 in Roane County, Tennessee (Table M-3 and Table M-10). Potential effects would be possible if suitable cave habitat occurs in this corridor and is inhabited by the species, and if such activities are actually conducted within this corridor and near an inhabited cave, all of which are currently unknown.

Virginia spiraea (*Spiraea virginiana*) could possibly be affected by uprate activities in the corridor of transmission line L5173 in Rhea County, Tennessee (Table M-3), because this species is known to occur just outside the corridor near Piney Creek (Figure M-11 and Table M-10) and may thus also occur near this creek within the corridor. The species could also be affected by upgrade activities in the corridors of transmission lines in Whitely County, Kentucky, and Bledsoe, Cumberland, Hamilton, Roane, Scott, Sequatchie, VanBuren, and White Counties, Tennessee (transmission lines listed in Table M-10), counties in which the species is known to occur (Table M-8). Potential effects would be possible if suitable habitat occurs in these corridors and is occupied by the species, and if upgrade activities are actually conducted within these corridors and near occupied habitat, all of which are currently unknown.

Price's potato-bean (*Apios priceana*) could be affected by upgrade activities in the corridors of transmission lines L5167 and L5702 in Franklin County, Tennessee (Table M-10), counties in which the species is known to occur (Table M-8). Potential effects would be possible if suitable habitat occurs in these corridors and is occupied by the species, and if upgrade activities are actually conducted within these corridors and near occupied habitat, all of which are currently unknown.

Cumberland rosemary (*Conradina verticillata*) could be affected by upgrade activities in the corridors of transmission lines L5204 and L5205 in Cumberland, L5882 in Scott, and L5173 in White Counties, Tennessee (Table M-10), counties in which the species is known to occur (Table M-8). Potential effects would be possible if suitable habitat occurs in these corridors and is occupied by the species, and if upgrade activities are actually conducted within these corridors and near occupied habitat, all of which are currently unknown.

White fringeless orchid (*Platanthera integrilabia*) could be affected by upgrade activities in the corridors of transmission lines in Whitely County, Kentucky, and Bledsoe, Cumberland, Franklin, Grundy, Hamilton, Roane, Scott, Sequatchie, VanBuren, and Warren Counties, Tennessee (transmission lines listed in Table M-10), counties in which the species is known to occur (Table M-8). Potential effects would be possible if suitable habitat occurs in these corridors and is occupied by the species, and if upgrade activities are actually conducted within these corridors and near occupied habitat, all of which are currently unknown.

The Carolina northern flying squirrel, painted tigersnail, spruce-fir moss spider, several plant species, and rock gnome lichen are unlikely to occur in upland areas within the bounds of corridors of transmission lines (Table M-10 [species for which NA is noted]) are likewise unlikely to be adversely affected by transmission line upgrades.

The critical habitats for the spruce-fir moss spider and Indiana bat were dismissed from further evaluation in Section M.6.2.

At the ESP stage, NRC regulated ground-disturbing activities are not approved. If an applicant later requests a COL or CP relying on the ESP, additional protective measures, if any, would be developed in consultation with other applicable Federal, State, and local agencies at the COL or CP stage.

M.8 Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions (not involving other Federal actions because these would undergo separate Section 7 consultation) that are reasonably certain to occur in the Action Area (FWS and NMFS 1998-TN1031). The Action Area for bats is defined in Section M.7.1.4. It consists of the land area within about 0.5 mi from the CRN Site boundary, BTA, and the route of the 69-kV transmission line, which includes land within the Grassy Creek Habitat Protection Area and ORR to the north, as well as to the south of the Clinch River. This Action Area encompasses the area of the direct and indirect effects of habitat loss and the indirect effects of noise, human activity, and lighting. Cumulative impacts may result when the effects of future State, Tribal, local, or private actions are overlaid on those arising from the building and operation activities associated with the CRN Site, BTA, and underground transmission line. Within the Action Area for bats, the future actions that would affect resources used by bats include anticipated continued small-scale development of the ORR as well as small-scale, dispersed agricultural development and forest harvest in non-ORR lands to the south and west. The effects of these small-scale activities alone in the Action Area would be minor in comparison to those associated with building and operating activities at the CRN Site, BTA, and affected underground transmission line area, especially during the period of building activities, and would likely be somewhat offset in the long-term by reversion of abandoned agricultural or timber land back to forest. Thus, the effects of agricultural development and forest harvest on bats would be generally similar to those arising from building and operating activities at the CRN Site, BTA, and affected underground transmission line area.

The Action Area for aquatic species is within the CRN Site and the BTA as well as the adjacent stretch of the Clinch River arm of the Watts Bar Reservoir from the proposed location of the intake at approximately CRM 17.9, on the east side of the CRN Site to approximately CRM 14 just downstream of the barge-unloading facility to the barge-unloading facility. Within the Action Area, potential future actions include small-scale, dispersed agricultural development along the opposite shore of the Clinch River arm of the Watts Bar Reservoir from the site. The effects of these activities alone, although similar, would also be minor in comparison to effects of building and operating activities at the CRN Site, BTA, and affected underground transmission line area.

Note that because there is no Action Area for the offsite transmission lines (Section M.7.8), there is no corresponding evaluation of cumulative impacts.

M.9 Conclusions

TVA applied to the NRC for an ESP to address certain siting issues associated with building multiple SMRs at the CRN Site on the Clinch River in the southwest part of the City of Oak Ridge, Tennessee. The CRN Site is presently undeveloped, although a portion of it has a history of disturbance as part of site preparation for the CRBR project discontinued in the early 1980s. If the NRC issues an ESP, that action will resolve certain siting issues for up to 20 years but will not actually authorize TVA to construct or operate reactors on the CRN Site. TVA will still have to apply to the NRC in the future for a COL or CP before proceeding to construct the reactors.

This BA evaluates the potential effects from building and operating SMRs at the CRN Site on five bat species (the gray bat, Indiana bat, NLEB, tri-colored bat, and little brown bat), two mussel species (pink mucket and sheepnose mussel), one fish species (spotfin chub), and one amphibian species (hellbender). The tri-colored bat, little brown bat, and hellbender are not actually protected under the ESA, but may be listed in the future. The Action Area for bats addressed in the BA encompasses lands within about 0.5 mi from the CRN Site boundary, BTA, and the route of the 69-kV transmission line, which encompasses the area of direct and indirect effects of habitat loss and the indirect effects of noise, human activity, and lighting.

The Action Area for aquatic habitats addressed in the BA encompasses the streams and ponds on the CRN site, BTA, and other affected areas as well as adjoining portions of the Clinch River arm of Watts Bar Reservoir. Aquatic habitats on the CRN Site and in the vicinity include multiple streams and ponds (TVA 2017-TN4921). They also include multiple streams crossed by the proposed route for the 69-kV underground transmission line and the Clinch River arm of the Watts Bar Reservoir from above the location of the intake at approximately CRM 17.9, on the east side of the CRN Site to approximately CRM 14 just downstream of the barge-unloading facility and approximately 1.5 mi downstream of the discharge (located at approximately CRM 15.5 on the west side of the CRN Site).

The BA was prepared by terrestrial and aquatic biologists with NRC and its contractor, PNNL, and the USACE, which is a cooperating agency working under NRC's lead to prepare an EIS for the ESP. The biologists visited the Action Area on and in the vicinity of the site and communicated with the FWS multiple times from 2014 through 2017. This BA evaluates effects based on a PPE representing a conceptual design developed by TVA to support the ESP application submitted to NRC in 2017. If TVA subsequently decides to submit an application for a COL or CP to NRC, it will include with that application an updated, more specific design. The NRC would at that time prepare a subsequent BA that would update this current BA to reflect the updated design, species, and habitats known to potentially occur in the Action Areas at that time, and baseline conditions in the Action Areas at that time.

M.9.1 CRN Site, BTA, and Vicinity Including the Affected 69 kV Transmission Line Corridor

Effects determinations drawn by the review team at this time are provided in Table M-11 for each of the nine species addressed in this BA for the CRN Site, BTA, and buried 69 kV transmission line. These determinations are predicated on the conceptual project design and PPE that TVA submitted to the NRC when applying for the CRN Site ESP as outlined in Section M.3.3 of this BA and the evaluations of direct and indirect effects on each species presented in Section M.7 of this BA.

Table M-11. Effect Determinations for Federally Listed Species and FWS Requested Species from Building and Operating the Proposed SMRs at the CRN Site

Common Name	Scientific Name	Status	Determination
Gray bat	*Myotis grisescens*	E	May affect, likely to adversely affect (LAA)
Indiana bat	*Myotis sodalis*	E	May affect; LAA
NLEB	*Myotis septentrionalis*	T	May affect; LAA
Tri-colored bat	*Perimyotis subflavus*	—	May affect, LAA
Little brown bat	*Myotis lucifugus*	—	May affect, LAA
Pink mucket mussel	*Lampsilis abrupta*	E	May affect, not likely to adversely affect (NLAA)
Sheepnose mussel	*Plethobasus cyphyus*	E	May affect, NLAA
Spotfin chub	*Erimonax monachus*	T	May affect, NLAA
Hellbender	*Cryptobranchus alleganiensis*	—	May affect, NLAA

E = Federal endangered; T = Federal threatened.

Source: USFWS Environmental Conservation Online System (https://ecos.fws.gov/ecp/).

The review team concludes that the building and operating activities at the CRN Site, BTA, and affected transmission line areas may affect and are likely to adversely affect (LAA) each of the five bat species addressed. Most of the potential adverse effects would be related to loss of forest habitat and increased daytime and nighttime noise, human activity, and lighting. However, the review team does not believe that the project could jeopardize any of the bat species.

The review team concludes that building and operating activities at the CRN Site, BTA, and affected transmission line areas may affect but is not likely to adversely affect (NLAA) any of the aquatic species addressed in this BA. Extensive prior disturbance of once suitable habitats for these species in the Action Area makes their continued presence unlikely. The review team acknowledges the possible presence of hellbenders in the shallows of the Clinch River arm of

Watts Bar Reservoir upstream from the CRN Site to Melton Hill Dam, but this portion of the reservoir is unlikely to be affected by building and operating activities at the CRN Site and BTA.

M.9.2 Offsite Transmission Line Upgrades

As discussed in Section M.7.8, there is no information on the locations and extent of habitat disturbance within the uplands of the offsite transmission line corridors. Consequently, an evaluation of potential impacts to the Federally listed bat species, Berry cave salamander, and several plant species that could occur in the uplands (Table M-10, species without a NA notation) could not be performed (Section M.7.8). Thus, the review team is unable to make impact conclusions for these species at this time. The review team's conclusion for Federally listed Carolina northern flying squirrel, painted tigersnail, spruce-fir moss spider, several plant species, and rock gnome lichen that likely would not occur in the uplands of the offsite transmission line corridors (Table M-10, species with a NA notation) is NLAA. The determination for the critical habitat for the Indiana bat and spruce-fir moss spider is no adverse modification because the critical habitats for the species do no occur within or near the transmission line corridors (Section M.6.2).

The review team concludes that the transmission line upgrades would have no effect (NE) on each of the aquatic species (fish and mollusks) in Table M-10. This conclusion reflects the assumption that TVA would not perform any work within rivers, streams, ponds, reservoirs, wetlands, or other surface-water bodies as part of the transmission line upgrades. It also reflects TVA's commitment to implement construction BMPs to prevent sedimentation of waterbodies near areas where work is performed. It also reflects the fact that any work conducted as part of the upgrades would be brief, not involve any widespread grading, and employ construction BMPs to prevent or minimize sedimentation and erosion.

TVA's identification of transmission line segments for upgrades is strictly conceptual at this point in time. At the COL or CP stage, TVA or another applicant, would be able to accurately assess the need for transmission line upgrades necessitated by the project and identify specific locations for work required as part of the upgrades. Any subsequent BA prepared as part of a review of a future COL or CP application for the CRN Site would examine any information contained in the future application that may be inconsistent with any of the review team's assumptions at this time. The subsequent BA would also be prepared at a time when TVA has clearer information about exactly where work would have to be performed.

M.10 References

10 CFR Part 50. *Code of Federal Regulations*, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities." Washington, D.C. TN249.

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." Washington, D.C. TN250.

10 CFR Part 52. *Code of Federal Regulations*, Title 10, *Energy*, Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." Washington, D.C. TN251.

40 CFR Part 125. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 125, "Criteria and Standards for the National Pollutant Discharge Elimination System." Washington, D.C. TN254.

32 FR 4001. March 11, 1967. "Native Fish and Wildlife; Endangered Species." *Federal Register*, Fish and Wildlife Service, Washington, D.C. TN2750.

41 FR 24062. June 14, 1976. "Endangered Status for 159 Taxa of Animals." *Federal Register,* Department of the Interior, Washington, D.C. TN5173.

41 FR 41914. September 24, 1976. "Determination of Critical Habitat for American Crocodile, California Condor, Indiana Bat, and Florida Manatee." *Federal Register*, Fish and Wildlife Service, Washington, D.C. TN275.

42 FR 45526. September 9, 1977. "Final Threatened Status and Critical Habitat for Five Species of Southeastern Fishes." *Federal Register*, Fish and Wildlife Service, Washington, D.C. TN5178.

42 FR 47840. September 22, 1977. "Endangered and Threatened Wildlife and Plants: Correction and Augmentation of Public Rulemaking on Critical Habitats." *Federal Register*, Fish and Wildlife Service, Washington, D.C. TN5355.

43 FR 28932. July 3, 1978. "Determination that Seven Eastern U.S. Land Snails are Endangered or Threatened Species." *Federal Register*, Fish and Wildlife Service, Washington, D.C. TN5374.

66 FR 35547. July 6, 2001. "Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Spruce-fir Moss Spider." *Federal Register*, Fish and Wildlife Service, Washington, D.C. TN5381.

66 FR 65256. December 18, 2001. "National Pollutant Discharge Elimination System: Regulations Addressing Cooling Water Intake Structures for New Facilities." *Federal Register,* Environmental Protection Agency, Washington, D.C. TN243.

72 FR 57416. October 9, 2007. "Limited Work Authorizations for Nuclear Power Plants." *Federal Register,* Nuclear Regulatory Commission, Washington, D.C. TN260.

76 FR 38095. June 29, 2011. "Endangered and Threatened Wildlife and Plants; 90-Day Finding on a Petition to List the Eastern Small-Footed Myotis and the Northern Long-Eared Bat as Threatened or Endangered." *Federal Register*, Fish and Wildlife Service, Washington, D.C. TN1798.

77 FR 14914. March 13, 2012. "Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Sheepnose and Spectaclecase Mussels Throughout Their Range, Final Rule." *Federal Register,* Department of the Interior, Washington, D.C. TN5177.

78 FR 61046. October 2, 2013. "Endangered and Threatened Wildlife and Plants; 12–Month Finding on a Petition To List the Eastern Small-Footed Bat and the Northern Long-Eared Bat as Endangered or Threatened Species; Listing the Northern Long-Eared Bat as an Endangered Species." *Federal Register*, Fish and Wildlife Service, Washington, D.C. TN3207.

80 FR 17974. April 2, 2015. "Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Northern Long-Eared Bat With 4(d) Rule—Final Rule and Interim Rule with Request for Comments." *Federal Register*, Fish and Wildlife Service, Washington, D.C. TN4216.

81 FR 62826. September 13, 2016. "Endangered and Threatened Wildlife and Plants; Threatened Species Status for *Platanthera integrilabia* (White Fringeless Orchid)." *Federal Register*, Fish and Wildlife Service, Washington, D.C. TN5378.

82 FR 60362. December 20, 2017. "Endangered and Threatened Wildlife and Plants; 90-Day Findings for Five Species." *Federal Register*, Fish and Wildlife Service, Washington, D.C. TN5416.

80 Stat. 926. 1966. Endangered Species Preservation Act of 1966. Public Law 89-669. TN5344.

16 U.S.C. § 1531 et seq. Endangered Species Act of 1973. TN1010.

Baranski, M.J. 2011. *Aquatic Natural Areas Analysis and Evaluation Oak Ridge Reservation*. ORNL/TM-2011/13, Oak Ridge National Laboratory, Oak Ridge, Tennessee. Accession No. ML18019A939. TN5164.

BRC (Breeder Reactor Corporation). 1985. *The Clinch River Breeder Reactor Plant Project*. Final Report, Oak Ridge, Tennessee. Accession No. ML18064A893. TN5245.

CBD (Center for Biological Diversity) and DoW (Defenders of Wildlife). 2016. *Petition to list the Tricolored Bat* Perimyotis subflavus *as Threatened or Endangered under the Endangered Species Act*. Tucson, Arizona and Washington, D.C. Accession No. ML18019A110. TN5360.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. FWS/OBS-79/31, Fish and Wildlife Service, Washington, D.C. Accession No. ML18019A904. TN5186.

Cox, P.B., A.J. Dattilo, and J.T. Baxter, Jr. 2015. *Clinch River Small Modular Reactor Site Terrestrial Plant Communities and Botanical Resources Survey Report*. Revision 5, Tennessee Valley Authority, Knoxville, Tennessee. Accession No. ML17334A049. TN5193.

Currie, R.R. 1993. *Recovery Plan for American Hart's-Tongue* (Asplenium scolopendrium *var*. americanum). Southeast Region, U.S. Fish and Wildlife Service, Atlanta, Georgia. Accession No. ML18019A907. TN5306.

DOE (U.S. Department of Energy). 1984. *Clinch River Breeder Reactor Plant Project Site Redress Plan*. Washington, D.C. Accession No. ML18065A004. TN5282.

DOE (U.S. Department of Energy). 2017. *Oak Ridge Reservation Annual Site Environmental Report 2016*. DOE/ORO/251, Oak Ridge, Tennessee. Accession No. ML18019B167. TN5081.

DOE (U.S. Department of Energy), TVA (Tennessee Valley Authority), and PMC (Project Management Corporation). 1984. *Clinch River Breeder Reactor Plant Site Redress Planning Task Force Report*. Washington, D.C., Knoxville Tennessee, and Oak Ridge, Tennessee. Accession No. ML17334A059. TN5221.

EPA (U.S. Environmental Protection Agency). 2004. "Level III and IV Ecoregions of EPA Region 4." Washington, D.C. Accession No. ML18023A339. TN5158.

EPA (U.S. Environmental Protection Agency). 2013. "Level III and IV Ecoregions of the Continental United States." Washington, D.C. Accession No. ML18023A341. TN5033.

Etnier, D.A. and W.C. Starnes. 1993. *The Fishes of Tennessee*. University of Tennessee Press, Knoxville, Tennessee. Accessed October 11, 2017, at http://trace.tennessee.edu/utk_utpress/2/. TN5054.

FWS (U.S. Fish and Wildlife Service). 1982. *Gray Bat Recovery Plan*. FWS Reference Service, Denver, Colorado. Accession No. ML18023A169. TN929.

FWS (U.S. Fish and Wildlife Service). 1997. "Threatened and Endangered Species, Gray Bat (*Myotis grisescens*)." Washington, D.C. Accession No. ML18023A170. TN5194.

FWS (U.S. Fish and Wildlife Service). 2005. *Biological Opinion on the Impacts of the Laxare East & Black Castle Contour Coal Mining Projects on the Indiana Bat.* West Virginia Field Office, Elkins, West Virginia. Accession No. ML18059A111. TN5382.

FWS (U.S. Fish and Wildlife Service). 2006. "Threatened and Endangered Species: Indiana Bat (*Myotis sodalis*)." Fort Snelling, Minnesota. Accession No. ML15043A589. TN4167.

FWS (U.S. Fish and Wildlife Service). 2007. *Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision*. Great Lakes-Big Rivers Region, Fort Snelling, Minnesota. Accession No. ML14302A612. TN934.

FWS (U.S. Fish and Wildlife Service). 2009. Gray *Bat (*Myotis grisescens*) 5-Year Review: Summary and Evaluation*. Midwest Region, Columbia, Missouri. Accession No. ML18023A172. TN5330.

FWS (U.S. Fish and Wildlife Service). 2009. *Indiana Bat* (Myotis sodalis) *5-Year Review: Summary and Evaluation.* Midwest Region, Region 3, Bloomington, Indiana. Accession No. ML18059A112. TN5356.

FWS (U.S. Fish and Wildlife Service). 2014. *Northern Long-Eared Bat Interim Conference and Planning Guidance, USFWS Regions 2, 3, 4, 5, & 6*. Bloomington, Minnesota. Accession No. ML15043A596. TN4162.

FWS (U.S. Fish and Wildlife Service). 2015. "Price's Potato-bean (*Apios priceana*). Midwest Region, Bloomington, Minnesota. Accession No. ML18059A113. TN5375.

FWS (U.S. Fish and Wildlife Service). 2015. "Section 7 Technical Assistance: Summary of Indiana Bat Ecology." Midwest Region, Bloomington, Minnesota. Accession No. ML18023A175. TN5312.

FWS (U.S. Fish and Wildlife Service). 2015. *Zebra Mussel (*Dreissena polymorpha*) Ecological Risk Screening Summary*. Washington, D.C. Accession No. ML18023A174. TN5218.

FWS (U.S. Fish and Wildlife Service). 2017. *Biological Opinion: Office of Surface Mining and Enforcement Approval of Surface Mining at Kopper Glo Mining, LLC, Cooper Ridge Surface Mine, OSMRR Permit Number 3370, Claiborne County, Tennessee*. FWS Tennessee Ecological Field Services Office, Cookeville, Tennessee. Accession No. ML18059A114. TN5346.

FWS (U.S. Fish and Wildlife Service). 2017. "Fact Sheet: Rusty Patched Bumble Bee." Midwest Region, Bloomington, Minnesota. Accession No. ML18059A119. TN5376.

FWS (U.S. Fish and Wildlife Service). 2017. "IPaC Information for Planning and Consultation." ECOS – Environmental Conservation Online System, Fort Collins, Colorado. Accession No. ML18023A181. TN5328.

FWS (U.S. Fish and Wildlife Service). 2017. Letter from M.E. Jennings to NRC, dated May 5, 2017, regarding "FWS# 2017-I-473. U.S. Nuclear Regulatory Commission – Requests for Participation in the Environmental Scoping Process and a List of Federally Protected Species Within the Area Under Evaluation for the Proposed Clinch River Nuclear Site Located in Oak Ridge, Roane County, Tennessee." Cookeville, Tennessee. Accession No. ML17205A341. TN5090.

FWS (U.S. Fish and Wildlife Service). 2017. Letter from M.E. Jennings to NRC, dated July 20, 2017, regarding "FWS# 2017-I-473. U.S. Nuclear Regulatory Commission (NRC) – Updated List of Federally Threatened and Endangered Species that Potentially Occur near the Proposed Clinch River Small Modular Nuclear Reactor Facility in Oak Ridge, Roane County, Tennessee." Cookeville, Tennessee. Accession No. ML17205A342. TN5091.

FWS (U.S. Fish and Wildlife Service). 2017. "National Wetlands Inventory: Wetlands Mapper." Madison, Wisconsin. Available at https://www.fws.gov/wetlands/data/mapper.html. TN5327.

FWS (U.S. Fish and Wildlife Service). 2017. "Species Profile for Hellbender (*Cryptobranchus alleganiensis*)." ECOS–Environmental Conservation Online System, Fort Collins, Colorado. Accession No. ML18059A116. TN5365.

FWS (U.S. Fish and Wildlife Service). 2017. "Species Profile for Indiana Bat (*Myotis sodalis*). ECOS–Environmental Conservation Online System, Fort Collins, Colorado. Accession No. ML18059A115. TN5357.

FWS (U.S. Fish and Wildlife Service). 2017. "Species Profile for Morefield's Leather Flower (*Clematis morefieldii*). ECOS–Environmental Conservation Online System, Fort Collins, Colorado. Accession No. ML18059A120. TN5411.

FWS (U.S. Fish and Wildlife Service). 2017. "Species Profile for Pink Mucket (Pearlymussel) (*Lampsilis abrupta*)." ECOS–Environmental Conservation Online System, Fort Collins, Colorado. Accession No. ML18059A117. TN5370.

FWS (U.S. Fish and Wildlife Service). 2017. "Species Profile for Sheepnose Mussel (*Plethobasus cyphyus*)." ECOS–Environmental Conservation Online System, Fort Collins, Colorado. Accession No. ML18059A118. TN5371.

FWS (U.S. Fish and Wildlife Service). 2017. "Species Profile for Spotfin Chub (*Eriminax monachus*)." Washington, D.C. Accession No. ML18023A178. TN5219.

FWS (U.S. Fish and Wildlife Service) and NMFS (National Marine Fisheries Service). 1998. *Endangered Species Act Consultation Handbook, Procedures for Conducting Section 7 Consultation and Conference*. Washington, D.C. Accession No. ML14171A801. TN1031.

GDNR (Georgia Department of Natural Resources). 2017. Email from A. Yellin to J. Becker, PNNL, dated September 24, 2017, regarding "Environmental Review for Georgia Portion of the Proposed Transmission Line." Atlanta, Georgia. Accession No. ML18012A441. TN5397.

Hamrick, E.B. 2015. *Clinch River – Addendum Barge/Traffic Area Terrestrial Animal Survey Report*. Tennessee Valley Authority, Knoxville, Tennessee. Accession No. ML17334A047. TN5187.

Henderson, A.R. and C.L. Phillips. 2015. *Clinch River Small Modular Reactor and Barge/Traffic Site Stream Survey Report*. Tennessee Valley Authority, Knoxville, Tennessee. Accession No. ML17334A051. TN5162.

Holliman, F.M., J.B. Reynolds, and T.J. Kwak. 2003. "Electroshock-Induced Injury and Mortality in the Spotfin Chub, a Threatened Minnow." *North American Journal of Fisheries Management* 23:962–966, Philadelphia, Pennsylvania. TN5364.

Howard, C.S., A.R. Henderson, and C.L. Phillips. 2015. *Clinch River Small Modular Reactor and Barge/Traffic Site, Evaluation of Aquatic Habitats and Protected Aquatic Animals Technical Report*. Revision 5, Tennessee Valley Authority, Knoxville, Tennessee. Accession No. ML17334A053. TN5049.

Humphries, W.J. and T.K. Pauley. 2004. "Life History of the Hellbender, Cryptobranchus alleganiensis, in a West Virginia Stream." *American Midland Naturalist* 154:135–142, Notre Dame, Indiana. TN5363.

Johnson, J.B., J.W. Edwards, and W.M. Ford. 2011. "Nocturnal Activity Patterns of Northern Myotis (*Myotis septentrionalis*) During the Maternity Season in West Virginia (USA)." *Acta Chiropterologica* 13(2):391–397, Warsaw, Poland. TN1852.

Jones, J., S. Ahlstedt, B. Ostby, B. Beaty, M. Pinder, N. Eckert, R. Butler, D. Hubbs, C.Walker, S. Hanlon, J. Schmerfeld, and R. Neves. 2014. "Clinch River Freshwater Mussels Upstream of Norris Reservoir, Tennessee and Virginia: A Quantitative Assessment from 2004 to 2009." *Journal of the American Water Resources Association* 1-17, Middleburg, Virginia. TN5324.

KSNPC (Kentucky State Nature Preserves Commission). 2017. Email from I. Horn to J. Becker, PNNL, dated October 2, 2017, regarding "KY HNP Review of Transmission Line Segment for Clinch River SMR ESP Project in Tennessee." Frankfort, Kentucky. Accession No. ML18012A656. TN5400.

Kunz, T.D. and J.D. Reichard. 2010. *Status Review of the Little Brown Myotis (Myotis lucifugus) and Determination that Immediate Listing under the Endangered Species Act is Scientifically and Legally Warranted*. Boston University's Center for Ecology and Conservation Biology, Boston, Massachusetts. Accessed January 12, 2018, at https://www.bu.edu/cecb/files/2010/12/Final-Status-Review.pdf. TN5373.

LeGrand, H.G., E.B. Hamrick, and J.T. Baxter, Jr. 2015. *Clinch River Small Modular Reactor Site Terrestrial Animal Survey Report.* Revision 7, Tennessee Valley Authority, Knoxville, Tennessee. Accession No. ML17334A052. TN5188.

Mack, J.J. 2001. *Ohio Rapid Assessment Method for Wetlands, Manual for Using Version 5.0, Ohio EPA Technical Bulletin Wetland/2001-1-1*. Ohio Environmental Protection Agency, Columbus, Ohio. Accession No. ML18023A193. TN5289.

Mayasich, J., D. Grandmaison, and C. Philips. 2003. *Eastern Hellbender Status Assessment Report*. NRR/TR-2003/09, Natural Resources Research Institute, Duluth, Minnesota. Accession No. ML12171A230. TN5179.

McCracken, M.K., N.R. Giffen, A.M. Haines, B.J. Guge, and J.W. Evans. 2015. *Bat Species Distribution on the Oak Ridge Reservation*. ORNL/TN-2015/248, Oak Ridge National Laboratory, Oak Ridge, Tennessee. Accession No. ML18023A196. TN5287.

McKerrow, A. 1996. *Recovery Plan for Cumberland Sandwort* (Arenaria cumberlandensis). Southeast Region, U.S. Fish and Wildlife Service, Atlanta, Georgia. Accession No. ML18023A197. TN5302.

McKerrow, A. 1996. *Recovery Plan for Large-flowered Skullcap* (Scutellaria Montana). Southeast Region, U.S. Fish and Wildlife Service, Atlanta, Georgia. Accession No. ML18023A198. TN5304.

Middleton, G. 2014. *Acoustic Monitoring of Bat Echolocation Calls on the Oak Ridge Reservation (Pilot Study) 2013 Environmental Monitoring Report*. Tennessee Department of Environment & Conservation, Oak Ridge, Tennessee. Accession No. ML18019A068. TN5347.

Middleton, G. 2015. *Acoustical Monitoring of Bats on the Oak Ridge Reservation 2014*. Tennessee Department of Environment & Conservation, Oak Ridge, Tennessee. Accession No. ML18019A104. TN5348.

Middleton, G. 2016. *Acoustic Monitoring of Bats on the ORR 2015 (Draft)*. Tennessee Department of Environment & Conservation, Oak Ridge, Tennessee. Accession No. ML18019A103. TN5349.

Mirarchi, R., J. Garner, M. Mettee, and P. O'Neil, eds. 2004. *Alabama Wildlife,* Volume 2, *Imperiled Aquatic Mollusks and Fishes*. University of Alabama Press, Tuscaloosa, Alabama. TN5174.

Murdock, N.A. 1993. *Recovery Plan for Spreading Avens* (Guem radiatum). U.S. Fish and Wildlife Service Southeast Region, Atlanta Georgia. Accession No. ML18059A123. TN5377.

Murdock, N.A. and K. Langdon. 1997. *Recovery Plan for Rock Gnome Lichen* (Gymnoderma lineare) *(Evans) Yoshimura and Sharp*. U.S. Fish and Wildlife Service Southeast Region, Atlanta, Georgia. Accession No. ML18059A122. TN5380.

NASS (National Agricultural Statistics Service). 2017. "CropScape – Cropland Data Layer, 2016." Washington, D.C. Accessed July 20, 2017, at https://nassgeodata.gmu.edu/CropScape/. TN5144.

NatureServe. 2017. "NatureServe Explorer: An Online Encyclopedia of Life—Species Quick Search." Arlington, Virginia. Available at http://explorer.natureserve.org/index.htm. TN5216.

Neves, R.J. and P.L. Angermeier. 1990. "Habitat Alteration and its Effects on Native Fishes in the Upper Tennessee River System, East-Central U.S.A." *Journal of Fish Biology* 37(Issue Supplement):45–52, Medford, Massachusetts. TN5053.

Nickerson, M.A., K.L. Krysko, and R.D. Owen. 2003. "Habitat Differences Affecting Age Class Distributions of the Hellbender Salamander, *Cryptobranchus alleganiensis*." *Southeastern Naturalist* 2(4)619–629, Steuben, Maine. TN5368.

Norquist, C. 1994. *Morefield's Leather Flower* Clematis morefleidii *Recovery Plan*. U.S. Fish and Wildlife Service, Jackson, Mississippi. Accession No. ML18059A124. TN939.

NRC (U.S. Nuclear Regulatory Commission). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. Volumes 1 and 2, NUREG–1437, Washington, D.C. Accession Nos. ML040690705, ML040690738. TN288.

NRC (U.S. Nuclear Regulatory Commission). 2000. *Environmental* Standard *Review* Plan—Standard *Review Plans for Environmental Reviews for Nuclear Power Plants*. NUREG–1555, Main Report and 2007 Revisions, Washington, D.C. Available at http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/toc/. TN614.

NRC (U.S. Nuclear Regulatory Agency). 2013. *Final Environmental Impact Statement Related to the Operation of Watts Bar Nuclear Plant Units Nos. 1 and 2*. NUREG-0498, Supplement No. 2, Washington, D.C. Accession Nos. ML13144A092, ML13144A093. TN5165.

NRC (U.S. Nuclear Regulatory Commission). 2017. Letter from A.H. Fetter to U.S. Fish and Wildlife Service, dated April 20, 2017, regarding "Request for Participation in the Environmental Scoping Process and a List of Protected Species Within the Area Under Evaluation for the Proposed Clinch River Nuclear Site Early Site Permit Application Review." Washington, D.C. Accession No. ML17069A249. TN5089.

NRC (U.S. Nuclear Regulatory Commission). 2018. *Clinch River Nuclear Site Early Site Permit Application Environmental Audit Summary Report*. Washington, D.C. Accession No. ML17226A020. TN5386.

Ogle, D.W. 1992. *Virginia Spiraea* (Spiraea virginiana Britton) *Recovery Plan*. U.S. Fish and Wildlife Service Region Five, Newton Corner, Massachusetts. Accession No. ML18059A125. TN5379.

ORNL (Oak Ridge National Laboratory). 2017. Email from K. McCracken to J. Becker, PNNL, dated September 18, 2017, regarding "Fish Population Data for Ish Creek." Oak Ridge, Tennessee. Accession No. ML18016A334. TN5358.

OSMRE (Office of Surface Mining Reclamation and Enforcement). 2017. "ARblast: All Resources on Blasting. Rules, Regulations, Research, and Resources." Washington, D.C. Accession No. ML18059A126. TN5353.

Parmalee, P.W. and A.E. Bogan. 1998. *Freshwater Mussels of Tennessee*. University of Tennessee Press, Knoxville, Tennessee. Accession No. ML042800060. TN5166.

Parr, P.D., G.S. Byrd, J.W. Johnson, Jr., and N.R. Giffen. 2015. *Forest Management Plan for the DOE Oak Ridge Reservation: An Interdisciplinary Approach for Managing a Heritage Resource*. ORNL/TM-2015/98, Oak Ridge National Laboratory, Oak Ridge, Tennessee. Accession No. ML18023A329. TN5151.

Pilarski-Hall, K. 2015. *Clinch River Small Modular Reactor Site: Technical Report Natural Areas (Managed Areas & Sites).* Revision 2, Tennessee Valley Authority, Knoxville, Tennessee. Accession No. ML17334A050. TN5185.

Pilarski-Hall, K. and B.P. Lees. 2015. *Clinch River Small Modular Reactor Site Wetland Survey Report.* Revision 4, Tennessee Valley Authority, Knoxville, Tennessee. Accession No. ML18036A352. TN5299.

Pilarski-Hall, K. and R.A. Kennon. 2015. *Clinch River Small Modular Reactor Site Supplemental Wetland Survey Report Barge/Traffic Area*. Revision 1, Tennessee Valley Authority, Knoxville, Tennessee. Accession No. ML18036A351. TN5290.

PNNL (Pacific Northwest National Laboratory). 2017. Summary of Notes from Telephone Conference Call with U.S. Fish and Wildlife Service on October 24, 2017 with Additional Notes from Dustin Boles, FWS, Telephone Call to Jim Becker, PNNL, on October 23, 2017. Richland, Washington. Accession No. ML18040A429. TN5384.

Rakes, P.L., J.R. Shute, and P.W. Shute. 1999. "Reproductive Behavior, Captive Breeding, and Restoration Ecology of Endangered Fishes." *Environmental Biology of Fishes* 55:31–42, Netherlands. TN5367.

Shea, A.B. and T.H. Roulston. 1996. *Recovery Plan for Cumberland Rosemary* (Conradina verticillata). Southeast Region, U.S. Fish and Wildlife Service, Atlanta, Georgia. Accession No. ML18023A336. TN5303.

Shute, J.R., P.L. Rakes, and P.W. Shute. 2005. "Reintroduction of Four Imperiled Fishes in Abrams Creek, Tennessee." *Southeastern Naturalist* 4(1):93–110, Steuben, Maine. TN5366.

TDEC (Tennessee Department of Environment & Conservation). 2014. *Environmental Monitoring Report, January through December 2013*. Nashville, Tennessee. Accession No. ML18023A358. TN5288.

TDEC (Tennessee Department of Environment & Conservation). 2016. "Contaminants in Fish." Knoxville, Tennessee. Accession No. ML18023A307. TN5172.

TDEC (Tennessee Department of Environment & Conservation). 2016. *Environmental Monitoring Report 2015.* Nashville, Tennessee. Accession No. ML18059A132. TN5350.

TDEC (Tennessee Department of Environment & Conservation). 2017. "Rare Species by County, Roane County." Nashville, Tennessee. Accession No. ML18023A318. TN5217.

TNBWG (Tennessee Bat Working Group). 2017. "Gray Bat." Nashville, Tennessee. Accession No. ML18026A607. TN5329.

TNBWG (Tennessee Bat Working Group). 2017. "Tri-Colored Bat." Nashville, Tennessee. Accession No. ML18059A137. TN5359.

TNC (The Nature Conservancy). 2003. *The Cumberlands and Southern Ridge & Valley Ecoregion: A Plan for Biodiversity Conservation.* Arlington, Virginia. Available at https://www.conservationgateway.org/ConservationPlanning/SettingPriorities/EcoregionalReports/Documents/CSRVPlan.pdf. TN5036.

TNHP (Tennessee Natural Heritage Program). 2017. Email from S. Williams to J. Becker, PNNL, dated September 11, 2017, regarding "Map Package for TN NHP." Nashville, Tennessee. Accession No. ML18026A552. TN5361.

TNSOS (Tennessee Secretary of State). 2017. "Effective Rules and Regulations of the State of Tennessee: 0400 Rules of the Tennessee Department of Environment and Conservation, Division of Water Resources Water Pollution Control." Nashville, Tennessee. Accessed January 23, 2017, at http://share.tn.gov/sos/rules/0400/0400-40/0400-40.htm. TN5071.

TRC (ThirdRock Consultants, LLC). 2010. *Mollusk Survey of the Tennessee River Near Watts Bar Nuclear Plant (Rhea County, Tennessee).* Lexington, Kentucky, Accession No. ML18026A610. TN5175.

TRC (ThirdRock Consultants, LLC). 2011. *Evaluation of Freshwater Mollusk and Habitat, Clinch River, CRM 15.0 – 19.0, Roane County, Tennessee.* Lexington, Kentucky. Accession No. ML17334A055. TN5168.

Tucci, P. 1992. *Hydrology of Melton Valley at Oak Ridge National Laboratory, Tennessee*. Water-Resources Investigations Report 92-4131, U.S. Geological Survey, Nashville, Tennessee. Accession No. ML18026A611. TN5034.

TVA (Tennessee Valley Authority). 2012. *A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Transmission Construction and Maintenance Activities*. Revision 2.1-2012, Chattanooga, Tennessee. Accession No. ML18036A929. TN4911.

TVA (Tennessee Valley Authority). 2013. *Biological Monitoring to Characterize the Aquatic Community near the Site of the Proposed Clinch River Small Modular Reactor 2011*. Chattanooga, Tennessee. Accession No. ML17334A058. TN5167.

TVA (Tennessee Valley Authority). 2016. "Clinch River Nuclear Site Early Site Permit Application, Part 02—Site Safety Analysis Report (Revision 0)." Chattanooga, Tennessee. Accession No. ML16144A074. TN5018.

TVA (Tennessee Valley Authority). 2016. Letter from J.W. Shea to NRC, dated May 12, 2016, regarding "Application for Early Site Permit for Clinch River Nuclear Site." CNL-16-081, Oak Ridge, Tennessee. Accession No. ML16139A752. TN5002.

TVA (Tennessee Valley Authority). 2016. Letter from J.W. Shea to NRC, dated December 13, 2016, regarding "Submittal of Supplemental Information Regarding Terrestrial Ecology in Support of Early Site Permit Application for Clinch River Nuclear Site." CNL-16-200, Chattanooga, Tennessee. Accession No. ML16348A552. TN5145.

TVA (Tennessee Valley Authority). 2016. Letter from J.W. Shea to NRC, dated December 16, 2016, regarding "Submittal of Supplemental Information Regarding Aquatic Ecology in Support of Early Site Permit Application for Clinch River Nuclear Site." CNL-16-201. Chattanooga, Tennessee. Accession No. ML16356A485. TN5008.

TVA (Tennessee Valley Authority). 2017. "Clinch River Nuclear Site Early Site Permit Application, Part 03—Environmental Report (Revision 1)." Chattanooga, Tennessee. Accession No. ML18003A471. TN4921.

TVA (Tennessee Valley Authority). 2017. Letter from J.W. Shea to NRC, dated July 7, 2017, regarding "Submittal of Supplemental Information Related to the Environmental Audit in Support of Early Site Permit Application for Clinch River Nuclear Site." CNL-17-088, Chattanooga, Tennessee. Accession No. ML17206A091. TN4920.

TVA (Tennessee Valley Authority). 2017. Letter from J.W. Shea to NRC, dated August 1, 2017, regarding "Submittal of Supplemental Information Related to the Environmental Audit in Support of Early Site Permit Application for Clinch River Nuclear Site." CNL-17-097, Chattanooga, Tennessee. Accession No. ML17234A003. TN4922.

TVA (Tennessee Valley Authority). 2017. Letter from J.W. Shea to NRC, dated September 5, 2017, regarding "Supplemental Information Related to Environmental Report Figures in Support of Early Site Permit Application for Clinch River Nuclear Site." CNL-17-118, Chattanooga, Tennessee. Accession No. ML17346B286. TN5226.

TWRA (Tennessee Wildlife Resources Agency). 2017. Email from B. Flock to J. Becker, PNNL, dated November 3, 2017, regarding "Clinch River Small Modular Nuclear Reactor Project." Nashville, Tennessee. Accession No. ML18064A895. TN5362.

USACE (U.S. Army Corps of Engineers). 1987. *Corps of Engineers Wetlands Delineation Manual*. Wetlands Research Program Technical Report Y-87-1, Environmental Laboratory, Vicksburg, Mississippi. Accession No. ML042790476. TN2066.

USACE (U.S. Army Corps of Engineers). 2010. *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region*. ERDC/EL TR-10-9, Engineer Research and Development Center, Vicksburg, Mississippi. Accession No. ML18026B233. TN5325.

USDOT (U.S. Department of Transportation). 2017. "Construction Equipment Noise Levels and Ranges." Chapter 9 in *Construction Noise Handbook*. Federal Highway Administration, Washington, D.C. Accession No. ML18059A141. TN5383.

USGS (U.S. Geological Survey). 1998. "Ecoregions of Tennessee." Washington, D.C. Accession No. ML18026B253. TN5159.

USGS (U.S. Geological Survey). 2016. "Land Cover Trends Project: Ridge and Valley." Denver, Colorado. Accession No. ML18026B254. TN5035.

von Oettingen, S.L. 1992. *Small Whorled Pogonia* (Isotria medeoloides) *Recovery Plan*. Region Five, U.S. Fish and Wildlife Service, Newton Corner, Massachusetts. Accession No. ML18026B260. TN5307.

Williams, J.D., A.E. Bogan, and J.T. Garner. 2008. *Freshwater Mussels of Alabama and the Mobile Basin in Georgia, Mississippi, and Tennessee*. University of Alabama Press, Tuscaloosa, Alabama. TN5372.

Williams, J.D., M.L. Warren, Jr., K.S. Cummings, J.L. Harris, and R.J. Neves. 1993. "Conservation Status of Freshwater Mussels of the United States and Canada." *Fisheries* 18(9):6-22, Abingdon, Oxford, England. TN5369.

Woods, A.J., J.M. Omernik, and D.D. Brown. 1999. *Level III and Level IV Ecoregions of Delaware, Maryland, Pennsylvania, Virginia, and West Virginia*. U.S. Environmental Protection Agency, Corvallis, Oregon. Accession No. ML083220457. TN1805.

Woods, A.J., J.M. Omernik, and D.D. Brown. 2003. "Map of Level III and Level IV Ecoregions of EPA Region 3." U.S. Environmental Protection Agency, Corvallis, Oregon. Accession No. ML14252A897. TN1806.

WSDOT (Washington State Department of Transportation). 2017. "Construction Noise Impact Assessment." Chapter 7 in *Biological Assessment Preparation for Transportation Projects – Advanced Training Manual*. Olympia, Washington. Accessed December 15, 2017, at https://www.wsdot.wa.gov/Environment/Biology/BA/BAguidance.htm. TN5313.

M.11 List of Contributors

Name	Affiliation	Credentials	Role
J. Peyton Doub	US Nuclear Regulatory Commission, Office of New Reactors	30 Years of Experience in Wetland Delineation and Mitigation, Forest Surveys, Species Surveys, Ecological Risk Assessment, and NEPA Certified Environmental Professional (CEP) Professional Wetland Scientist (PWS) M.S., Plant Physiology, University of California at Davis, 1984 B.S., Plant Sciences, Cornell University, 1982	Technical Reviewer
James Becker	PNNL	26 Years of Experience in Wildlife and Plant Sciences, NEPA, ESA, Species Surveys, and Ecological Risk Assessment M.S. Wildlife Science, University of Washington, 1989 B.S. Botany and Range Science, Brigham Young University, 1987	Terrestrial Ecology
Rebekah Krieg	PNNL	15 years of experience as an aquatic ecologist with 20 years of NEPA experience in Aquatic Ecology. M.S. in Fisheries and Oceanographic Science from the University of Washington, BS in Biology from Washington State University.	Aquatic Ecology
Stephanie Liss	PNNL	8 years of Experience in Fisheries and Aquatic Ecology, with 3 years of NEPA Experience in Aquatic and Terrestrial Ecology, Noise, and Human Health And Safety. M.Sc. Natural Resources and Environmental Sciences, University of Illinois at Urbana-Champaign, 2013.	Aquatic and Terrestrial Ecology

Name	Affiliation	Credentials	Role
		B.Sc. Natural Resources and Environmental Sciences, University of Illinois at Urbana-Champaign, 2010.	
Joanne Duncan	PNNL	8 Years SharePoint Reference Database Administrator and Document Bibliography Coordinator/Manager B.A., Biology, Hood College, 1979	Technical Editing
Cary Counts	PNNL	45 Years of Experience at PNNL in Research, Contracts, and Technical Communications B.S., Ceramic Engineering, Clemson University, 1964 M.S., Environmental Systems Engineering, Clemson University, 1972.	Technical Editing

NRC FORM 335 **U.S. NUCLEAR REGULATORY COMMISSION**
(12-2010)
NRCMD 3.7

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

1. REPORT NUMBER
(Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.)
NUREG-2226
Volume 2
Draft

2. TITLE AND SUBTITLE
Environmental Impact Statement for an Early Site Permit (ESP) at the Clinch River Nuclear Site
Draft Report for Comment

3. DATE REPORT PUBLISHED

MONTH	YEAR
April	2018

4. FIN OR GRANT NUMBER

5. AUTHOR(S)
See Appendix A

6. TYPE OF REPORT
Technical

7. PERIOD COVERED (Inclusive Dates)

8. PERFORMING ORGANIZATION - NAME AND ADDRESS (If NRC, provide Division, Office or Region, U. S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)
Division of New Reactor Licensing
Office of New Reactors
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

9. SPONSORING ORGANIZATION - NAME AND ADDRESS (If NRC, type "Same as above", if contractor, provide NRC Division, Office or Region, U. S. Nuclear Regulatory Commission, and mailing address.)
Same as above

10. SUPPLEMENTARY NOTES
Docket 52-047

11. ABSTRACT (200 words or less)

This environmental impact statement (EIS) has been prepared in response to an application to the U.S. Nuclear Regulatory Commission (NRC) by Tennessee Valley Authority (TVA) for an early site permit (ESP). The U.S. Army Corps of Engineers (USACE) is a cooperating agency on this EIS. This EIS includes the analysis by the NRC and USACE staff, which considers and weighs the environmental impacts of building, operating and decommissioning two or more SMRs at the CRN Site.

After considering the environmental impacts of the proposed NRC action, the NRC staff's preliminary recommendation to the Commission is that the ESP be issued as requested. The recommendation is based on (1) the application and supplemental information submitted by TVA, including Revision 1 of the Environmental Report (ER); (2) consultation with Federal, State, Tribal and local agencies; (3) the staff's independent review; (4) the staff's consideration of comments related to the environmental review that were received during the public scoping process; and (5) the assessments summarized in the EIS, including the potential mitigation measures identified in the ER and this EIS.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)
Clinch River Nuclear Site Early Site Permit
Clinch River Nuclear Site Environmental Review
Clinch River Nuclear Small Modular Reactor Project
Draft Environmental Impact Statement, DEIS
National Environmental Policy Act, NEPA
NUREG-2226

13. AVAILABILITY STATEMENT
unlimited

14. SECURITY CLASSIFICATION
(This Page)
unclassified
(This Report)
unclassified

15. NUMBER OF PAGES

16. PRICE

NUREG-2226, Vol 2 **Environmental Impact Statement for an Early Site Permit (ESP) at the Clinch River Nuclear Site** **April 2018**

Draft Report for Comment