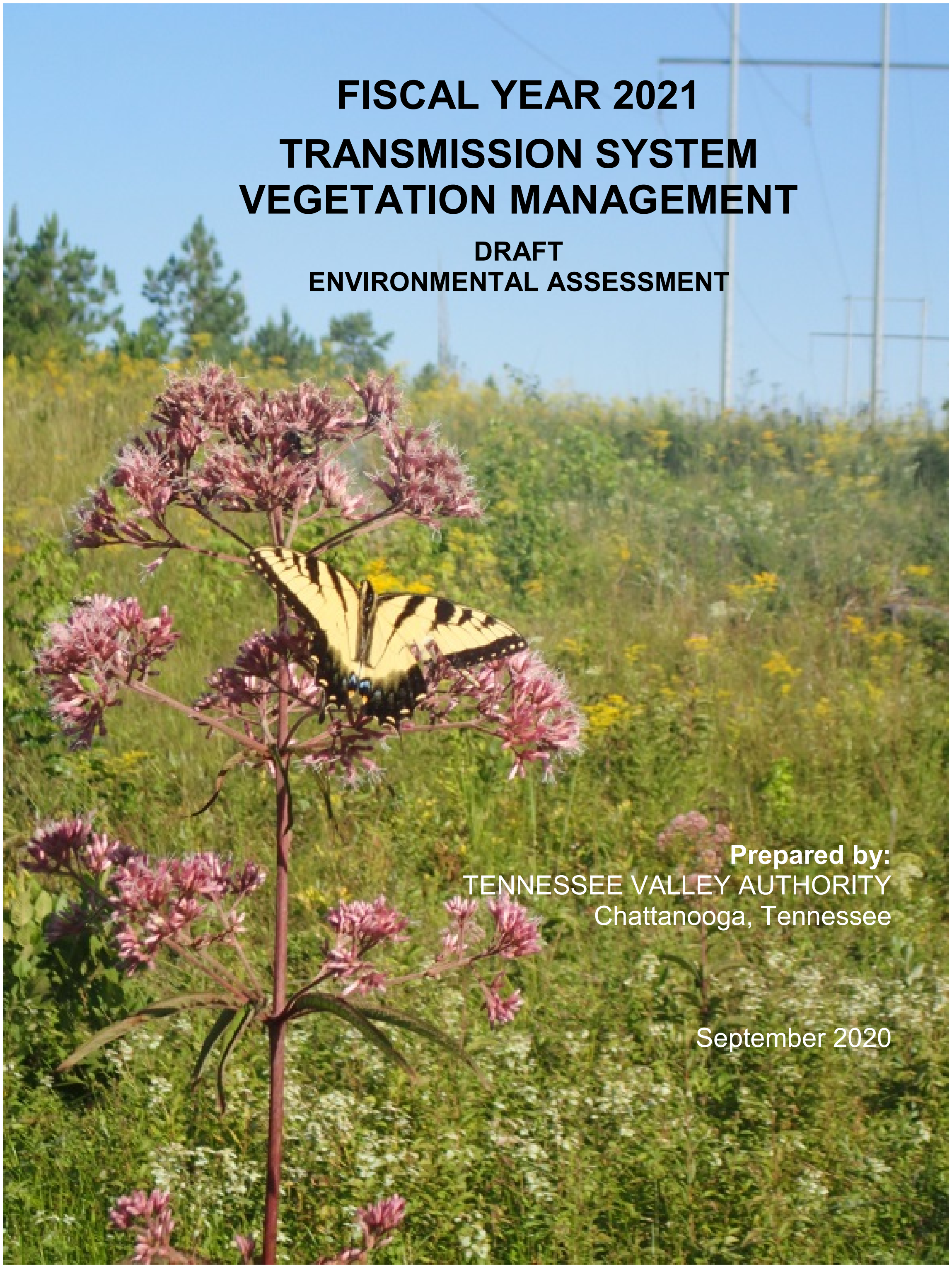
Document Type: EA-Administrative Record
Index Field: Draft EA
Project Name: Transmission System Vegetation Management
Project Number: 2020-21



FISCAL YEAR 2021

TRANSMISSION SYSTEM VEGETATION MANAGEMENT

DRAFT ENVIRONMENTAL ASSESSMENT

Prepared by:
TENNESSEE VALLEY AUTHORITY
Chattanooga, Tennessee

September 2020

This page intentionally left blank

COVER SHEET

Transmission System Vegetation Management Environmental Assessment

Proposed Action: The Tennessee Valley Authority (TVA) has prepared this Environmental Assessment (EA) to address potential environmental, social, and economic impacts associated with the proposed management of vegetation within its existing active transmission line rights-of-way (ROW).

Type of document: Environmental Assessment

Lead agency: Tennessee Valley Authority

Contact: Anita E. Masters
Tennessee Valley Authority
1101 Market Street, BRC 2C
Chattanooga, TN 37402

Abstract:

TVA needs to manage the vegetation within its active transmission right-of-way (ROW) to assure the safe and reliable operation of its transmission facilities. Routine assessment methods to establish a basis for vegetation control measures were evaluated in a programmatic Environmental Impact Statement (PEIS) released in 2019. This Environmental Assessment addresses the planned Fiscal Year 2021 vegetation management of individual transmission line segments and tiers from the PEIS providing a more site-specific review and analysis. TVA proposes to target previously cleared or maintained areas along some segments of transmission ROWs in TVA's 12 managed ROW sectors. Typically, vegetation management activities consist of herbicide application (90%), mechanical control (6% - i.e., brush hogs, equipment mounted saws) and manual methods (4% - i.e., chainsaw, handsaw). Tree work would be limited to trees that would present an immediate hazard to the reliability of the transmission system.

The PEIS document was prepared at the programmatic level to encompass ROW vegetation management across TVA's transmission system. A Record of Decision was issued in October 2019 indicating TVA's preferred vegetation management program would be to manage the full extent of the ROW to a meadow-like end-state. However, TVA will not fully implement this program at this time. Current plans are to follow vegetation management methods as prescribed by a July 31, 2017 court injunction order currently in place in the *Sherwood v. TVA* litigation. TVA will continue to maintain the buffer zones on the edges of its ROW in a manner as described in its 1997 and 2008 Line Maintenance Manuals (TVA 1997; TVA 2008) and tree work would be limited to trees that would present an immediate hazard to the reliability of the transmission system

Table of Contents

List of Appendices

List of Tables

List of Figures

Acronyms, Abbreviations, and Glossary of Terms Used

acre	A unit measure of land area equal to 43,560 square feet.
access road	A dirt, gravel, or paved road that is either temporary or permanent, and is used to access the right-of-way and transmission line structures for construction, maintenance, or decommissioning activities.
ANSI	American National Standard Institute
BA	Biological Assessment
BMP	Best Management Practices
border zone	The border zone is the area located between the outside edge of the ROW and the wire zone. The width of this area varies based upon ROW width, voltage, structure type, and structure height.
buffer zone	A portion of the border zone on some transmission ROWs that has not been subjected to routine maintenance.
CAA	Clean Air Act
CFR	Code of Federal Regulations
compatible vegetation	Compatible vegetation is that which will never grow sufficiently close to a conductor so as to violate the minimum clearance distances.
conductors	Cables that carry electrical current
CWA	Clean Water Act
danger tree	Tree located off the ROW that, under maximum sag and blowout conditions, would strike a transmission line structure or come within an unsafe distance of a transmission line if it were to fall toward the line. For most transmission lines, this distance is five feet, but for higher voltage lines, the distance is generally 10 feet.
EA	Environmental Assessment
easement	A legal agreement that gives TVA the right to use property for a purpose such as a right-of-way for constructing, maintaining, and operating a transmission line.
EIS	Environmental Impact Statement
endangered species	A species in danger of extinction throughout all or a significant part of its range.
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ephemeral stream	Watercourses or ditches that only have water flowing after a rain event; also called a wet-weather conveyance.
ERO	Electric Reliability Organization
ESA	Endangered Species Act
extant	In existence; still existing; not destroyed or lost
feller-buncher	A piece of heavy equipment that grasps a tree while cutting it, which can then lift the tree and place it in a suitable location for disposal; this equipment is used to prevent trees from falling into sensitive areas, such as a wetland
FERC	Federal Energy Regulatory Commission
FGDC	Federal Geographic Data Committee

floor work	Vegetation management activities typically consisting of mechanical control (e.g., brush hogging) and herbicide application which target previously cleared or maintained areas along the transmission rights-of-way to achieve an end-state vegetation community consisting of a mix of herbaceous and low-growing shrub species.
FY21	TVA's Fiscal Year 2021 runs from October 1, 2020 through September 30, 2021
GHG	Greenhouse Gas
groundwater	Water located beneath the ground surface in the soil pore spaces or in the pores and crevices of rock formations.
hazard	Vegetation that is a risk to the reliability of the transmission system and/or safety of the public. An *immediate hazard* is any vegetation that upon inspection potentially presents a jeopardy or risk to the public safety or the transmission system reliability during the period from the date of inspection or evaluation until the next scheduled Preventative Maintenance tree maintenance activity.
incompatible vegetation	Incompatible vegetation is that which has the potential to grow sufficiently close to a conductor so as to violate the minimum clearance distances.
inspections	Periodic review the condition of transmission system rights-of-way by means of aerial inspections, ground inspections, and as-needed, field inspections to determine maintenance needs, and any need to adjust the cycle of scheduled work due to emergent conditions.
IPaC	Information, planning and assessment database (USFWS)
IVM	Integrated Vegetation Management
kV	Symbol for kilovolt (1kV equals 1,000 volts)
LiDAR	Light Detection and Ranging
LPC	Local Power Company
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Corporation
NESC	National Electric Safety Code
NF	National Forest
NHPA	National Historic Preservation Act
NLAA	Not Likely to Adversely Affect
NPDES	National Pollutant Discharge Elimination
NPS	National Park Service
NRHP	National Register of Historic Places
NRI	Nationwide Rivers Inventory
NPV	Net Present Value
NWI	National Wetland Inventory
O-SAR	Office-Level Sensitive Area Review
outage	An interruption of the electric power supply to a user
PA	Programmatic Agreement
PEIS	Programmatic Environmental Impact Statement
RCRA	Resource Conservation and Recovery Act

riparian	Related to or located on the banks of a river or stream
ROW	Right-of-way, a corridor containing a transmission line
runoff	That portion of total precipitation that eventually enters a stream or river
SHPO	State Historic Preservation Officer
SMZ	Streamside Management Zones
structure	A pole or tower that supports a transmission line
substation	A facility connected to a transmission line used to reduce voltage so that electric power may be delivered to a local power distributor or user.
TCP	Traditional Cultural Properties
threatened species	A species likely to become endangered within the foreseeable future
tree work	Vegetation maintenance activities consisting of manual control (e.g., chainsaw) and mechanical control (e.g., equipment mounted saws and other devices) which focus on tree removal or tree trimming.
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USET	United South and Eastern Tribes, Inc.
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
wetland	A marsh, swamp, or other area of land where the soil near the surface is saturated or covered with water, especially one that forms a habitat for wildlife
wire zone	The wire zone includes the area directly under the lines

CHAPTER 1 – PURPOSE AND NEED FOR ACTION

The Tennessee Valley Authority (TVA), like other energy companies, develops long-range vegetation management plans for its transmission system according to industry-wide standards. This planning process includes considerations regarding how and when TVA would control the vegetation growing within its transmission line rights-of-way (ROW). TVA has prepared this Environmental Assessment (EA) to address potential environmental, social, and economic impacts associated with the fiscal year 2021 (FY21) planning cycle for the proposed management of vegetation within transmission ROWs. This EA, which tiers from TVA's programmatic Transmission System Vegetation Management Environmental Impact Statement (PEIS) (TVA 2019), identifies individual transmission line ROW segments in which vegetation management activities are proposed.

1.1 Purpose and Need

The purpose of TVA's transmission system vegetation management program is to strategically manage TVA's existing transmission line ROW in a manner consistent with applicable laws, orders, standards, practices and guidance, while providing reliable electricity transmission to TVA's customers and protecting environmental resources to the extent possible. Failure to address vegetation clearance and management of brush, downed vegetation and small trees could result in wildfires, major power outages, and injury to life or property. The need for the proposed action includes:

- Enhance public safety through controlled vegetation management of TVA's transmission lines.
- Effectively manage vegetation that interferes with the safe, efficient and reliable operation of transmission lines so TVA can continue to provide the public safe and reliable electric power in a cost-effective and environmentally sound manner.
- Comply with North American Electric Reliability Corporation (NERC) standards to maintain transmission lines in a safe and reliable operating condition.

1.2 Introduction and Background

1.2.1 TVA's Transmission System

TVA's transmission system consists of a network of more than 16,000 miles of electric transmission lines all contained within approximately 238,000 acres of utility ROW. Most of TVA's transmission system is located on private lands. TVA typically acquires perpetual rights through purchased easements to manage vegetation in order to protect transmission lines and the transmission system.

Electricity is provided to its customers by the transmission of electricity typically ranging from 46,000 to 500,000 volts (46 to 500 kilovolts [kV]). High voltage allows electricity to be transmitted over long distances with maximum efficiency. The electricity is delivered to more than 50 directly served, large industrial customers and to 153 local power companies (LPC). These LPCs typically utilize voltages in the range of 4 to 69 kV to connect with end use customers (e.g., residential homes).

1.2.2 The Need for Transmission System Reliability

Reliability of TVA's transmission system is extremely important because interruptions can cause widespread and extended outages. For example, one high-voltage transmission line can support a primary substation, but if an interruption occurs on this transmission line, all other substations that depend on the primary substation also will be interrupted. The other secondary substations distribute power to homes, businesses, hospitals, and safety devices, such as traffic lights. Therefore, the loss of one primary substation can affect thousands of people.

NERC began enforcing its Reliability Standard FAC-003 Transmission Vegetation Management Program on June 18, 2007. The industry-wide reliability standard states that transmission systems, like the TVA system, must maintain adequate transmission line clearances as required by the National Electric Safety Code (NESC) in order to be able to survive single-failure events while continuing to serve customer needs with adequate voltage. Because failure to address the vegetation clearance, compliance and monitoring requirements of FAC-003 can result in wildfires, major power outages, and injury to life or property, NERC can apply regulatory penalties for non-compliance, including mitigation and fines.

As such, the vegetation management cycle on ROWs associated with transmission lines is typically conducted on a three-year cycle. In addition, floor vegetation maintenance work incorporates a greater percentage of herbicide use to expedite adequate clearance.

Vegetation that is not managed properly contributes to unnecessary electrical transmission interruptions. On LPC distribution lines, safe working clearance distances can be more easily maintained due to the lower voltages and corresponding electrical arc potential. On higher voltage transmission lines, conductive objects, such as trees and vegetation, pose a greater threat to interrupting the power system because the higher energy levels enable the electricity to arc over greater distances to the object and then to the ground.

1.2.3 TVA's Vegetation Management Program

TVA's transmission system serves nearly ten million residents in a more than 82,000-square-mile area. For vegetation management purposes this area is divided into six regions consisting of a total of 12 sectors (Figure 1-1). TVA develops a yearly plan using an integrated vegetation management approach to identify roughly one-third of the transmission system which needs vegetation management within each of the 12 sectors. This area, shown on Figure 1-1, comprises the study area for this EA as this area is inclusive of all areas where TVA maintains ROW. Analysis of impacts to individual ROW segments that undergo vegetation management practices in the EA adopts a sector area perspective.

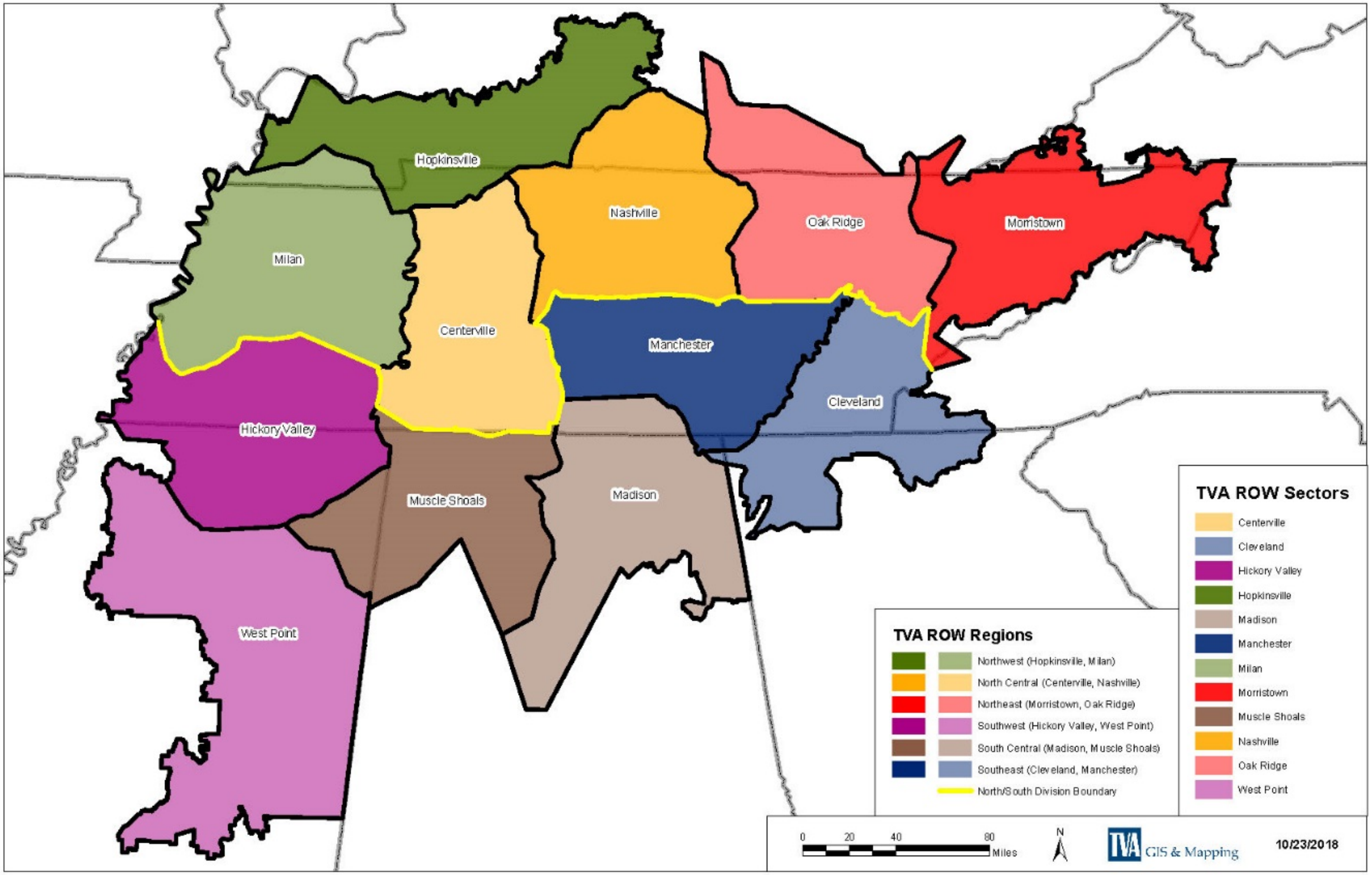


Figure 1-1. TVA's Fiscal Year 2021 Environmental Assessment Study Area and the Right-of-way Vegetation Management

TVA's vegetation management program along its transmission ROW consists of the following basic components:

- *Floor work* – Vegetation maintenance activities which target previously cleared or maintained areas along the transmission ROWs. Typically, floor activities consist of mechanical control (e.g., brush hogging, which is also known as bush hogging and will be referred to as brush hogging in this document) and herbicide application.
- *Tree work* – Vegetation maintenance activities which focus on tree removal or tree trimming. Typically, tree activities consist of manual control (e.g., chainsaw) and mechanical control (e.g., equipment mounted saws and other devices).
- *Inspections* – Periodic review of transmission ROW condition to determine maintenance needs, and any need to adjust the cycle of scheduled work due to emergent conditions.
- *Planning and Support* – The transmission ROW manager develops plans to maintain his or her respective ROWs in a cost-effective, efficient, and environmentally responsible manner to minimize vegetation-related interruptions.
- *Communication* – Notification of, communication to and education for the property owner.
- *Reliability and Compliance* – Vegetation management activities maximize reliability of the transmission system. Vegetation maintenance activities also must be compliant where applicable with the NERC Reliability Standard FAC-003.As summarized in Table 1-1, TVA's transmission ROW can be classified into three broad categories based on the need for routine vegetation maintenance. TVA has vegetation management rights for the entirety of the 238,000 acres of active transmission ROW. TVA, however, only actively maintains approximately 46 percent or 110,752 acres because about 51 percent of the transmission ROW is used as cropland, golf courses, orchards or similar uses that integrate compatible vegetation, which is primarily maintained by the landowner. Compatible vegetation is that which will never grow sufficiently close to a conductor so as to violate the minimum clearance distances. While the floor of the transmission ROW is often maintained by others in these areas, TVA conducts routine inspection and vegetation management of ditch banks, fence rows, towers, and other features. Trees that are tall enough to either fall within an ROW or grow to an unsafe distance of transmission lines are managed on all lands within and adjacent to the TVA ROW. A relatively small amount of the TVA transmission system ROW (4,720 acres) does not require routine vegetation management by anyone. These areas include transmission ROW that spans open water or deep valleys where vegetation growing at lower elevations cannot threaten the transmission line.

What is "compatible" and "incompatible" vegetation?

Compatible Vegetation: Vegetation will never grow sufficiently close to a conductor so as to violate the minimum clearance distances. Example: low-growing shrubs and herbaceous plants.

Incompatible Vegetation: Vegetation that has the potential to violate minimum clearance distances. Example: young woody trees.

TVA typically also manages danger trees on lands along and adjacent to the TVA transmission ROW. A danger tree is a tree, located on and off the ROW that would strike a transmission line structure or come within an

What are "Danger" Trees?

Danger trees are trees located on and off the ROW that are tall enough to fall within an unsafe distance of transmission lines. For most transmission lines, this distance is five feet, but for higher voltage lines, the distance is generally 10 feet.

unsafe distance of a transmission line if it were to fall toward the line. For most transmission lines, this distance is five feet, but for higher voltage lines the distance is generally 10 feet. Danger trees that are or have the potential to be an immediate hazard to the safety and reliability of TVA's transmission line system must be removed. Any reference to danger tree removal includes all trees that fit this definition.

TVA is currently subject to a court injunction issued on July 31, 2017 by the U.S. District Court for the Eastern District of Tennessee in the lawsuit, *Sherwood v. TVA*, No. 3-12-cv-156 (Appendix A). This injunction requires "TVA [to] maintain buffer zones on the edges of its ROW in a manner as described in its 1997 and 2008 Line Maintenance Manuals" until TVA prepares and publishes a thorough Environmental Impact Statement pursuant to the National Environmental Policy Act (NEPA) analyzing TVA's ROW vegetation management program. In response to the *Sherwood* litigation, TVA stopped removing woody vegetation except for trees that are an immediate hazard to the reliability of the transmission system and/or safety of the public.

In response to the court order, TVA issued a final PEIS to programmatically address vegetation management within the TVA power system's transmission line ROW on August 30, 2019 and a released a Record of Decision on October 18, 2019 (84 FR 55995) identifying its preferred vegetation management alternative (TVA 2019). TVA understands that the injunction will remain in place until the court has ruled on TVA's motion regarding the propriety of the PEIS. TVA will continue to operate according to the injunction until it is lifted by the court.

1.2.4 Vegetation Management Practices

The study area supports a variety of vegetation including trees, brush and herbaceous plants. As described in TVA's PEIS (2019), Transmission ROW vegetation management is necessary to ensure that the source of safe and reliable electric power to TVA's end-users is not interrupted by trees or other vegetation growing under or near the transmission lines. To protect public safety and improve power reliability, TVA maintains different areas within a transmission ROW (Figure 1-2):

- *Wire Zone* – Generally, the wire zone includes the area directly under the lines.

- *Border Zone* – The border zones are located between the outside edge of the ROW and the wire zone. The width of this area varies based upon ROW width, voltage, structure type, and structure height.

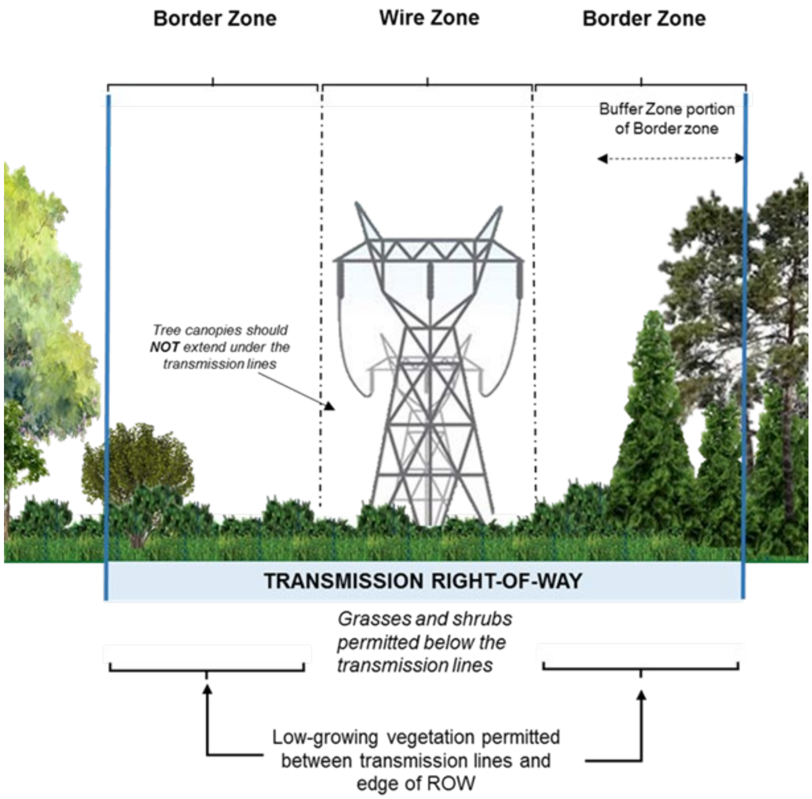


Figure 1-2. Transmission Line Rights-of-Way Zones

Within the Border Zone of some transmission ROWs there is an area that has in the past been considered a Buffer Zone. The Buffer Zone is a portion of the Border Zone that has not been subjected to routine maintenance. To reduce the risk of trees or branches falling onto lines, or lines sagging or swaying into trees, incompatible vegetation in the wire and border zones should be removed. Per the 2017 court injunction, TVA shall continue to maintain the buffer zones on the edges of its ROW according to its 1997 and 2008 Line Maintenance Manuals (TVA 1997; TVA 2008). Only trees that present an immediate hazard to the reliability of the transmission system would be removed until the injunction is lifted.

1.2.5 Emphasis on Integrated Vegetation Management

The Federal Energy Regulatory Commission (FERC) and NERC both recognize the American National Standard Institute (ANSI) Tree, Shrub and Other Woody Plant Maintenance-Standard Practices for electric utility ROW as a best management practice (BMP) (ANSI 2012).

The concept of Integrated Vegetation Management (IVM) is the basis of this standard and is defined as:

> A system of managing plant communities in which compatible and incompatible vegetation is identified, action thresholds are considered, control methods are evaluated, and selected control(s) are implemented to achieve a specific objective. Choice of control methods is based on effectiveness, environmental impact, site characteristics, safety, security, and economics.

TVA's IVM process consists of six elements (Figure 1-3).

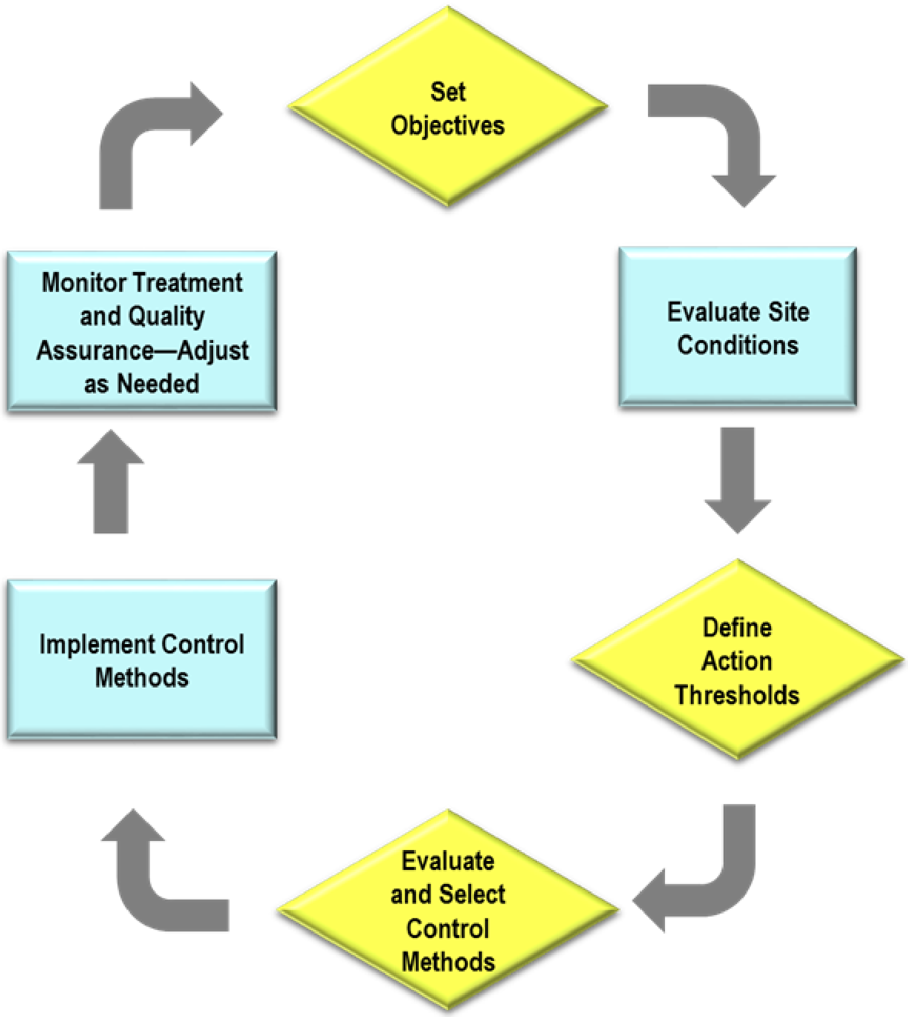


Figure 1-3. TVA Integrated Vegetation Management Process

The goal of IVM is to provide an integrated and balanced approach of vegetation management that considers the overall long-term effect on public health and safety, reliability of electric transmission, environmental stewardship, and cost. As vegetation growth is dynamic, the planning and implementation process is iterative and continuous; this allows flexibility to adjust plans as needed.

Setting objectives, defining action thresholds and selecting site-specific application of tools to control vegetation are all considered in the IVM process. TVA believes that the IVM process provides the greatest flexibility for decisions regarding transmission ROW management; thus, the alternatives it considers in this EA are based on the IVM concept. Tools are selected based upon a thorough consideration of the end-state and form of the plant communities that are subject to control and an integrated application of TVA's office-level sensitive area review (O-SAR) process. The O-SAR process, described below in Section 2.2.2, prescribes the need for site-specific field surveys and particular tool use based on the documented or potential presence of sensitive environmental resources.

1.2.6 Selection of Vegetation Control Methods

The process for selecting from various vegetation management methods is determined based on the location, the existing plant communities, and with the integration results of TVA's O-SAR process. The vegetation control methods or tools and their appropriate uses for various transmission ROW conditions are identified and discussed in TVA's PEIS (2019).

Of the vegetation control methods available for transmission ROW vegetation maintenance (e.g., manual, mechanical, and herbicide/growth regulators), the most suitable approach would be the one that best achieves the management objectives at each site within the transmission ROW (see Table 1-2). The site-specific selection of control methods (individually or in combination) are based on a range of factors including an understanding of environmental resources and their sensitivities, knowledge of specific site characteristics, safety, economics, and current land use issues.

Table 1-1. Methods Appropriate for Use on TVA Transmission ROWs

	Vegetation Control Method		
	Manual	**Mechanical**	**Herbicide**
Agricultural Areas	Usually not many trees requiring control.	Usually not many trees requiring control.	Appropriate for target vegetation control. Agricultural landowner often uses herbicide methods for localized treatments of weeds.
Forested Areas	Manual methods appropriate for tree removal.	Appropriate for dense stands of vegetation and for removal of buffers.	Appropriate for target vegetation control (including invasive weeds), and stump treatments of deciduous trees.
Grassland and Shrub	Usually not many trees requiring control. Would address invasive weeds in very limited cases. Root systems would not be controlled; seeds have the potential to spread.	Appropriate for clearing brush on access roads, or around towers.	Appropriate for general application and for invasive weed control.
Residential Areas	Would address invasive weeds in very limited cases. Weed roots would not be controlled; seeds have the potential to spread.	Would address invasive weeds in very limited cases. Weed roots would not be controlled; seeds have the potential to spread.	Appropriate for controlling invasive weeds, selected application.
Danger Trees Outside the ROW	Manual methods are appropriate for selective removal of danger trees.	Appropriate; however, mechanical methods tend to be non-selective and used for smaller tree heights.	Growth regulator may be appropriate to stunt growth of potential danger trees.

Effective vegetation control along the transmission ROW typically requires the use of a combination of methods depending on the target vegetation type. TVA uses herbicides predominantly during routine floor vegetation management and a mix of manual and mechanical methods to remove trees. Noxious or invasive plant species are controlled predominantly by a mix of methods dominated by mechanical techniques and herbicides. By comparison, tall-growing, incompatible trees and shrubs are typically controlled using a more balanced application of all techniques (manual, mechanical, and herbicide).TVA recognizes that each tool has inherent advantages and disadvantages (TVA 2019).

Setting objectives, defining action thresholds and selecting site-specific application of tools to control vegetation all require consideration as part of the IVM process. Use of all the methods identified (manual, mechanical, and herbicide/growth regulators) is appropriate and necessary to ensure flexibility of application, increased environmental sensitivity, and cost effectiveness for each site-specific application.

1.3 Decisions to be Made

The primary decision before TVA is whether to ensure safe and reliable electric power to TVA's power service area by strategically managing vegetation along its transmission line ROWs consistent with applicable laws, regulations, court orders, standards, practices and guidance, while protecting environmental resources to the extent possible. If the proposed vegetation management is to occur along transmission line ROWs, other secondary decisions are involved. These include the type and timing of vegetation control methods. TVA's decision will consider factors such as environmental impacts, economic issues, and the availability of resources.

1.4 Related Environmental Reviews

In 2019, TVA released the PEIS, which is incorporated by reference (TVA 2019). This review more broadly represented a comprehensive analysis of management activities and potential environmental impacts associated with TVA's vegetation management program across all sectors within the TVA power service area. Various vegetation management methods and tools were considered as part of the analysis. TVA issued a Record of Decision on October 18, 2019 identifying its preferred vegetation management program alternative as a condition-based control strategy with a goal of maintaining the rights-of-way in a meadow-like end-state (84 FR 55995).

1.5 Public Involvement

TVA has developed a public communication plan that includes a Web site as the primary platform for public outreach. TVA has also used local news outlets and notices placed in the local newspapers to notify other interested members of the public of the proposed FY21 vegetation management.

The project Web site is intended to serve as the primary hub for distributing information to the public. Visitors to the page can navigate from the project Web site to other web sites for additional information pertaining to TVA's transmission system and current vegetation management. The Web site directs the public to submit scoping comments via email, mail, or an online comment form accessed from the project Web site.

1.6 Prior Agency and Tribal Involvement

During the review of TVA's vegetation management program (TVA 2019), TVA contacted federal and state agencies, as well as federally recognized Native American tribes represented in the TVA power service area (see Appendix B).

Pursuant to Section 7 of the ESA, and in consultation with the (U.S. Fish and Wildlife Service) USFWS, TVA prepared a programmatic Biological Assessment (BA) that evaluated impacts of a suite of TVA routine actions on federally listed bats present in the TVA power service area. This consultation was completed in April 2018 (Appendix C). TVA also has consulted with the USFWS on routine vegetation management activities carried out on TVA transmission ROWs for all other threatened and endangered species. This consultation was completed in May 2019 (Appendix D).

Pursuant to Section 106 of the (National Historic Preservation Act) NHPA, and in consultation with the Advisory Council on Historic Preservation; the state historic preservation officers (SHPOs) of Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee and Virginia; and all federally recognized Indian tribes with an interest in the region, TVA prepared a Programmatic Agreement (PA) for existing TVA operation and maintenance activities, including vegetation management. This consultation was completed in February 2020 (Appendix E).

Further, TVA coordinated with other federal land management agencies in conjunction with the PEIS. During the PEIS, the National Park Service (NPS) and the U.S. Forest Service (USFS) served as cooperating agencies contributing on vegetation management practices on TVA transmission line ROWs crossing federal lands in their jurisdiction. Regardless, these agencies would be notified, and consulted with, as appropriate, concerning any transmission line ROW segments proposed for vegetation management. Other relevant agreements and consultations, as appropriate, are included in Appendix F.

Following the release of the Final PEIS, copies or notices of its availability with instructions on access was provided to agencies, federally recognized Indian tribes represented in the TVA power service area, and individuals that had expressed interest in the project.

1.7 Scope of the Environmental Assessment and Issues to be Addressed

TVA prepared this EA in compliance with NEPA, regulations promulgated by the Council on Environmental Quality, and TVA's procedures for implementing NEPA (18 CFR 1318). This EA which tiers from the review of TVA's vegetation management program (TVA 2019), identifies individual transmission line segments in each of the 12 managed ROW sectors in which vegetation management activities are proposed (Appendix G), and provides more site-specific review and analysis, as appropriate. For the purpose of this EA, all areas proposed for vegetation management within ROW segments have been previously cleared and continuously maintained, and tree work would be limited to immediate hazard trees until the court injunction has been lifted.

To facilitate "tiering" the PEIS established the process TVA considers when making decisions regarding vegetation management, identified potential environmental impacts associated with vegetation management tools, and established mitigation measures that would minimize environmental impacts (TVA 2019). This EA integrates the findings and conclusions of this analysis.

In the PEIS, TVA determined that the resources listed below could potentially be impacted by the alternatives considered (TVA 2019). These resources were identified based on internal scoping as well as comments received during previous public scoping periods for transmission line projects.

- Surface Water
- Aquatic Ecology
- Vegetation
- Wildlife
- Threatened and Endangered Species
- Wetlands
- Managed and Natural Areas Parks and Recreation
- Cultural and Historic Resources

Further, the PEIS concluded that the potential effects of floor-work and hazard/danger tree vegetation management on transmission line ROWs would be minor, short-term, temporary, negligible, and/or none related to air quality and global climate change, geology, groundwater, hydrogeology, floodplains, socioeconomics and environmental justice, transportation, visual resources, land use and prime farmland, solid and hazardous waste, and public health and safety. Thus, any further analysis for effects to these resources was not deemed necessary.

TVA's action would satisfy the requirements of Executive Order (EO) 11988 (Floodplain Management), EO 11990 (Protection of Wetlands), EO 12372 (Intergovernmental Review), EO 12898 (Environmental Justice), EO 13112 as amended by 13751(Invasive Species), EO 13653 (Preparing the U. S. for the Impacts of Climate Change), and applicable laws including the Farmland Protection Policy Act, the NHPA of 1966, Endangered Species Act of 1973 (ESA), as amended, Clean Water Act (CWA), and Clean Air Act (CAA).

1.8 Necessary Federal Permits or Licenses

No federal permits or licenses are required to implement the proposed management of vegetation on TVA transmission ROWs.

This page intentionally left blank

2.1 Alternatives Including the Proposed Action

As described in Chapter 1, the scope of the potential alternatives is informed by the purpose and need of the proposed action, namely, the need to manage and/or eliminate vegetation that interferes with the safe and reliable operation of the transmission system. A description of the proposed action is provided below in Section 2.1.2. Additional background information about its existing vegetation management practices, as well as the need to address future management along the transmission ROW is also provided.

This chapter has five major sections:

1. A description of alternatives;
2. A explanation of the process of vegetation management;
3. A comparison of anticipated environmental effects by alternative;
4. Identification of mitigation measures; and
5. Identification of the preferred alternative.

2.1.1 Alternative A – No Action Alternative – Do Not Perform Routine Vegetation Management

Under the No Action Alternative, there would be no change to the current state of vegetation within the wire or border zone of TVA transmission line ROWs. Individual ROW segments that TVA has identified in which floor work vegetation management activities are needed would not take place.

Likewise, pursuant to the *Sherwood v TVA* injunction, the vegetated ROW “buffer” would not be removed under this alternative. This vegetation management process is prescribed by the court injunction order currently in place in the *Sherwood v. TVA* litigation. According to the court order, TVA must leave existing trees in the maintained area of the ROW so long as they do not pose an immediate hazard to the transmission lines or structures.

Under this alternative, TVA may remove or trim any tree in the previously maintained areas of ROW, or in the non-maintained areas of ROW, or any danger tree outside the transmission ROW, in accordance with its contract rights, that TVA deems to present an immediate hazard to its transmission line or structures. Tree work in remaining buffer areas would be limited as follows (subject to the terms of the *Sherwood* injunction, which states that any ROWs not already cleared to the extent of the ROW easement widths cannot currently be maintained to the easement widths):

• 500 kV transmission line.	200-foot-wide ROW.	Clear and maintain a 150-foot-wide center area and leave a 25-foot-wide non-maintained area on each side of the maintained area.
• 500 kV transmission line.	175-foot-wide ROW.	Clear and maintain a 150-foot-wide center area and leave a 12.5-foot-wide non-maintained area on each side of the maintained area.

• 161 kV transmission line.	150-foot-wide ROW.	Clear and maintain a 100-foot-wide center area and leave a 25-foot-wide non-maintained area on each side of the maintained area.
• 161 kV transmission line.	100-foot-wide ROW.	Clear and maintain the entire 100-foot-wide ROW.
• 161 kV transmission line.	75-foot-wide ROW.	Clear and maintain the entire 75-foot-wide ROW.
• 69 kV transmission line.	75-foot-wide ROW.	Clear and maintain the entire 75-foot-wide ROW.

Floor work would continue to be evaluated on a nominal three-year cycle in previously cleared areas. As a result, the existing ROW would continue to contain vegetation incompatible with TVAs transmission system. The volume of non-compatible woody vegetation is also increasing within the previously-cleared ROWs due to the court injunction order.

The No Action Alternative does not adequately address the potential for service outages from trees growing into the line, falling into the line, or creating a fire hazard to the transmission lines and structures, and thereby creates an increased risk to reliability. The No Action Alternative also does not adequately address the risk to public safety that can stem from wildfires caused by power lines. In addition, the No Action Alternative would lead to a marked increase in worker safety concerns, due to the increased risk of serious injuries and fatalities associated with the increased need to undertake manual removal of large danger trees.

The net present value (NPV) of the cost to maintain the transmission ROW for the next 20 years under the No Action Alternative is estimated to be approximately $205 million (TVA 2019). However, tree work costs are higher for this alternative and would increase over time due to the inefficiencies inherent in removal of only immediate hazard trees, as opposed to removal of all incompatible trees during routine vegetation maintenance. This increase would be a direct result of continued vegetation growth until the vegetation grows sufficiently to meet the definition of immediate hazard, which would necessitate addressing that imminent hazard in the next maintenance cycle. In addition, the increased costs include management of new trees that sprout and grow as a result of the less aggressive vegetation maintenance as required by the injunction.

Consequently, this alternative would not satisfy the project purpose and need and, therefore, is not considered a viable or reasonable vegetation management alternative. It does, however, provide a benchmark for comparing the environmental impacts of implementation of the Action Alternative.

2.1.2 Alternative B – Action Alternative – Perform Routine Vegetation Management

Under the Action Alternative, TVA proposes as part of TVA's FY21 planning cycle to implement its process of routine vegetation management within approximately one-third of its transmission system ROWs within each of the 12 managed sectors (Figure 1-1; Appendix G). TVA would use an IVM approach to promote the establishment of a plant community "end-state" dominated by low-growing herbaceous and shrub-scrub species that do not interfere with the safe and reliable operation of the transmission system. The goal of this vegetation management alternative would be to allow compatible vegetation to establish and propagate to reduce the presence of woody species. TVA would continue to use all assessment techniques, including Light Detection and Ranging (LiDAR) data.

TVA's policy and direction for managing vegetation along its transmission line ROW integrates an IVM strategy allowing TVA to apply a range of methods depending on the target vegetation type. The proposed Action Alternatives incorporates this IVM approach based on a carefully planned, multidimensional strategy developed in consultation with forestry and habitat experts. IVM aims to create conditions on the transmission ROW that improve safety and prevent power outages by creating inherently more compatible and self-sustaining ecosystems while ensuring compliance with regulatory standards (TVA 2016).

The proposed Action Alternative to manage vegetation is "context sensitive" within an overarching IVM approach in its selection of methods and in its incorporation of TVA's O-SAR process to avoid and minimize impacts (Figure 2-1). The scope of the potential alternative is constrained by the need for TVA to eliminate vegetation that interferes with the safe and reliable operation of the transmission system including both the conductor and structures. The establishment of a stable, low-growing plant community would reduce the intensity of vegetation control once the desired end-state in each location has been achieved.

Routine vegetation management includes the identification and removal of vegetation within the transmission ROW incompatible with TVA's desired end-state condition. Within transmission ROWs primarily maintained by TVA, vegetation for most of the transmission system has routinely undergone floor work (i.e., that which is focused on the maintained herbaceous community) which is planned on an established cycle and would be controlled using a mixture of methods. In general, vegetation within the ROW would be controlled using a mix of approximately 90 percent herbicide, 6 percent mechanical and 4 percent manual methods. However, the net effect of TVA's O-SAR process is to consider the site-specific sensitivity at a given location on the transmission ROW in the development of a context sensitive approach to tools for vegetation management that not only have an effect on method selection for floor work but also for tree work (Figure 2-1).

All danger trees would be removed using a combination of mechanical or manual methods depending on the specific site conditions. However, under this alternative, TVA would continue to use a context sensitive approach for selection of different tools by area (floor vs. trees) and for respective environmental settings or vegetation maintenance as summarized in Figure 2-1.

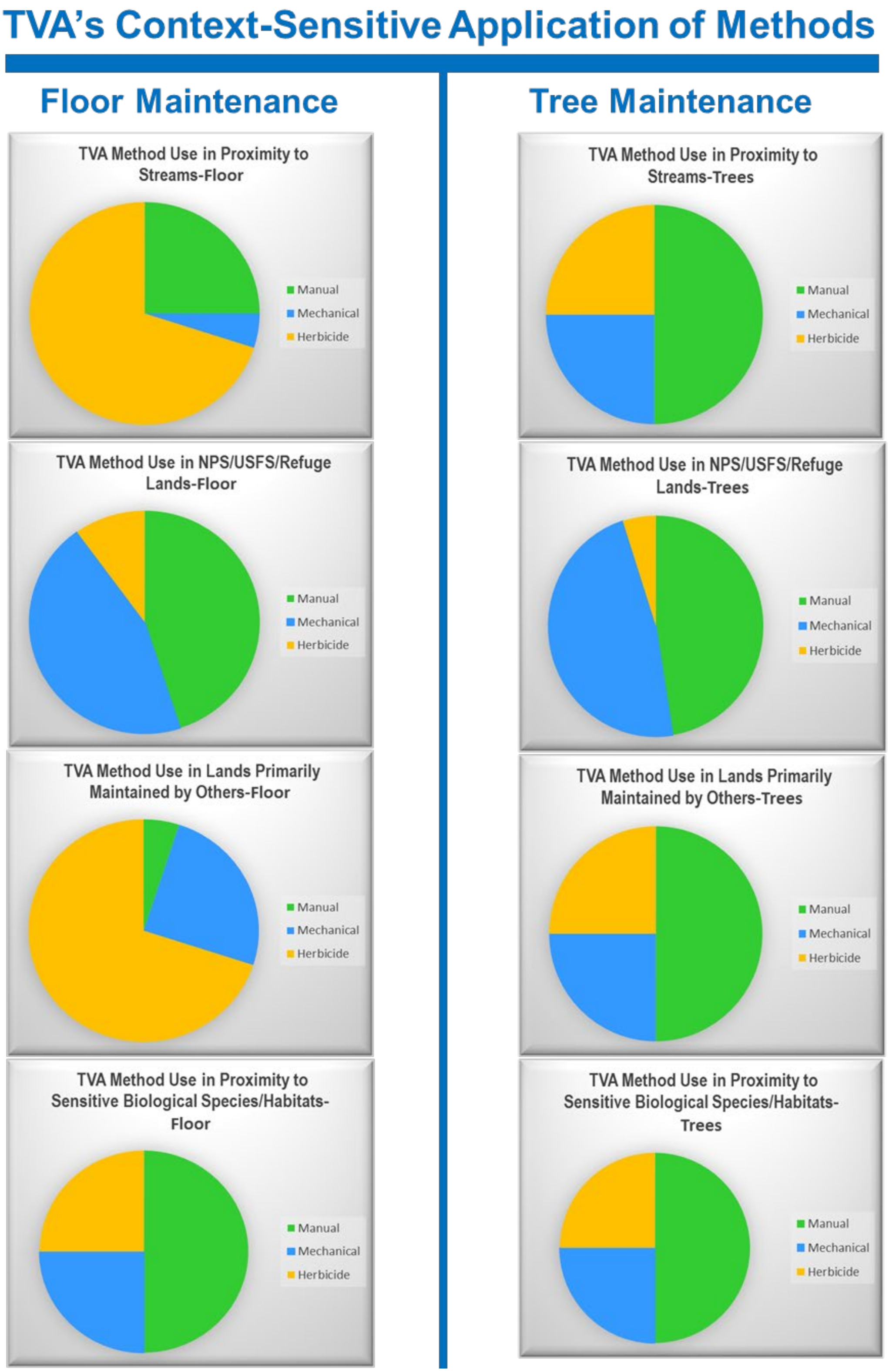


Figure 2-1. TVA's Context Sensitive Application of Vegetation Control Methods

These ecosystems foster beneficial, attractive and low-maintenance habitat where incompatible vegetation is discouraged and other, more benign forms of vegetation can thrive. By combining selective use of herbicides with physical vegetation removal, IVM can more thoroughly eradicate incompatible vegetation and allow more “compatible” species to fill in, making it harder for tall-growing vegetation to reestablish.

As illustrated in Figure 2-2, TVA predominantly uses herbicides during routine floor vegetation maintenance and a mix of manual and mechanical methods to remove trees. Noxious or invasive plant species are predominantly controlled by a mix of methods dominated by mechanical techniques and herbicide application. By comparison, tall growing incompatible trees and shrubs typically are controlled using a more balanced application of all techniques (manual, mechanical, and herbicide).

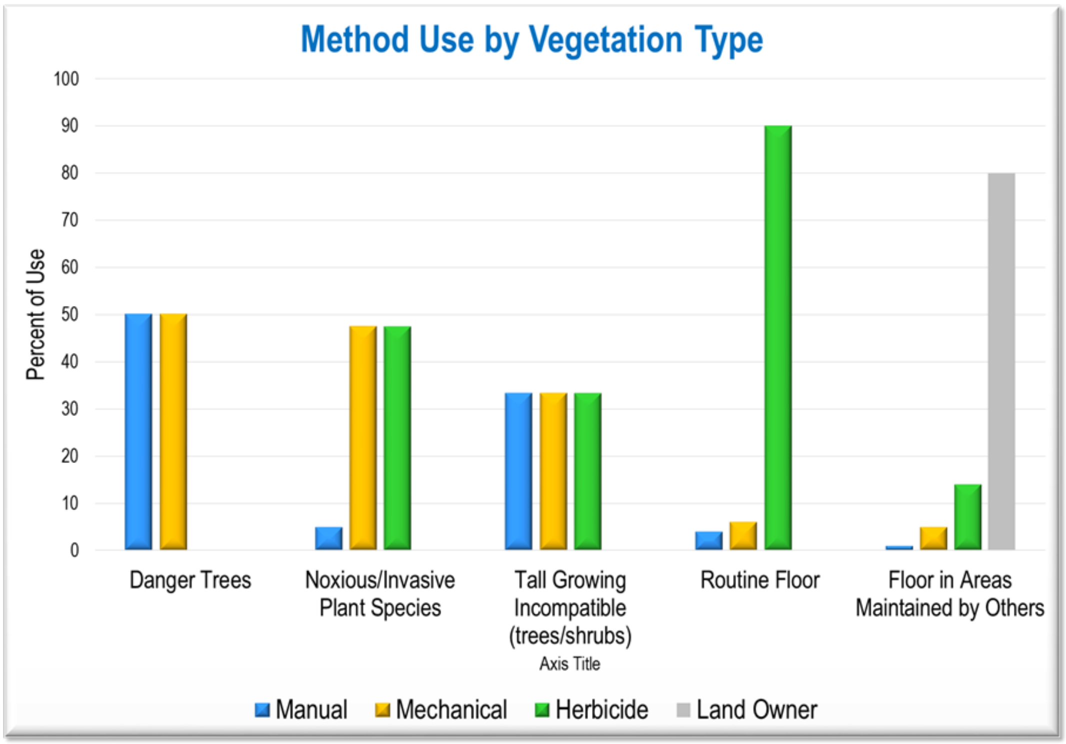


Figure 2-2. Relative Frequency of Method Use by Target Vegetation Type

Due to the *Sherwood v. TVA* litigation, TVA has stopped removing woody vegetation except for trees that are an immediate hazard to the reliability of the transmission system and/or safety of the public. As a result, buffer zones within the existing ROW continue to increasing contain vegetation incompatible with TVA’s transmission system. The volume of non-compatible woody vegetation is also increasing within the previously-cleared ROWs due in part to compliance with the *Sherwood* injunction.

Under the Action Alternative, compatible trees and shrubs would be allowed in areas maintained actively by others (such as residential lands, orchards, forest plantations, agricultural lands or other similar areas). Where terrain conditions provide for higher clearances (i.e., ravines, steep slopes etc.), vegetation may not conflict with the safe and reliable operation of the transmission lines, and thus would not need to be removed.

The proposed alternative includes routine assessment methods to establish a basis for vegetation control measures. The assessment process is accomplished by a variety of methods including aerial inspections, ground inspections, as-needed field inspections, and information from TVA personnel, property owners, and the general public.

Another powerful assessment technique available to TVA is aerial three-dimensional imagery to map areas of the transmission ROW. This imagery is procured using aerial photography, remote sensing methods, photogrammetry, and LiDAR data. Using these techniques, the height of vegetation growing within the transmission ROW (wire and border) can be measured and assessed to determine its potential to be a current or near-term (i.e., 5 to 10 years depending on growth rate of individual species) threat to transmission lines or structures and thus, to reliability. TVA can use information obtained by these techniques to determine planning needs to conduct both routine and recurring vegetation maintenance and for identifying incompatible vegetation for removal.

The NPV of the cost to maintain the transmission ROW for the next 20 years under this alternative is estimated to be approximately $180 million. In the long-term, however, it would be less expensive to maintain the transmission ROW under this alternative.

2.2 Process of Managing Vegetation within Transmission Line ROWs

2.2.1 Vegetation Management Framework

Each year TVA assesses vegetation conditions on and along its transmission ROW to identify vegetation that potentially could interfere with the safe, efficient and reliable operation of the existing transmission system, and public safety. TVA also must comply with the NERC Reliability Standard (FAC-003) where applicable. Maintaining adequate clearance between transmission line conductors and tall growing vegetation is essential to reliability, safety, and compliance with applicable regulatory standards. As noted in Chapter 1, TVA's transmission system vegetation management responsibilities encompass approximately 238,000 acres of transmission ROW.

The framework for TVA's vegetation management program within its transmission system consists of the following basic components:

- Inspections
- Planning and Support
- Floor work
- Tree work
- Communication
- Reliability and Compliance

Floor work on TVA's transmission system is routine and focused on periodic, repeated application of vegetation control measures. Floor work is used to maintain plant communities in an herbaceous or low-growing condition to prevent future incompatibility with transmission facilities, thereby promoting reliability and regulatory compliance. Vegetation management of lands primarily maintained by others includes cropland, golf courses, orchards, lawns, and other developed landscapes. Within these areas of the transmission ROW, floor work primarily is performed by landowners maintaining landscapes in residential and developed lands and by routine agricultural practices (e.g., cultivated fields, hay fields, pastures, orchards, etc.). Even on property maintained by others, TVA retains rights for vegetation management within its transmission line easements. Landowners cannot engage in activities that violate the easement terms or create an unreasonable interference to TVA operations. TVA typically manages vegetation along fence rows, tower structures, ditch banks and other features, as resources allow. Floor work is conducted using a range of tools and methods as described in Chapter 1 and in TVA's review of its vegetation management program (TVA 2019). Floor activities typically consist of herbicide application with lesser amounts of mechanical and manual control methods.

Tree work throughout TVA's transmission system (including lands primarily managed by others) focuses on removal of incompatible trees to maintain the safety and integrity of the transmission system. Tree work includes removal of trees that may become a risk to the reliability of the transmission system within the transmission ROW easement and removal of danger trees outside of the transmission ROW easement. However, as previously discussed, the *Sherwood* injunction requires "TVA [to] maintain buffer zones on the edges of its ROW in a manner as described in its 1997 and 2008 Line Maintenance Manuals" (TVA 1997; TVA 2008). TVA has thus stopped removing woody vegetation except for trees that are an immediate hazard to the reliability of the transmission system and/or safety of the public. Typically, trees are controlled through manual methods (e.g., chainsaw) and mechanical controls (e.g., equipment-mounted saws, mowers). Tree work throughout TVA's transmission system is directed by inspections and assessments that identify incompatible woody vegetation and guide control measures.

As part of the process, TVA develops a vegetation removal plan specific to each transmission line project area based on local terrain conditions, species composition, growth form, and vegetative density. TVA has developed a stepwise process incorporated under all of the proposed vegetation management alternatives to ensure that vegetation management proactively protects environmental resources, considers land use and land ownership, and enhances health and safety. This process applies to planned vegetation maintenance activities and is not applicable to addressing emergency needs.

Under this approach TVA ensures the following steps are implemented:

1. **Identify the area of vegetation maintenance and type of required activity to ensure safety and reliability.**
    a. *Floor work* – Identify the types of vegetation that require control (invasive weeds, tall-growing vegetation).
    b. *Tree Work* – Tree removal of incompatible vegetation that would represent a current or future hazard to the transmission system.
2. **Identify surrounding land use (i.e., urban, forested, agriculture, pasture, etc.) and landowners.**
    a. Address ROW vegetation maintenance within special use lands associated with NPS, USFS, tribal lands, or other special use/conservation lands in accordance with any existing agreements or regulations.
    b. Follow current TVA process for notifying property owners.
    c. Evaluate surrounding land uses to determine constraints on vegetation control. Incorporate appropriate BMPs as described in *A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Construction and Maintenance Activities Revision 3-2017* (TVA 2017a). The manual can be accessed here.

3. Identify sensitive or natural resources within an area of activity and implement any special requirements associated with performing work in those areas.

a. Review and interpret O-SAR data (see Section 2.2.2 below).
b. Identify appropriate mitigation measures as outlined in TVA's guide for environmental and best management practices (TVA 2017a) for the following resources:

- Streamside Management Zones (SMZ).
- Wetlands.
- Other sensitive resources which can include, but are not limited to, caves, federal and state-listed threatened, endangered or special status species (plants and animals), public water supplies, groundwater, critical or unique wildlife or habitat (e.g., trout streams, designated critical habitat, wading-bird nesting areas, heronries, sinkholes), and cultural resource features.

c. Evaluate work area for safety factors in relation to TVA personnel and the general public.
d. Identify areas with steep or unstable slopes (usually greater than 30 percent). Certain types of mechanical equipment may not be feasible in these areas.
e. Ensure TVA personnel and contractors are properly trained for specific techniques required for special requirements.

Environmental Constraint:
Streamside Management Zones

BMP Employed: When removing vegetation within an SMZ, TVA uses buffers of a minimum 50 feet on each side of the bank. Buffer width is predetermined based on waterway, primary use, topography, physical barriers, and resource sensitivity. Removal of vegetation within an SMZ is limited to only tall-growing, incompatible species, preserving the low-growing vegetation to minimize disturbance. Stumps must be left in place and all debris from vegetation removal must be removed from within the SMZ.

4. Determine vegetation control methods.

a. Consider Steps 1 through 3.
b. Consider safety.
c. Consider cost.
d. Incorporate appropriate BMPs and guidance as described in TVA's guide for environmental and BMPs (TVA 2017a or most current revision) and current TVA Vegetation Management Guidelines as described in Appendix H.

5. Prepare appropriate environmental documentation.

a. Determine if the work is within the parameters of the PEIS (2019).
   1. If yes, determine if work is covered under an existing Categorical Exclusion or EA.
   2. If not, conduct further environmental review if anticipated impacts are substantially different from those evaluated in the PEIS.
   3. Monitor to determine whether follow-up treatments or mitigation measures are necessary.

6. Determine appropriate debris management method and re-vegetation method if required.

1. Determine whether reseeding is necessary or appropriate under the circumstances.
2. Determine appropriate debris management method considering Steps 1 through 3 above.

7. Determine re-inspection requirements.

1. Determine steps needed to evaluate whether vegetation treatments and/or mitigation measures are working properly and to ensure that other resources are not being adversely affected.
2. Monitor to determine whether follow-up treatments or mitigation measures are necessary

2.2.2 TVA's Integrated Sensitive Area Review Process

The types of sensitive resources occurring in or near the transmission ROW vary widely and include threatened and endangered plant and animal species, caves, heron/osprey rookeries, natural areas, and wetlands. To protect sensitive resources on transmission line ROWs, TVA developed the O-SAR process as an integral component of all of its vegetation management practices. The O-SAR process is used to address routine vegetation maintenance activities and is discussed in greater detail in the TVA's PEIS (2019).

As part of the O-SAR process, qualified biologists perform reviews of the entire transmission system every 3 years. These desktop reviews use computer-based mapping programs and a wide array of digital data, in lieu of field surveys, to ascertain where sensitive resources may occur on TVA transmission ROWs. Field verified data is added to the O-SAR data, if and when it becomes available. Sensitive resources identified as part of the review process are grouped into five general categories (Table 2-1). The more common widely available data sets used in office-level reviews include aerial photography, U.S. Geological Survey (USGS) topographic maps, National Wetland Inventory (NWI) data, U.S. Environmental Protection Agency (EPA) Level 4 ecoregion maps, and Natural Resource Conservation Service soils maps. TVA's approach is unique in that it uses specific data as part of the O-SAR review that includes both transmission line/structure locations coupled with TVA's extensive Regional Natural Heritage database. This is a "living[1]" database that contains over 30,000 occurrence records for protected plants, animals, caves, heronries, eagle nests, and natural areas for the entire TVA study area.

[1] TVA adds records based on field survey findings, and TVA's Regional Natural Heritage database is periodically synced with both the USFWS federal listing of threatened and endangered species and state Natural Heritage programs.

Table 2-1. Elements of TVA's Office-Level Sensitive Area Review Database

Sensitive Resource Categories	Data Descriptions
Plants	Locations (documented or potential) of federally or state-listed plant species or unique plant communities.
Aquatic Animals	Locations (documented or potential) of federally or state-listed aquatic animal species.
Terrestrial Animals	Locations (documented or potential) of federally or state-listed terrestrial animal species, bald eagle nests, caves, heron rookeries, osprey nests, Indiana/northern long-eared bat habitat, and other unique resources.
Natural Areas	Locations of federal, state, local, or non-profit lands managed for ecological and/or recreational purposes. A few examples include National Parks, Federally Designated Critical Habitat, Tennessee Designated Natural Areas, state Wildlife Management Areas, and land trust properties.
Wetlands	Includes NWI wetlands; potential wetlands identified by TVA using topographic features, water bodies, soils boundaries, and proximity to NWI; and field verified wetlands delineated during TVA field surveys of transmission ROW.

Sensitive resources identified within the O-SAR database are defined as polygons and assigned a "Class" level with specific guidance governing transmission ROW vegetation management planning efforts. Sensitive area class definitions for vegetation management activities are provided in Appendix I. The guidance may be informational or prescriptive and result in limitations of particular control measures, requirements for notification to TVA biologists, or the need for site-specific field surveys to be performed by TVA biologists prior to work activities. This guidance constitutes an important aspect of the implementation of BMPs to minimize environmental impact. The guidance is particularly important to clearly define what vegetation maintenance activities are permissible within sensitive areas, taking into account the specific sensitive resources that occur or might occur on a given section of transmission ROW. The guidance also seeks to give certainty and flexibility to TVA transmission ROW personnel, who develop vegetation control activities over large areas under schedule and budget constraints. On lands managed by NPS and USFS, additional reviews by appropriate agency staff is required prior to the implementation of vegetation management practices. Among other things, the need for additional review will be determined by TVA's respective property rights and/or any effective agreements. For instance, NPS parcels on ROW may not have any chance of T&E plants or animals, but herbicide use is still not allowed because of specific guidance per the land manager.

2.2.3 Programmatic Agreements and Consultations

TVA's formulation of vegetation management alternatives also integrates the content of PAs and consultations developed and executed in coordination with other federal and state agencies. TVA uses these program-level, regulatory-based determinations to avoid or minimize adverse effects of TVA actions.

As described in Section 1.6, and in accordance with Section 7 of the ESA, TVA consulted with the USFWS to assess, on a programmatic basis, the impact of 10 overarching TVA routine actions on four federally listed bat species (gray bat, Indiana bat, northern long-eared bat, Virginia big-eared bat) and their habitats. As part of this effort, TVA prepared a programmatic BA, which was submitted to USFWS on June 18, 2017. Within the BA, TVA analyzed the effects of 96 routine activities associated with the 10 routine actions. One of the routine actions was maintenance of existing electric transmission assets, which included vegetation management activities along transmission line ROWs.

TVA determined that 21 of the 96 activities will have no effect on Indiana bat or northern long-eared bat; 72 activities may affect, but are not likely to adversely affect these two species; and three activities are likely to adversely affect these two species. Potential adverse effects to Indiana bat and northern long-eared bat could result from tree removal (two of three activities) or prescribed fire (one of three activities). Of these, tree removal is identified as an activity that can occur during vegetation maintenance activities. The use of prescribed fire is limited to portions of TVA Reservoir Lands and would not be used during vegetation maintenance activities. TVA also determined that 21 activities covered under the programmatic BA will have no effect on gray bat or Virginia big-eared bat, and 75 activities may affect, but are not likely to adversely affect these two species.

As a component of the BA, TVA committed to implementing conservation measures to avoid and minimize impacts associated with routine actions, as well as to continue conducting conservation measures that may benefit or promote the recovery of the Indiana bat, northern long-eared bat, gray bat, and Virginia big-eared bat.

In response to TVA's programmatic BA on bats and routine actions, the USFWS prepared a programmatic Biological Opinion, concurring with TVA's "effects determinations" and proposed conservation measures. This programmatic consultation was completed in April 2018, and it will be carried out over a 20-year term. Documentation of this consultation including the USFWS Biological Opinion is included Appendix C.

TVA also consulted with the USFWS to assess the impacts of routine activities associated with TVA's transmission ROW vegetation management program on all species listed under the ESA (other than the four federally listed bat species addressed in the programmatic consultation) with potential to occur in the study area. This consultation was completed and the USFWS issued a Biological Opinion in May 2019 concurring with TVA's effects determinations. The Biological Opinion is included in Appendix D. BMPs and conservation measures developed in conjunction with this consultation to avoid and minimize effects to sensitive species will be integrated into TVA's transmission ROW vegetation management procedures.

TVA also consulted with the Advisory Council on Historic Preservation, the SHPO of Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee and Virginia (respectively), and all federally recognized Indian tribes with an interest in the region for existing TVA operation and maintenance activities, including vegetation management. Pursuant to Section 106 of the NHPA this consultation was completed in February 2020 (see Appendix E).

2.3 Comparison of Alternatives

The environmental impacts of each of the management alternatives under consideration are summarized in Table 2-2. These summaries are derived from the information and analyses vegetation maintenance methods provided in the Affected Environment and Environmental Consequences sections for each resource in Chapter 3 and/or in TVA's PEIS for resource issues that were determined to be minor, short-term, temporary, negligible, and/or none (TVA 2019).

Table 2-2. Summary and Comparison of Alternatives by Resource Area

No Action Alternative **Do Not Perform Vegetation Management**	**Action Alternative** **Perform Routine Vegetation Management**
Reliability	
Increased risk of non-compliance with reliability standards.	Enhances compliance with reliability standards.
Vegetation	
No immediate change in baseline condition. However, continued growth of vegetation would change species composition from an herbaceous community to a more shrub/scrub community, and possibly over time changing to one with more wooded/forested species. As per the 2017 injunction, only trees that would present an immediate hazard to the reliability of the transmission system would be removed. In the short-term, there would be less need for tree removal. But in the long-term there would be an ever-increasing volume of trees that would be identified as immediate hazards.	Impact to vegetation would be short-term as the areas have undergone routine, vegetation management to be maintained as a low-growing herbaceous community. As per the 2017 injunction, only trees that would present an immediate hazard to the reliability of the transmission system would be removed. In the short-term, there would be less need for tree removal. But in the long-term there would be an ever-increasing volume of trees that would be identified as immediate hazards.
Wildlife	
No immediate change in baseline condition. However, continued growth of vegetation would change species composition over time. As per the 2017 injunction, only trees that would present an immediate hazard to the reliability of the transmission system would be removed. In the short-term, there would be less need for tree removal. But in the long-term there would be an ever-increasing volume of trees that would be identified as immediate hazards.	Potential impacts would be negligible as the vegetation has already been routinely managed supporting an herbaceous community. Vegetation managed in a meadow-like state would be of greater value to wildlife. As per the 2017 injunction, only trees that would present an immediate hazard to the reliability of the transmission system would be removed. In the short-term, there would be less need for tree removal. But in the long-term there would be an ever-increasing volume of trees that would be identified as immediate hazards.
Aquatic Biology	
No change in baseline condition.	Potential short-term and long-term impacts associated with sedimentation during ROW vegetation management. Impact to aquatic biota avoided or minimized through the use of TVA's O-SAR process and adherence to avoidance and minimization measures and BMPs.

No Action Alternative **Do Not Perform Vegetation Management**	**Action Alternative** **Perform Routine Vegetation Management**
Threatened and Endangered Species	
No change in baseline condition. Impact to threatened and endangered species would be minimized through the use of TVA's O-SAR process and adherence to avoidance and minimization measures in the TVA's ESA consultations and applicable BMPs. As per the 2017 injunction, only trees that would present an immediate hazard to the reliability of the transmission system would be removed. In the short-term, there would be less need for tree removal. But in the long-term there would be an ever-increasing volume of trees that would be identified as immediate hazards.	Potential short-term and long-term impacts to threatened and endangered species/habitats as a result of vegetation management. Impacts would be minimized through the use of TVA's O-SAR process and adherence to avoidance and minimization measures in TVA's ESA consultations and applicable BMPs. As per the 2017 injunction, only trees that would present an immediate hazard to the reliability of the transmission system would be removed. In the short-term, there would be less need for tree removal. But in the long-term there would be an ever-increasing volume of trees that would be identified as immediate hazards.
Surface Water[1]	
No change in baseline condition.	Potential impacts associated with runoff and sedimentation during vegetation management. Impacts avoided or minimized through the use of TVA's O-SAR process and adherence to avoidance and minimization measures and BMPs.
Wetlands	
No change in baseline condition.	Potential indirect, minor impacts associated with sedimentation during floor vegetation management. Impact minimized through the use of TVA's O-SAR process and adherence to mitigation measures and BMPs.
Natural and Managed Areas	
No change in baseline condition.	No change in baseline condition. Impact minimized through the use of TVA's O-SAR process and adherence to mitigation measures and BMPs.
Parks[1]	
No change in baseline condition.	No change in baseline condition.
Cultural Resources	
No change in baseline condition.	Provides flexibility in the improvement and management of visual quality of historic properties. In limited cases where impacts exist during ROW vegetation management, those impacts would be minimized through adherence to BMPs and Section 106 or program alternative, such as the PA, where applicable.

No Action Alternative Do Not Perform Vegetation Management	Action Alternative Perform Routine Vegetation Management
Floodplains[1]	
No change in baseline condition.	Potential for minor floodplain impacts due to vegetation removal and debris. BMPs minimize debris in floodplains such that the impact of debris management on floodplains and flow alteration would be minor.
Geology, Groundwater and Soils[1]	
No change in baseline condition.	Increased, albeit limited, potential for soil disturbance and erosion in the long-term as a result of vegetation management of the ROW. Impacts would be avoided or minimized through adherence to avoidance and minimization measures and BMPs.
Land Use and Prime Farmland[1]	
No impact.	No impact to prime farmland. Minor potential impact to land use during vegetation management. Impacts would be avoided or minimized through adherence to avoidance and minimization measures and BMPs.
Visual Resources[1]	
No change in baseline condition. As per the 2017 injunction, only trees that would present an immediate hazard to the reliability of the transmission system would be removed. In the short-term, there would be less need for tree removal. But in the long-term there would be an ever-increasing volume of trees that would be identified as immediate hazards.	Temporary, short-term impact during ROW vegetation management as the ROW would be managed to a meadow-like state. As per the 2017 injunction, only trees that would present an immediate hazard to the reliability of the transmission system would be removed. In the short-term, there would be less need for tree removal. But in the long-term there would be an ever-increasing volume of trees that would be identified as immediate hazards.
Health and Safety[1]	
Short- and long-term safety diminished for those who are working due to risks associated with manual processes required for individual tree removals.	Enhanced worker safety in the long-term by controlled vegetation management but safety enhancement is slightly less because some compatible trees would remain.
Public Health and Safety would be at increasing risk due to the increased numbers of violations of vegetation clearances in the transmission system and the decrease in system reliability.	Enhanced property owner safety and public health and safety due to TVA controlled vegetation management and reliability of the transmission system.

No Action Alternative **Do Not Perform Vegetation Management**	**Action Alternative** **Perform Routine Vegetation Management**
Solid and Hazardous Waste[1]	
No change in baseline condition in the short-term as initially there would be less need for tree removal. But in the long-term there would be an ever-increasing volume of trees that would be identified as immediate hazards. As per the 2017 injunction, only trees that would present an immediate hazard to the reliability of the transmission system would be removed.	Temporary, short-term impact during ROW vegetation management as the ROW would be managed to a meadow-like state. As per the 2017 injunction, only trees that would present an immediate hazard to the reliability of the transmission system would be removed. In the short-term, there would be less need for tree removal. But in the long-term there would be an ever-increasing volume of trees that would be identified as immediate hazards.
Transportation[1]	
No change in baseline condition.	Impacts to transportation during ROW vegetation management would be negligible.
Air Quality and Climate Change[1]	
No change in baseline condition.	Temporary, short-term increased impacts during ROW vegetation management.
Noise[1]	
No change in baseline condition.	Temporary, short-term increased impacts during ROW vegetation management.
Socioeconomics & Environmental Justice[1]	
No impact.	No impact.
Cumulative Effects	
No change in baseline condition.	Incremental benefits to habitat are negligible given the context of the study area.

[1] TVA previously determined potential effects to this resource would be minor, short-term, temporary, negligible, and/or none as a result of routine vegetation management activities (TVA 2019).

2.4 TVA's Preferred Alternative

TVA's preferred alternative is Alternative B, the Action Alternative – Perform Routine Vegetation Management which would include removal of trees that are deemed as hazardous. This alternative is considered to provide the best balance in enhancing system reliability and safety, minimization of environmental impacts, and striving for cost effectiveness.

Vegetation management under this alternative would be accomplished with an IVM approach to promote the establishment of low-growing herbaceous plant communities compatible with the safe and reliable operation of the transmission system. TVA would also use an approach that is condition based for identification and removal of incompatible vegetation and danger trees that would use LiDAR and other assessment techniques.

Routine vegetation maintenance would include identification and removal of vegetation within the transmission ROW that is incompatible with TVA's desired end-state condition. Within lands primarily managed by TVA, floor work would occur on previously cleared and routinely maintained ROW resulting in an end-state consisting of a mix of herbaceous and low-growing shrub species. This vegetation community is more compatible with the transmission system and is expected to provide improved habitat value that over time is expected to minimize intensity of maintaining the floor.

Under Alternative B there would be greater coordination and interaction with local landowners to identify compatible vegetation than with the No Action Alternative. Although TVA would need to remove trees identified as hazardous, TVA would work with local property owners, when requested, to evaluate the compatibility of vegetation within or near the transmission ROW. Vegetation compatible with the safe and reliable operation of the transmission system may be allowed to remain within the ROW. Relative to the No Action Alternative, this alternative would enhance compliance with reliability standards.

Impacts associated with this alternative primarily include temporary short-term impacts during vegetation maintenance activities to most natural resources. Because vegetation removal activities would be conducted within previously established ROW, the overall effect on vegetation is considered to be moderate as the routine maintenance of vegetation would not destabilize the general plant communities within the study area. Long-term impacts of this management alternative are related to the repeated cyclic disturbance within the ROW.

The effects of Alternative B include both short-term and long-term impacts; however, sound planning and the incorporation of TVA's O-SAR process and other BMP measures would avoid and minimize long-term impacts. Alternative B provides benefits in terms of habitat quality and management intensity based on the desired end-state.

Impacts on factors related to the human environment (land use, socioeconomics, air, noise, cultural resources, solid/hazardous waste, public and worker safety, etc.) are generally considered to be localized and temporary. This alternative keeps incompatible vegetation away from transmission lines, reducing the likelihood of devastating, and possibly fatal, wildfires. Consequently, this alternative reduces the risk to homeowners' safety.

2.5 Summary of Mitigation Measures

Mitigation measures identified in Chapter 3 to avoid, minimize, or reduce adverse impacts to the environment are summarized below. Any additional project-specific mitigation measures, such as avoiding areas identified from desktop reviews as having a high probability of any sensitive resources, have been identified on a site-specific basis and are provided in Section 3.9.

TVA has prepared comprehensive standard BMPs that represent mitigation measures that are effective in avoiding, minimizing, rectifying and compensating for effects of vegetation management activities. These BMPs are detailed in TVA's guide for environmental and best management practices (TVA 2017a). Topics addressed in this manual include the following:

- Best Management Practices for Construction and Maintenance Activities including Vegetation Management.
- Sensitive Resources and Buffer Zones.
- Structural Controls, Standards and Specifications.
- Seeding/Stabilization Techniques.
- Practices and procedures are provided that directly relate to the vegetation management activities including initial woody vegetation removal, good housekeeping, waste disposal, herbicide use, and stormwater discharge management.

Integration of TVA's O-SAR process as described in Section 2.2.2.

CHAPTER 3 – AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter provides a description of the potentially affected environmental resources in the study area and the general impacts of vegetation control. The descriptions below of the potentially affected environment are based on published and unpublished reports, the use of TVA's O-SAR process and on personal communications with resource experts. This information establishes the baseline conditions against which TVA decision makers and the public can compare the potential effects of implementing the alternatives under consideration.

The analysis of potential effects to endangered and threatened species and their habitats included records of occurrence within a three-mile radius for terrestrial animals, a five-mile radius for plants, and within 10-digit hydrologic unit code[2] (HUC) watershed for aquatic animals. The analysis of potential effects to aquatic resources included the local watershed, but was focused on watercourses within or immediately adjacent to the proposed ROW and associated temporary access roads. The analysis of potential wetland presence was conducted at the ecoregion level (Level III, Omnerick 1987). Because wetland habitat and extent can vary across ecoregions, wetlands are discussed relative to typical wetland resources by ecoregion. The area of potential effect (APE) for architectural resources included all areas within a 0.5-mile radius from the proposed TL route, as well as any areas where the project would alter existing topography or vegetation in view of a historic resource. The APE with respect to archaeological resources included the entire ROW width for the transmission line segments and the associated temporary access roads.

3.1 Vegetation

3.1.1 Affected Environment

The twelve sectors TVA uses to organize ROW vegetation management activities intersect nine distinct Level III ecoregions (Omernik 1987). The ecoregions support a diverse array of plant communities including deciduous, mixed evergreen-deciduous, and evergreen forest, as well as herbaceous vegetation (see Figure 3-1). Many types of specific plant communities occur throughout the TVA power service area including bottomland hardwood, mixed mesophytic, upland oak-hickory, and swamp forests along with an array of herbaceous communities (TVA 2019).

Specific plant communities located on and adjacent to TVA transmission line ROW vary greatly across the TVA power service area. Plant communities can range from highly disturbed, early successional habitats dominated by invasive species, to rich, diverse herbaceous communities that possess landscape level conservation importance. The relative quality of plant habitats found in any given ROW depends on a multitude of factors, including many that are unrelated to vegetation management decisions implemented by TVA. Factors outside of TVA control that influence plant communities include land use (previous and current), geology, landscape position, soil texture, depth to bedrock, aspect, and rainfall.

---

[2] The United States is divided and subdivided to into hydrologic units by the U. S. Geological Survey. There are six levels of classification. A 10-digit HUC is the fifth (watershed) level of classification.

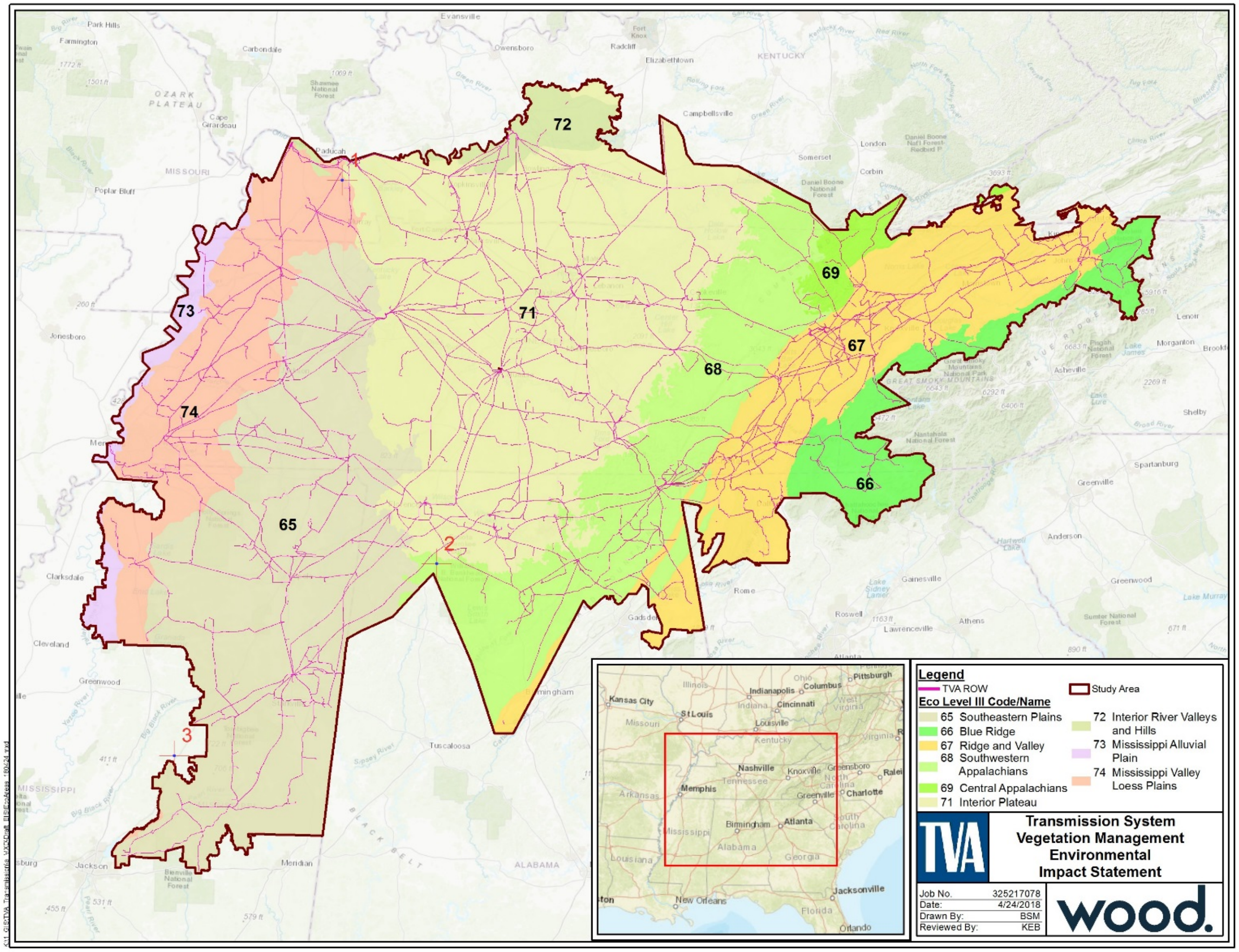


Figure 3-1. Level III Ecoregions within the TVA Study Area

Many plant communities within and adjacent to TVA ROW are heavily disturbed and dominated by weedy species found most often in pastures, lawns, and developed areas. However, there are also habitats that intersect the TVA transmission system that have regional conservation significance. Many of these communities are rare, restricted to very small geographic areas and/or are threatened by human activities. Examples include glades, prairies, barrens, marshes, bogs, fens, and seeps. A few generations ago, native grassland habitats were relatively abundant in portions of the southeastern U.S.; today they are rare (Noss 2013). Reasons for this decline in intact grasslands are many, but growth in agriculture, residential and commercial development, fire suppression, and colonization by invasive species are primary factors. As a result, a subset of transmission line ROWs that vegetation management represent some of the only relatively intact grasslands remaining on the landscape. Approximately 20 globally rare herbaceous communities, as defined by NatureServe, have the potential to occur within TVA transmission line ROWs (TVA 2019). Within the TVA ROW sectors where FY21 vegetation management would occur, important grassland habitat is most likely to occur in the Inner Nashville Basin of central Tennessee, the Eastern Highland Rim of Tennessee and northern Alabama, the Cumberland Plateau and Plateau Escarpment in Alabama, Kentucky and Tennessee, Blackland Prairie in Mississippi, Southern Table Plateau on Lookout and Sand Mountain in Alabama and Georgia, the Crawford-Mammoth Cave Uplands and adjacent Western Pennyroyal Karst Plain in Kentucky, and small portions of the Ridge and Valley in Tennessee and Alabama.

Invasive plants are well-established and wide-spread throughout the TVA power service area. While not well-established in most of the high-quality grassland habitat, these species are abundant across many TVA ROWs, including those slated for vegetation management activities in FY21. EO 13112 Invasive Species (February 3, 1999) directed TVA and other federal agencies to prevent the introduction of invasive species (both plants and animals), control their populations, restore invaded ecosystems and take other related actions. EO 13751 issued on December 8, 2016, amends EO 13112 and directs actions by federal agencies to continue coordinated federal prevention and control efforts related to invasive species.

Land uses, including high intensity grazing, agriculture, and residential or commercial development, severely degrade natural communities. TVA vegetation management activities along ROW, as well as the ROW in general, serve as both vectors for invasive species and refugia for rare grassland communities and species. The relative proportion of invasive species on any given ROW is often determined by factors outside of TVA control. For example, the prior and current ROW land use can have a material effect on the potential for invasive species to gain a competitive advantage over native species.

3.1.2 Environmental Consequences for Vegetation

Localized herbicide application and mowing are the vegetation management tools that would be used most frequently to clear vegetation on the floor of the open ROW. Other Manual, Mechanical, and Herbicide Application Methods, along with Debris Management and Restoration activities, occur very infrequently or do not have the potential to affect vegetation on a meaningful scale (TVA 2019). Tree clearing along the ROW margins would result in a negligible overall change to plant habitats present on the landscape.

Localized applications of herbicide would result in some level of off-target impact. In situations where the woody stem count is high on a given ROW, even localized application of herbicides could produce substantial impacts to non-target species. However, these areas of high woody stem count would be unlikely to support high-quality herbaceous habitats, usually because of site-specific conditions unrelated to TVA vegetation management (i.e., owner land use, soil type, landscape position, etc.). In drier transmission line ROW areas with rocky or sandy soils, where woody stem count is inherently lower, localized herbicide application could foster herbaceous plant communities that are rare on the landscape. These important plant habitats may be globally rare or just relatively diverse herbaceous communities, with limited distribution remaining in the southeastern U.S.

Mowing would remove nearly all woody stems; however, the amount of re-growth can be rapid depending on conditions on the ground. For example, in drier areas with sandy or rocky soils, the rate of tree establishment and growth is relatively slow. In this case mowing can help to maintain high quality native plant communities. However, in all but the driest habitats in the eastern U.S., tree invasion is rapid, and woody plants quickly replace herbaceous species. In addition, repeated mowing of transmission line ROW encourages stump resprouting (sucker growth) and promotes dense stands of woody species. This is particularly problematic in wetlands or on sites with rich soils. Using mowing alone, or as the primary mechanism for vegetation removal on ROWs, would reduce species diversity and encourage the dominance of woody plants able to proliferate through root resprouting.

TVA uses the O-SAR process (see Section 2.2.2) to avoid impacts to important plant habitats within transmission line ROWs by limiting the use of the most damaging methods in areas likely to contain grasslands dominated by native plant species. Broadcast and aerial herbicide is restricted on about 17 percent (about 41,000 acres) of TVA transmission line ROW that are likely to contain important habitat. Manual, mechanical, and localized herbicide methods can be used in these areas. These methods likely serve to perpetuate important herbaceous habitats found in the ROW by eliminating trees that rapidly encroach into open areas without appropriate disturbance. Slightly less than 1 percent (about 2,000 acres) of TVA transmission line ROW is known to contain rare plant habitats. These areas are denoted in the O-SAR database, and when vegetation maintenance is scheduled to occur in such locations, TVA biologists and operations staff would work together to ensure the habitats are protected. Sometimes the proposed work would not affect the plant communities found within the ROW. Other times operations staff augments the timing or method of proposed work to protect sensitive resources. For proposed work planned during FY21, the TVA botanist would coordinate individually with every ROW for all sites in each sector that contain documented rare plant habitat. This would ensure that the most potentially damaging tools, like broadcast herbicide, would not be used in ROW supporting important grassland habitats and that the proposed vegetation management activities would not have significant impacts on terrestrial plant ecology of the region.

3.2 Wildlife

3.2.1 Affected Environment

The proposed Action Alternative study area includes segments of ROW within each of the twelve TVA ROW Sectors across the TVA Region. The Affected Environment for this EA has previously been described in the Transmission System Vegetation Management PEIS (TVA 2019). Wildlife habitat within and around the segments proposed for maintenance in FY21 ranges in quality. Low-quality habitat includes maintained lawns near residential and industrial areas as well as disturbed forest fragments around power-generating facilities. Moderate-quality habitat consists of early successional and herbaceous communities within and along transmission line ROWs bordered by forest edges (edge habitats). Higher-quality habitat include contiguous blocks of forest along reservoir shorelines. Important habitats found within and along transmission line ROWs include riparian corridors, bluffs, swamps, grasslands, rivers and associated stream tributaries, reservoirs, islands, larger un-fragmented forested landscapes, and karst (cave) habitats.

Transmission line ROW corridors are typically dominated by open herbaceous habitats. Undeveloped open lands are comprised of cultivated fields, hayland/pasture, shrub/scrub, and other non-forested cover types. Secondary growth or young trees that have grown up since that last maintenance cycle that are scattered in otherwise open herbaceous habitats within the ROW may occur in sections of ROW that are needing maintenance. Mature forested habitat may be present in transmission line ROWs under lines that span valleys or steep mountain sides. Riparian and wetland habitats within and near TVA transmission line ROW corridors are associated with stream valleys, depressional areas, reservoir systems and areas with localized groundwater discharge. Coupled with unique features such as vernal pools, oxbows, bluffs and islands, these areas provide a diverse array of nesting and foraging habitats for wildlife (TVA 2011a). Birds, mammals, reptiles, amphibians, and pollinators that are commonly found in these areas have been described in the PEIS (TVA 2019).

Review of the TVA Regional Natural Heritage database in June 2020 indicated that two bald eagle nests, ten caves, and 156 osprey nests are known to occur within 50 feet of the ROWs proposed for about three miles of the proposed project area. An additional 26 caves are within 200 feet of these ROWs and an additional 10 bald eagle nests, 37 osprey nests, as well as seven heronries exist within 660 feet of these ROWs (See Table 3-1).

Table 3-1. Total Number of Terrestrial Animal Resources from (A) Within 50 feet of TVA ROW or (B) Where O-SAR Restrictions Overlap TVA ROW Vegetation Management Proposed in Fiscal Year 2021[1]

TVA Right-of-Way Vegetation Management Sectors	Terrestrial Animal Federally and State-listed Species							
	Caves		Osprey		Heronries		Bald Eagle	
	A	B	A	B	A	B	A	B
Cleveland	1	4	15	22	0	1	1	1
Centerville	1	4	28	28	0	0	0	0
Hopkinsville	1	1	15	16	0	0	0	1
Hickory Valley	0	0	13	13	0	0	0	0
Manchester	2	3	9	11	0	1	1	3
Madison	4	7	20	34	0	2	0	3
Milan	0	0	33	36	0	0	0	0
Muscle Shoals	1	2	4	8	0	1	0	1
Morristown	0	7	3	6	0	0	0	3
Nashville	0	1	1	3	0	0	0	0
Oak Ridge	0	4	12	13	0	2	0	0
West Point	0	0	9	10	0	2	0	0

[1] Source: TVA Regional Natural Heritage Database, queried July 2020.

A few bald eagle nests occur on transmission line structures themselves. These large nests are typically built on the highest crossbeam of the tower. However, the majority of nests known from within 660 feet of TVA transmission lines are in trees adjacent to the transmission line ROW. Eagle nest records in the TVA Regional Natural Heritage database include those recently used as well as those that haven’t been used in a decade or more. This is because eagle nests themselves receive protections whether or not occupied.

All but one of the osprey nests are located on transmission towers and are thus directly in the middle of the ROWs. The transmission tower structures typically associated with 161-kV lines (the same size as the lines proposed for maintenance in this EA) are typically between 80 and 110 feet above the ground. While osprey can and do build nests anywhere on the tower with a suitable platform, the majority of them seem to be built on the highest crossbeam of the towers putting the nests approximately 70 to 100 feet off the ground where vegetation management actions would occur.

Two of the seven heronries also occur on transmission towers. However, herons tend to build nests in the lower sections of the towers where beams intersect. Therefore, they are typically closer to the ground where vegetation management could occur. The remainder of heronries are in trees within 660 feet of the ROW proposed for maintenance.

Review of the USFWS’s IPaC website in July 2020 resulted in the identification of 37 migratory bird species of conservation concern that have the potential to occur in the Study Area. Of these species, only 14 have the potential to occur in the action area during migration (American golden plover, bobolink, dunlin, lesser yellowlegs, marbled godwit, Nelson’s sparrow, red-throated loon, ruddy turnstone, semipalmated sandpiper, short-billed dowitcher, swallow-tailed kite, whimbrel, willet, yellow rail). Five others are only found in the action areas during winter or migration (LeConte’s sparrow, long-eared owl, northern saw-whet owl, rusty blackbird, yellow-bellied sapsucker). Eighteen species could be in the action area during the breeding season: American kestrel, bald eagle, black-billed cuckoo (uncommon breeders in the area), black-capped chickadee, blue-winged warbler, Canada warbler, cerulean warbler (uncommon breeders in the area), eastern whip-poor-will, golden eagle, golden-winged warbler (uncommon breeders in the area), Henslow’s sparrow (uncommon breeders in the area), Kentucky warbler, king rail, least tern, prairie warbler, prothonotary warbler, red-headed woodpecker, and wood thrush (Table 3-2).

Table 3-2. Migratory Birds of Conservation Concern with Potential to Occur within 50 feet of Proposed Fiscal Year 2021 ROW Vegetation Management[1]

Species	CL[2]	CV	HK	HV	MC	MD	ML	MS	MT	NA	OR	WP
American Golden Plover							X					
American Kestrel			X	X			X	X				X
Bald Eagle	X	X	X	X	X	X	X	X	X	X	X	X
Black-billed Cuckoo		X			X	X			X		X	
Black-capped Chickadee									X			
Blue-winged Warbler	X			X	X	X	X	X		X	X	
Bobolink		X			X	X		X	X		X	
Canada Warbler		X			X	X		X	X		X	
Cerulean Warbler	X	X	X	X	X	X		X	X	X	X	X
Dunlin				X			X	X				X
Eastern Whip-poor-will	X	X	X	X	X	X	X	X	X	X	X	X
Golden Eagle	X	X				X	X	X	X			
Golden-winged Warbler		X			X	X		X	X			

Species	CL[2]	CV	HK	HV	MC	MD	ML	MS	MT	NA	OR	WP
Henslow's Sparrow	X	X		X	X	X			X		X	
Kentucky Warbler	X	X	X	X	X	X	X	X	X	X	X	X
King Rail						X						
LeConte's Sparrow	X		X		X	X	X	X				X
Long-eared Owl								X				
Least Tern			X	X			X	X				X
Lesser Yellowlegs	X		X	X	X	X	X	X		X	X	X
Marbled Godwit												X
Nelson's Sparrow												X
Northern Saw-whet Owl					X			X				
Prairie Warbler	X	X	X	X	X	X	X	X	X	X	X	X
Prothonotary Warbler			X	X			X	X				X
Red-headed Woodpecker	X	X	X	X	X	X	X	X	X	X	X	X
Red-throated Loon				X			X					X
Ruddy Turnstone												X
Rusty Blackbird	X	X	X	X	X	X	X	X	X	X	X	X
Semipalmated Sandpiper	X		X	X	X	X	X	X		X	X	X
Short-billed Dowitcher							X	X				
Swallow-tailed Kite												X
Willet				X			X	X				
Wood Thrush	X	X	X	X	X	X	X	X	X	X	X	X
Yellow-belled Sapsucker		X			X	X		X	X		X	
Yellow Rail				X								

[1] Source: TVA Natural Heritage Database, queried July 2020
[2] ROW Sector Abbreviations: CL = Cleveland, CV = Centerville, HK = Hopkinsville, HV = Hickory Valley, MC = Manchester, MD = Madison, ML = Milan, MS = Muscle Shoals, MT = Morristown, NA = Nashville, OR = Oak Ridge, WP = West Point

3.2.2 Environmental Consequences for Wildlife

Each method of vegetation control that may be used during FY21 vegetation management activities has the potential to impact wildlife species and their habitats directly and indirectly. A more thorough impact analysis of each vegetative control method on wildlife can be found in TVA's Transmission System Vegetation Management PEIS (TVA 2019). A summary is provided in Appendix J. Manual control methods typically have a greater potential for disturbance than herbicide applications. Mowing, chainsaws, soil/ground disturbance due to machinery and heavy equipment could directly impact species in the path of the machinery by loss of life should they be unable to flee from the vegetation or borrows in the ground being impacted. Increased levels of noise could also stress nearby individuals. Ground disturbance resulting in sedimentation or contamination could impact sensitive cave systems deep underground.

Herbicide application is less damaging to soils when applied with backpacks and aerially. ROW maintenance activities focus herbicide application to woody species therefore leaving ground cover available for wildlife. This minimizes erosion, sedimentation, and potential damage to nesting and tunneling wildlife. However there is concern over the potential toxicity of the herbicide on non-target organisms (wildlife) and subterranean cave systems. TVA does not typically apply herbicides at the maximum recommended concentration, and low-volume backpack spraying should never reach maximum application rates. All herbicides currently used by TVA have been determined to be practically non-toxic to slightly toxic to mammals, birds and terrestrial invertebrates (bees) with the exception of Tebuthiuron which was determined to be moderately toxic to mammals. When working near aquatic features, TVA uses EPA-registered herbicides determined to be safe for use near aquatic environments. Again, see TVA's Transmission System Vegetation Management PEIS for more detailed impact analyses (TVA 2019).

TVA has several practices in place that minimize impacts to sensitive wildlife/terrestrial resources. BMPs are used near all regulated aquatic features and include use of mats on wetlands and the use of aquatic approved herbicides (TVA 2017a). TVA also uses the O-SAR process to avoid impacts to important terrestrial animals and their habitats by limiting the use of certain practices all together or during sensitive times of year. Each ROW proposed for FY21 vegetation management has several O-SAR buffers zones that touch the ROW. These buffers modify TVA ROW vegetation management actions such that impacts to sensitive resources are minimized.

The following O-SAR buffers would be applied near sensitive wildlife resources associated with the FY21 vegetation management actions:

- Cave - 200 feet - No herbicide use within 200 feet of cave due to potentially sensitive subterranean aquatic resource. Hand clearing or small machinery clearing only (i.e.: chainsaws, brush hog, mowers). Vehicles and equipment confined to existing access roads. Avoid entering cave.

- Osprey nest - 660 feet - Either 1) Assume presence. No broadcast spraying. Only use brush hogs or mowers for vegetation removal or selective herbicide spraying between March 1 and July 31 within 660 feet of nest site; OR 2) Request seasonal field survey to determine if nest is active.

- Heronry - 660 feet - Either 1) Assume presence. No broadcast spraying. Only use brush hogs or mowers for vegetation removal or selective herbicide spraying between February 1 and July 15 within 660 feet of nest site; OR 2) Request seasonal field survey to determine if nests are active.

- Bald Eagle nest - 660 feet - Either 1) Assume presence. No disturbance, spraying, or vegetation clearing would occur between December 1 and July 1 within 660 feet of nest site; OR 2) Request seasonal field survey to determine if nest is active.

In rare instances in which restricted actions need to take place while osprey or heron nests are active, TVA would coordinate with U.S. Department of Agriculture Wildlife Services (USDA-WS) to ensure any actions comply with the conditions specified under USDA's "Take" permit.

Migratory bird species (other than osprey, herons, and bald eagles addressed above) also have the potential to be impacted by the proposed actions. While the USFWS Information for Planning and Consultation (IPaC) database identified 37 species as having the potential to occur in the action area, over a third of those species are only likely to be found in the action area during migration. Migration stopovers are typically used on a short-term basis (one to several days) only in spring and fall. Due to the speed at which ROW vegetation management occurs there is a low likelihood that these migratory species would be in the action area at the time of maintenance. Many of these migratory species are shorebirds and would be found on mudflats along the edges of lakes and rivers where little vegetative maintenance would be needed and where TVA BMPs would be applied to minimize impacts to the aquatic resources.

Five other species (LeConte's sparrow, long-eared owl, northern saw-whet owl, rusty blackbird, yellow-bellied sapsucker) have the potential to occur in the action area during migration and during winter (non-breeding) months. Individuals of these species would be able to flush if disturbed due to their presence in the action area during non-nesting months. The potential to impact owls and sapsuckers roosting in tree cavities would be limited to scattered mature hazard trees along the edges of the ROW and forested habitat. Additional habitat would occur further in interior forested parcels.

Eighteen species could be in the action area during the breeding season when they are more sensitive to disturbance: American kestrel, bald eagle, black-billed cuckoo, black-capped chickadee, blue-winged warbler, Canada warbler, cerulean warbler, eastern whip-poor-will, golden eagle, golden-winged warbler, Henslow's sparrow, Kentucky warbler, king rail, least tern, prairie warbler, prothonotary warbler, red-headed woodpecker, and wood thrush. Special precautions are taken around bald eagle nests using the O-SAR process mentioned above and described in Section 2.2.2 and in previous documents (TVA 2019). No nesting golden eagles are known to occur in the action area or immediately surrounding. Therefore, this species likely only has the potential to be affected should it be foraging in ROWs at the time of the proposed actions. Golden eagles are expected to flush when disturbed by noise indicating oncoming vegetation management actions. Least terns nest on sandbars and open areas with little to no vegetation. There is almost no potential for ROW vegetative maintenance to occur in nesting habitat for least tern. As mentioned above black-billed cuckoo, cerulean warbler, golden-winged warbler, and Henslow's sparrow are uncommon breeders in the proposed action area. Therefore the potential to impact individuals of these species while they are immobile (i.e. eggs, nestlings) is lower than some of the other species. Several more of these breeding species nest in the interior of forests American kestrel, Canada warbler, cerulean warbler, eastern whip-poor-will, red-headed woodpecker, and wood thrush. Therefore, the potential to impact nests of these species would be confined to the removal of hazard trees in specific locations along the ROW edges should actions occur during nesting months. Those species that nest expanses of herbaceous growth in the ROWs such as Henslow's sparrow and Kentucky warbler would not be the target of proposed actions. Direct impacts to these species would most likely be limited to movement of machinery through an area. Those species that nest around bodies of water such as king rail and prothonotary warbler could be avoided due to TVAs BMPs around aquatic features. Species that nest on forest edges in shrubs or young trees scattered in fields such as black-billed cuckoo, black-capped chickadee, blue-winged warbler, golden-winged warbler, and prairie warbler have the greatest potential to be impacted by the proposed actions. Woody plant species, on which these species nest, would be the target of the maintenance actions. Should the proposed actions occur during the nesting season, immobile individuals (i.e. eggs, nestlings) could be sprayed with herbicide or have the vegetation removed mechanically. Based on EPA guidelines, no adverse impacts should occur to birds directly sprayed with herbicide while nesting. In addition, proposed vegetative maintenance occurs throughout the year, therefore impacts described above would only occur if these actions occurred during the few months of the year when nesting is occurring. In addition, these types of maintenance actions do not occur every year but rather are on a three-year cycle. Proposed actions are not expected to significantly impact populations of migratory birds. As required under EO 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds, TVA is currently developing an MOU (Memorandum of Understanding) in coordination with the USFWS as well as an Avian Protection Plan.

The outcome of these vegetative control methods is a ROW that is dominated by herbaceous species. These types of wildlife habitats would otherwise disappear due to forest regeneration should they be left unmaintained. This type of herbaceous habitat often unavailable anywhere else across the landscape (See Section 3.1) and provides habitat for wildlife that is becoming imperiled such as pollinator species and some species of migratory birds. Similarly, areas of ROW with some young woody regrowth provide needed habitats for other species of migratory birds. These habitats are normally ephemeral due to forest regeneration, but ROW maintenance actions provide the repeated disturbance and sun exposure needed for some of these fast growing woody species to regenerate. Therefore, while impacts could occur to those species using these ROW habitats should they be present during the actions it is the maintenance actions themselves that allow for the habitat for these species of wildlife to persist in the long-term.

3.3 Aquatic Ecology

3.3.1 Affected Environment

The twelve ROW vegetation management sectors encompass portions of several major watersheds that support high aquatic biotic diversity. Tennessee is reported to support approximately 319 fish species, including native and introduced species (Etnier and Starnes 1993) and 132 freshwater mussels (Parmalee and Bogan 1998). The Tennessee and Cumberland rivers have the highest number of endemic fish, mussel, and crayfish species in North America (Schilling and Williams 2002). The other major drainages within the TVA region share a diversity of aquatic life equal to or greater than the Tennessee River drainage (TVA 2015). There are approximately 42,000 miles of perennial streams and 46 TVA managed reservoirs in the study area (TVA 2011b). Most beneficial uses (as designated by the states) are supported in most water bodies in the study area including for fish and aquatic life support.

Fish species within the twelve sectors are represented by approximately 30 families with the largest being the perch family (more than 90 species), followed by minnows (more than 80 species), catfish (more than 20 species), suckers (21 species), and sunfishes (more than 20 species). The most diverse watershed within the 12 sectors is the Tennessee River watershed with an estimated 205 native species (Etnier and Starnes 1993).

As described in the PEIS, TVA has been monitoring the health of the major reservoirs within the Tennessee River system since 1990 to evaluate the ecological conditions. A multi-metric approach known as the Reservoir Fish Assemblage Index is used to evaluate ecological conditions for fish communities because of their importance in the aquatic food web and because fish life cycles are long enough to integrate conditions over time. Though altered from human activity, main stream reservoirs support healthy fish communities and generally rate good or fair based on attained Reservoir Fish Assemblage Index scores (McDonough and Hickman 1999). The number of species ranged from around 50 to 90 species per reservoir (TVA 2004).

Stream habitats in the study area include very large rivers (e.g., Mississippi and lower Tennessee), large rivers (e.g., lower Cumberland and upper Tennessee), medium rivers (e.g., lower Duck and Clinch), small rivers (e.g., Little, Buffalo), and numerous perennial, intermittent, and ephemeral streams (Meyer et al. 2007). Each of these stream habitat types have a characteristic fish composition with diversity generally increasing downstream along a gradient of increasing stream size, habitat heterogeneity, and habitat availability (Schlosser 1987). Therefore, larger streams and rivers are the most diverse systems in the study area. However, smaller streams (e.g., headwater streams and tributaries) are the most likely to be encountered during TVA vegetation maintenance activities due to their abundance throughout the study area. Smaller streams are characterized by small-bodied species such as small minnows, madtom catfishes, darters, and sculpins (Schlosser 1987). Darter species contribute heavily to the overall fish diversity in headwater streams in the study area with 73 species found in smaller reaches (Meyer et al. 2007). Some fish species found in the study area only use headwater streams for spawning and nursery areas. For example, the federally threatened slackwater darter lives in pools of perennial streams, but it migrates upstream to spawn in “slack water” formed by shallow springs, seeps, or flooded fields that slowly run off into adjacent headwater streams (Etnier and Starnes 1993).

Benthic (bottom dwelling) macroinvertebrate populations typically found in TVA’s reservoir system and non-reservoir aquatic environments are described in the PEIS (TVA 2019). Because benthic macroinvertebrates are relatively immobile, negative impacts to aquatic ecosystems can be detected earlier in benthic macroinvertebrate communities than in fish communities. Benthic invertebrates are a vital part of the food chain of aquatic ecosystems. Benthic invertebrate reservoir communities are strongly affected by seasonal thermal stratification, varying dissolved oxygen concentrations and large water level fluctuations in reservoirs. Poor benthic community ratings are typical of tributary reservoirs. Macroinvertebrate communities of reservoirs are generally low in diversity and comprised of tolerant taxa.

In contrast, benthic macroinvertebrate populations in non-reservoir aquatic environments are often comprised of assemblages that are representative of lotic habitats. Composition and quality of such communities are often correlated with such factors as stream size and placement within the watershed, surrounding land uses and proximity to point source and non-point source discharges. Within rural portions of TVA’s transmission line ROW, smaller streams may be expected to be composed of benthic invertebrates that are less tolerant of low dissolved oxygen levels and representative of a wide range of sub-habitats. For example, higher gradient riffle environments may be expected to support greater abundances of organisms that are clingers or swimmers. Smaller headwater streams within ROW may be dominated by only a few species, though all classes of invertebrates may be found.

Freshwater mussels are excellent indicators of water quality and habitat stability. Mussels provide many other important ecosystem services including filtering large quantities of water. The overall native mussel community has decreased from 42 species to 21 species (four of which invaded post-dam construction) due to loss of flow-sensitive species (Sickel et al. 2007).

Main stream tailwaters, like those off Kentucky Lake, are areas of highest mussel diversity in the regulated TVA system. Remaining riverine mussel species reach greater abundance and diversity in flowing main stream reaches, but their status remains only fair due to overall low diversity, low abundances, and low reproductive success for some species (TVA 2004). Dennis (1984) provided a detailed account of the distribution of mussels by stream size throughout the Tennessee River watershed (see Table I-19 in Dennis 1984). The greatest number of mussels (about 70 percent of species) are found in medium to large streams. Only six species were common to all stream sizes and found throughout the study area including: threeridge, purple wartyback, deertoe, mucket, pocketbook, and kidneyshell.

3.3.2 Environmental Consequences for Aquatic Ecology

Transmission line vegetation management activities have little potential to directly and indirectly affect the aquatic ecology of waterways within the study area, regardless of the methods applied. Potential effects include: ground disturbing activities such as the removal of vegetation that could result in minor and temporary erosion, sedimentation, and increased water temperatures; overspray or spills of non-aquatic rated herbicides into aquatic environments; and leaks of oil or fuel that could alter water quality. However, these impacts are expected to be rare and effects minimal because TVA employs a host of BMPs that are designed to minimize environmental impacts like soil disturbance/erosion, stream bank destabilization, instream deposition of woody debris, damage to instream habitats (vehicle/equipment traffic), and inadvertent discharge of herbicides or other petrochemical to aquatic environments.

TVA's routine integration of O-SAR database reviews, adherence to BMPs related to SMZs protocols and procedures, coupled with strict adherence to proper selection and use of herbicides in proximity to surface water minimizes potential impacts to aquatic ecosystems. Proper application of BMPs, including effective SMZs, would reduce direct and indirect effects to aquatic ecosystems in the transmission ROW. SMZs promote a vegetated riparian area that stabilizes stream banks, moderates water temperature, filters nutrients and sediments, and strongly influences energy pathways by controlling light penetration and inputs of organic material (Gregory et al. 1991; Allan and Castillo 2007). When properly using forestry BMPs, streams in the Southeast have shown little change in aquatic macroinvertebrate community diversity following timber harvesting (Warrington et al. 2017). Where changes occurred, they reflected a temporary (less than 5 year) shift in food resources from that based on detritus to one based on primary productivity (algal growth). This makes sense for a section of stream with a temporary reduction in leaf inputs, but an increased solar exposure that promotes photosynthesis. Vegetation control methods that included properly used herbicide applications showed no significant differences in macroinvertebrate indices from reference streams (Warrington et al. 2017). Forestry BMPs that include SMZs would effectively mitigate consequences of TVA's vegetation management program, even in small headwater streams.

Herbicide application has the potential to impact water quality via inadvertent application to stream channels, excess surface runoff, spray drift, and leaching through the soil profile (Annett et al. 2014; Tatum et al. 2017), however TVA employs standard operating procedures (e.g., label-directed use) and BMPs specifically designed to eliminate these risks. For example, overspray has the highest potential to acutely affect aquatic organisms (Rolando et al. 2017). Algae, microorganisms, macroinvertebrates, amphibians, and fish are affected by exposure to consistently elevated levels of herbicide (Warren et al. 2003; Warrington et al. 2017), but, in the environment, organism exposure would fluctuate due to varying physical and climatic conditions. Field measures for concentration and durations of exposure to herbicides are typically well below standard toxicity endpoints (Scarbrough et al. 2015; Rolando et al. 2017). For example, glyphosate-based herbicides have a low-runoff risk and rapidly dissipate when introduced to aquatic environments (Rolando et al. 2017). Acute and chronic toxicity of herbicides to aquatic organisms is dependent on herbicide type, concentration, exposure time, and varies by species; but, overall risks of aquatic ecosystem exposure to herbicides are low when used within legal label recommendations and applied by trained applicators.

Spot application is intended to use the least amount of herbicide possible to treat individual plants. Similarly, localized herbicide application consists of treating individual or small groupings of plants via basal, low-volume foliar, granular, and bare-ground treatments to minimize any overspray or excess runoff. Heavy rains could carry herbicides (e.g., granular pellets) offsite and into adjacent streams; however, rain would also serve to dilute any excess herbicide and limit any acute or chronic effects (Scarbrough et al. 2015).

Additionally, broadcast application methods using mechanized equipment also have the potential for ground-disturbing impacts (as described above). Inadvertent application to aquatic environments via overspray and drift are most likely with broadcast and aerial application methods. Drift is the airborne movement of herbicides through wind or evaporation to non-target areas. As described in the PEIS (TVA 2019), TVA uses BMPs (i.e., SMZs), prior planning, proper herbicide mixtures, and advanced technologies to reduce or eliminate drift during application. Therefore, herbicide toxicity to aquatic ecosystems is unlikely under TVA's standard procedures.

3.4 Threatened and Endangered Species

The TVA study area provides habitat for numerous species of plants and animals that have declining populations or are otherwise rare and considered to be endangered, threatened, or of special concern at the national and/or state level.

3.4.1 Regulatory Framework for Threatened and Endangered Species

The ESA (16 United States Code [USC] §§ 1531-1543) was passed to conserve the ecosystems upon which threatened and endangered species depend, and to conserve and recover those species. An endangered species is defined by the ESA as any species in danger of extinction throughout all or a significant portion of its range. A threatened species is defined as one likely to become endangered within the foreseeable future throughout all or a significant part of its range. Areas known as critical habitats, essential to the conservation of federally listed species, can also be designated under the ESA. The ESA establishes programs to conserve and recover federally listed species and makes their conservation a priority for federal agencies. Under Section 7 of the ESA, federal agencies are required to consider the potential effects of their proposed actions on federally listed species and critical habitats. If the proposed action has the potential to affect these resources, the federal agency is required to consult with the USFWS.

There are laws protecting listed species in all seven states in the study area. In a few states, protection is limited to species listed under the ESA, but in other states, legal protections are extended to additional species designated by the state as endangered, threatened, or other classifications such as "in need of management."

Conservation measures and avoidance and minimization measures identified in the following sections, as well as routine use of BMPs and project planning and environmental review processes, in some cases apply to state-listed species and habitats as well as to federally listed species and habitats. TVA has consulted with USFWS per Section 7(a)(2) of the ESA concerning the potential impacts of routine vegetation maintenance activities to affect federally threatened and endangered species within the study area. This consultation was completed and the USFWS issued a Biological Opinion in May 2019 concurring with TVA's effects determinations (Appendix D). TVA had previously consulted with USFWS on a suite of TVA routine actions on federally listed bats present in the TVA power service area. This consultation was completed in April 2018 (Appendix C).

3.4.1.1 Threatened and Endangered Species in the TVA Study Area

According to the USFWS IPaC database (USFWS 2017a) and the TVA Regional Natural Heritage database, 168 species listed under the ESA as endangered, threatened, proposed for listing, or candidates for listing have been reported from within the TVA study area. In addition, about 1,350 individual plant and animal species have been formally listed as protected species by one or more of the states, or otherwise identified as a species of conservation concern (TVA 2017b). Additionally, critical habitats for 43 federally listed species are located within the study area (USFWS 2017a; TVA 2019).

Of the nine ecoregions within the TVA power service area, the highest concentrations of terrestrial and aquatic species federally listed under the ESA occur in the Blue Ridge ecoregion (see Figure 3-1). Relatively few listed species occur in the Mississippi Alluvial Plain ecoregion. The taxonomic groups within the power service area with the highest proportion of species listed under the ESA are fish and mollusks. Factors contributing to the high proportions of vulnerable species in these groups include the high number of endemic species within the study area and the alteration of their habitats that increased the risk to these species. River systems with the highest numbers of listed aquatic species include the Tennessee, Cumberland and Coosa rivers (TVA 2015).

Population status trends for federally listed species in the TVA study area are variable (i.e., increasing, stable, or decreasing). For example, populations of a few listed species have increased, primarily because of conservation efforts, to the point where they are no longer listed under the ESA (e.g., bald eagle, peregrine falcon, and Tennessee coneflower). Other species have had their listing status downgraded from endangered to threatened (e.g., snail darter, large-flowered skullcap, and small whorled pogonia) due to increased population estimates and habitat protections. Among the federally listed species with populations that continue to decline are the American hart's tongue fern, Indiana bat, and northern long-eared bat. The formerly common northern long-eared bat recently was federally listed as threatened under the ESA due to dramatic population declines caused by white-nose syndrome. This pathogen was first reported in the TVA study area in 2009, and signs of mortality were first observed in 2011 (Samoray 2011). Population trends of many of the other listed species in the TVA study area are poorly understood.

Many species listed under the ESA occur in the immediate vicinity of the TVA transmission system ROW and could potentially be affected by its vegetation management. A summary of federally and state-listed species occurrences within 50 feet of TVA ROW where FY21 planned vegetation management is proposed is provided in Table 3-3. Appendix K includes a report of these federally and state-listed species occurrences identified from the TVA Regional Natural Heritage database.

The major habitats supporting federally listed species in the TVA study area include free-flowing rivers and streams, caves, limestone cedar glades, high elevation areas, shorelines, and bluff/rock outcrops. TVA has taken multiple actions to minimize the adverse effects of vegetation management on federally listed species (e.g., seasonal restrictions on select activities to avoid impacts to federally listed roosting bats and nesting turtles) (TVA 2011b) and has taken steps to conserve listed species occurring in other habitats (TVA 2015).

Table 3-3. Total Number of Federally Listed and State-Protected Species Occurrences Previously Reported from Within 50 feet of TVA ROW Where Vegetation Management is Proposed in Fiscal Year 2021[1]

TVA Right-of-Way Vegetation Management Sectors	Federally and State-listed Species				
	Plants	Terrestrial Animals			Aquatic Animals
		Bat	Eagle	Other	
Cleveland	2	1	1	1	2
Centerville	5	1	0	2	1
Hopkinsville	10	3	0	2	1
Hickory Valley	2	0	0	0	0
Manchester	36	0	1	0	0
Madison	39	0	0	0	0
Milan	3	0	0	1	0
Muscle Shoals	43	0	0	0	0
Morristown	8	4	0	1	1
Nashville	2	0	1	1	0
Oak Ridge	19	0	0	0	2
West Point	13	0	0	0	0

[1] Source: TVA Regional Natural Heritage Database, queried May 2020. Tally includes all federally listed and species tracked by individual states.

3.4.2 Affected Environment of Threatened and Endangered Plants

A May 2020 review of the TVA Regional Natural Heritage database indicated that 10 occurrences of 4 federally listed plants and 172 occurrence of 96 state-listed plants are known to occur within 50 feet of the TVA transmission line ROWs proposed for vegetation management during FY 2021 (Table 3-3). A complete list of species known to be present within and immediately adjacent to the TVA transmission ROWs is found in Appendix K. TVA records known locations of these species so vegetation management activities can be planned in a manner to avoid and/or minimize impacts in those areas. There are about 2,500 documented or potential sites for federally or state-listed plant species recorded in the O-SAR database within TVA ROW across the entire PSA. As described in Section 2.2.2, TVA uses this information to assign class rankings to sensitive areas that are used to guide management decisions regarding vegetation maintenance activities in the vicinity of recorded features. The location of all federally and state-listed plant species is recorded in the O-SAR database.

Within the TVA ROW sectors where FY21 vegetation management would occur, federally and state-listed plant species are most likely to occur where ROW plots intersect regions that support intact grassland habitat. These areas of high-quality habitat occur most often in the Inner Nashville Basin of central Tennessee, the Eastern Highland Rim of Tennessee and northern Alabama, the Cumberland Plateau and Plateau Escarpment in Alabama, Kentucky and Tennessee, Blackland Prairie in Mississippi, Southern Table Plateau on Lookout and Sand Mountain in Alabama and Georgia, the Crawford-Mammoth Cave Uplands and adjacent Western Pennyroyal Karst Plain in Kentucky, and small portions of the Ridge and Valley in Tennessee and Alabama.

3.4.3 Affected Environment of Threatened and Endangered Terrestrial Animals

Review of the TVA Regional Natural Heritage Project database in May 2020 indicated there are records of eight state-listed terrestrial animal species (alligator snapping turtle, Bachman’s sparrow, eastern hellbender, northern crawfish frog, northern pine snake, southeastern shrew, tricolored bat, and Virginia rail) and one federally listed species (northern long-eared bat) within 50 feet of the ROWs proposed for vegetative maintenance in FY21 (see Appendix K). Seven additional federally listed species have O-SAR polygons and associated restrictions that apply to ROWs within at least one sector with proposed vegetative maintenance in FY21 (black warrior waterdog, Carolina northern flying squirrel, flattened musk turtle, Indiana bat, Mitchell’s satyr, red-cockaded woodpecker, ringed map turtle; See Table 3-4). Review of the USFWS IPaC database system indicated seven additional federally listed species have the potential to be impacted by the proposed actions (bog turtle, gray bat, least tern, painted snake coiled forest snail, spruce-fir moss spider, Virginia big-eared bat, and wood stork). Finally one additional federally listed species, whooping crane, has been documented foraging in agricultural fields that intersect TVA ROW on Wheeler National refuge in the Madison Sector.

Table 3-4. Federally Listed Terrestrial Animal Species with O-SAR Restrictions Impact TVA Right-of-ways where Vegetation Management is Proposed in Fiscal Year 2021[1]

Common Name	Scientific Name	Federal Status[2]	O-SAR Polygons	Sector[3]
TERRESTRIAL ANIMALS				
Black Warrior Waterdog	*Necturus alabamnesis*	LE	2	MD, MS
Carolina Northern Flying Squirrel	*Glaucomys sabrinus coloratus*	LE	1	MT
Flattened Musk Turtle	*Sternotherus depressus*	LT	1	MS
Northern Long-eared Bat	*Myotis septentrionalis*	LT	65	CL, CV, HK, MC, MD, MT, MS, NA, OR
Indiana Bat	*Myotis sodalis*	LE	80	CL,CV, HK,HV, MC, MD, ML, MT, MS, NA, OR
Mitchell’s Satyr Butterfly	*Neonympha mitchellii mitchellii*	LE	33	HV, MS
Red-cockaded Woodpecker	**Picoides borealis**	LE	7	WP
Ringed Map turtle	*Graptemys oculifera*	LT	2	WP

[1] Source: TVA Regional Natural Heritage Database, queried July 2020.
[2] Status Codes: LE = Listed Endangered; LT = Listed Threatened;
[3] ROW Sector Abbreviations: CL = Cleveland, CV = Centerville, HK = Hopkinsville, HV = Hickory Valley, MC = Manchester, MD = Madison, ML = Milan, MS = Muscle Shoals, MT = Morristown, NA = Nashville, OR = Oak Ridge, WP = West Point

Alligator snapping turtles are found in deep rivers, oxbows, lakes or sloughs with slow moving water, as well as nearby ponds, tributary creeks, and swamps. They shelter under undercut banks, rock shelters or deep holes. They only leave the water during nesting season (NatureServe 2020). One potentially historical record of this species is known within 50 feet of a ROW with proposed maintenance in FY21 from the Nashville sector. The specimen was found in the wild in 1970, captured, and sent to the Memphis Zoo.

Bachman's sparrow inhabits dry, open woods, especially pines (National Geographic 2002). One possibly historic record (1960) of this species is known within 50 feet of a ROW with proposed maintenance in the Milan sector. This species used to thrive in longleaf pine forests found all over the southeastern U.S. Much of the habitat for this species has disappeared due to conversion of forest for timber harvest and development, as well as from fire suppression. Remaining habitats are fragmented and populations of this species have been in decline since the 1960s. With the loss of longleaf pine forests, the species has also adapted to use brushy, open fields. These types of habitat can be found within maintained TVA ROWs that would otherwise be lost due to forest regeneration.

Eastern hellbenders favor larger, fast-flowing, streams and rivers with large shelter rocks. Eggs are laid in depressions created beneath large rocks or submerged logs (Petranka 1998). Two records of hellbender are known from 50 feet of the action areas. One record is from the Hiawassee River the in the Cleveland sector other is from the Gasper River in the Hickory Valley sector. Sedimentation is one of the larger threats to suitable habitat for this species as it fills in space under rocks preventing them from being used as shelter or nesting habitat.

Northern crawfish frogs are associated with moist meadows, pasturelands, river flood plains, pine scrub, and golf courses. They use crayfish and rodent burrows for shelter, and can also be found under logs and in sewers. They breed from late February to early May in seasonal and permanent ponds primarily located in agricultural landscapes (NatureServe 2020). One record of this species is known within 50 of a ROW with proposed FY21 maintenance actions in the Hickory Valley sector. This frog was heard singing from a flooded agricultural field.

Northern pinesnakes are found in dry, sandy Pine Barrens, sand hills, and dry mountain ridges, most often in or near pine woods. They spend much of their time in underground borrows (Powell et al. 2016). They can also use scrub habitat and agricultural fields. One record of this species is known within 50 feet of a ROW proposed for maintenance in the Centerville sector. The specimen observed was collected and turned into a museum specimen in 1964. Northern pinesnakes may occur state-wide in Tennessee, but they have not yet been found in far west Tennessee, much of middle Tennessee, and the northern areas of East Tennessee (Scott and Redmond 2019).

Southeastern shrews are found in a variety of habitats including bogs and wetlands, grasslands and old fields, and lowland and upland forest. This species prefers moist to wet areas bordering riparian zones with heavy ground cover (NatureServe 2020). A southeastern shrew was captured during field surveys near a ROW with proposed FY21 actions in the Centerville sector. Populations of this species are considered secure throughout the TVA region.

Tricolored bats are found hanging in trees amongst clumps of live and dead leaves, in tree cavities, caves, mines, buildings, bridges, and rock crevices in summer. In the winter they roost in caves, mines, or other cave-like structures including box culverts and dams. They forage in forested areas and over water (TWRA 2020). Six individuals of these species were captured during field surveys for a proposed Department of Transportation project along an existing TVA ROW in the Cleveland sector. This species is known throughout the TVA region but has seen dramatic population declines in recent years due to the introduction of a novel fungus that causes white-nose syndrome.

Virginia rails prefer marshes and wetlands with shallow water, cattails, bulrushes and an abundance of invertebrates on which to forage. They are only found in the TVA region during migration (Cornell Lab of Ornithology 2019). In 2009, one specimen of this species was found in a field adjacent to a riparian zone within 50 feet of an existing TVA ROW with proposed FY21 actions.

One record of northern long-eared bat is known from within 50 feet of a ROW in the Cleveland Sector. In 2014, this bat was tracked to an electrical pole (not a TVA transmission pole) that runs along a road and under a TVA transmission line. An emergence count at the pole revealed 8 total bats emerging from the pole. The site has not been surveyed since this initial sighting. Other northern long-eared bat records within 50 feet of the proposed action areas include. Several pregnant and lactating female northern long-eared bats have been captured during mist net efforts in 2005 and 2010 at four different locations on two different lines in the Morristown sector.

All other species listed above with O-SAR buffers or identified by IPaC have not been recorded within 50 feet of the ROW with proposed maintenance actions for FY21. Nonetheless the potential exists for them to be impacted by the proposed actions should suitable habitat exist in the action area. Descriptions of habitat requirements and the potentially affected habitat associated with each of these species can be found in TVA's Transmission System Vegetation Management PEIS (TVA 2019).

3.4.4 Affected Environment of Threatened and Endangered Aquatic Animals

A query of TVA's Regional Natural Heritage database documented seven federally and state-listed aquatic species known to occur within 50 feet of the TVA ROW where vegetation management is proposed in FY21 (Appendix K). The watersheds of the Tennessee, Cumberland, and Coosa rivers support an unusually diverse group of aquatic animals, but human activities have resulted in adverse impacts to the streams and aquatic organisms therein (Etnier and Starnes 1993). Previous evidence suggests that the pristine stream habitats in the Tennessee River system had been inhabited by 91 freshwater mussel species (Parmalee and Bogan 1998). Mussels were beginning to be affected by human activities by the mid-1800s, and many of these freshwater mussels were already extirpated before the Tennessee River main stream impoundments (dams) were constructed (TVA 2011a). The lack of early fish collections does not allow a similar comment about the impact of these activities to Tennessee River main stream fish assemblages, but there likely were species of Tennessee River fish that became extinct before they were known to science (TVA 2011a). Diversity was higher in the study area in the past. However, exceptional species diversity is still observed in fish; mollusks, crayfish, aquatic insects, and various other invertebrate groups.

The O-SAR review process avoids impacts to sensitive aquatic resources within transmission ROWs by limiting the use of methods used within SMZs or unique/ important aquatic habitats. These areas are denoted in the O-SAR database, and when vegetation maintenance is scheduled to occur within these areas, TVA biologist and operations staff work together to ensure the species and/or habitats are protected. For work proposed during FY21, the TVA biologist would coordinate individually with every ROW in each sector that contains O-SAR aquatic zones. This would ensure that the most potentially damaging tools, like broadcast herbicide, are not used in these areas and the FY21 work would not have significant impacts to the aquatic ecology.

3.4.5 Environmental Consequences for Threatened and Endangered Plants

Localized herbicide application and mowing are the vegetation management tools that would be used most frequently in FY21 to clear vegetation on the floor of the open ROW. Other Manual, Mechanical, and Herbicide Application Methods, along with Debris Management and Restoration activities, occur very infrequently or do not have the potential to affect vegetation on a meaningful scale (TVA 2019).

Localized applications of herbicide do result in some level of off-target damage. In situations where the woody stem count is high on a given ROW, even localized application of herbicides can produce substantial damage to non-target species. However, these areas of high woody stem count are unlikely to support rare plants, usually because of site conditions unrelated to TVA vegetation management (i.e. owner land use, soil type, landscape position, etc.). In drier transmission ROW areas with rocky or sandy soils, where woody stem count is inherently lower, localized herbicide application can foster quality herbaceous plant communities as well as federally and state-listed plant species. From an ecological perspective, the disturbance associated with localized application of herbicide on ROW with rare plant species has taken the place of fire and large animal grazing, which would have been the primary mechanisms maintaining grasslands before European settlement of the region. Nearly all these open areas would rapidly transition to forest and the majority of rare plants and communities occurring there would disappear from the landscape without tree removal and localized herbicide use in the ROW.

Mowing removes nearly all woody stems when utilized, but the amount of re-growth can be rapid depending on conditions on the ground, resulting in a proliferation of woody species that form a rapidly growing, low canopy that suppresses rare herbaceous species. Using mowing alone, or as the primary mechanism for vegetation removal on ROW, often reduces species diversity and encourages the dominance of woody plants able to proliferate through root sprouting. Mowing in drier ROW, because of the slower overall tree growth rate can be more effective. Mowing is sometimes used in sensitive areas containing federally or state-listed species if herbicide cannot be applied without harming the population.

Slightly less than 1 percent (about 2,000 acres) of TVA transmission ROW is known to contain populations of rare plant species (TVA 2019). These areas are denoted as Class 2 sites in the O-SAR database. When vegetation management is scheduled to occur in these locations, TVA biologists and Transmission ROW operations staff work together to ensure the species are protected. Sometimes the proposed work would not affect the listed plants found in the ROW. Other times operations staff augments the timing or method of proposed work to protect sensitive resources. TVA (2019) outlined several examples of how O-SAR is used to avoid negative impacts to rare plants. Methods likely to be used in FY21 vegetation management include:

- Timing – Shifting the time frame of vegetation management, including mowing and herbicide application, to avoid impacting a threatened or endangered plant species.

- Flagging –TVA botanists perform field surveys to delineate specific areas where the state and federally listed species occur on ROW. Sites would be marked in the field with flagging tape and maps are provided to the herbicide contractor, along with instructions on how work should be conducted in these spans. Typically, foliar herbicide would not be applied within flagged areas and any woody vegetation within the relatively small areas would be removed with machetes.

- Conservation Spray –This technique differs from standard foliar application of herbicide because of extensive communication between TVA staff and herbicide applicators on the sensitive nature of the site. In addition, there is direct TVA oversight during the application, which leads to extra caution and large reductions in damage to non-target vegetation. While this technique has not been assessed in all situations encountered on ROW, thorough documentation indicates these very targeted, low-volume foliar application of herbicide to woody plants do not appear to negatively impact the federally threatened white fringeless orchid populations on TVA ROW (USFWS 2015).

- Natural Area Cooperation –TVA works with local land managers to coordinate vegetation management within sensitive areas on TVA ROW within natural areas (i.e. National Parks). With this model, professional land management agencies can perform ROW vegetation management within TVA ROW while preventing impacts to the sensitive resources, often federally and state-listed plant species. Agreements with land management agencies are made on a case-by-case basis.

The federally listed species known to occur in an adjacent to ROW plots proposed for FY21 work include green pitcher plant, leafy prairie-clover, Mohr's Barbara's buttons, and white fringeless orchid. During preparation of the Transmission System Vegetation Management EIS (TVA 2019), TVA consulted with the USFWS on the TVA ROW Vegetation Management program on the potential effects of the program on all federally listed plants and animals, including those listed above. TVA concluded, and the USFWS concurred, that the ROW Vegetation Management program is likely to adversely affect these four plant species. However, while the program may affect individual plants from time to time, TVA does not anticipate that vegetation management activities would extirpate any populations from the transmission line. In fact, conditions found in ROW where these four species occur are favorable for the plants; no suitable off ROW habitat occurs adjacent to leafy prairie-clover, Mohr's Barbara's buttons, and white fringeless orchid that would intersect planned FY21 vegetation management work. TVA ROW vegetation management proposed for FY21, would result in insignificant short-term impacts to individual federally and state-listed plants as well as long-term beneficial impacts to populations of those same species.

3.4.6 Environmental Consequences for Threatened and Endangered Terrestrial Animals

The proposed actions could impact all federally and state-listed terrestrial animal species recorded within 50 feet of the Action Alternative study area; however the severity of those impacts range greatly. The two (primarily) aquatic state-listed species reported within 50 feet of the action areas (alligator snapping turtle and eastern hellbender) could be impacted by the proposed actions should water quality be affected. However, as described in the Aquatic Ecology Section 3.3, BMPs would be used along all bodies of water that have the potential to provide habitat for these species. With the use of the BMPs, impacts to water quality, including sedimentation would be minimized. Only herbicides approved for use near water would be used near these features. As a result, impacts to these species are likely to be negligible.

Bachman’s sparrow could be impacted by proposed vegetative maintenance particularly during nesting season. This species nests on the ground at the base of a small shrub, clump of grass or seedling. While young shrubs and short seedlings would not be the target of vegetative maintenance, larger shrubs and taller seedlings certainly could be. Machinery used in these areas could directly impact nests. However, without vegetative maintenance in these areas the forest would regenerate and become unsuitable for this species. So while direct negative impacts could occur to this species should maintenance occur during nesting season (when eggs and nestlings are unable to flee), it is precisely the vegetative maintenance proposed that keeps the areas open and available for this species. In addition, such maintenance activities could occur year-round and is only likely to occur every three years. Therefore actions are not expected to impact populations of Bachman's sparrow.

Virginia rails are only found in the TVA region during migration. Therefore the likelihood that they would be in the action area at the time of the proposed actions is low. In addition they would be able to flush if disturbed. Impacts to habitat for this species (wetlands) would also be minimized due to BMPs around wetlands. Virginia rails are not expected to be significantly impacted by the proposed actions.

Northern crawfish frog habitat (often agricultural cropland) is not one that would be targeted for vegetative maintenance due to the lack of woody species. Therefore the potential for impacts would be limited to movement of machinery within the ROW to access other areas in need of maintenance. Northern crawfish frogs are not expected to be significantly impacted by the proposed actions.

Tricolored bats use a variety of habitats. Depending on the timing of the proposed actions this species would either be in a cave or cave-like habitats or in trees or other features out on the landscape. The O-SAR process identifies caves and puts restrictions on activities within 200 feet of caves (see Wildlife Section 3.2) such that actions would not impact tricolored bats should they be roosting in caves at the time of proposed actions. However, impacts could occur to tricolored bats should they be roosting in a tree deemed a hazard tree at the time of proposed maintenance. Adult tricolored bats roosting in clumps of leaves are expected to flush if disturbed by the noise of the machinery. However, should the tree be used as a maternity roost or if bats are roosting deep in tree cavities adverse impacts could occur, particularly if they take place during the month it takes pups (young) to become volant. Due to the scattered placement of hazard trees along miles of transmission line ROW and the variety of habitats this species is known to roost, it is not expected that proposed actions would significantly impact populations of this species.

Both northern pinesnake and southeastern shrews could be directly impacted by proposed actions should this species be found in the action area at the same time as the proposed vegetative maintenance. Adverse effects could occur should northern pinesnake burrows be found in the path of heavy machinery. Similarly, southeastern shrew nests could also be impacted by mowing or heavy machinery. Mobile individuals above ground are expected to flush if disturbed. While there is potential that adverse impacts could occur to individuals, the likelihood that would be present at the time of proposed actions, in the direct path of proposed actions, and unable to flush is lower than more common species. Therefore populations of northern pinesnake and southeastern shrew are not expected to be significantly impacted by proposed actions.

TVA's use of the O-SAR process to identify sensitive areas for federally listed species and modify actions to minimize the potential for impacts (seasonal restrictions, restricted activities) as well as BMPs, resulted in a may affect, but not likely to adversely affect determination for all federally listed terrestrial animal species (excluding bats and bog turtle). See Transmission System Vegetation Management PEIS (TVA 2019) for additional details. TVA consulted with the USFWS to assess the impacts of routine activities associated with TVA's transmission ROW vegetation management program on all species listed under the ESA with the potential to occur in the study area. This consultation was completed and the USFWS issued a Biological Opinion in May 2019 concurring with TVA's effects determinations (Appendix D). TVA consulted separately for the four federally listed bat species which are addressed in a programmatic consultation as described below (see Appendix C).

The record of northern long-eared bat in the electrical pole mentioned above has a unique O-SAR buffer placed around this pole to restrict actions within 150 feet of this potential roost. While it is not known if the site is still being used or if site was a maternity site, no tree removal or mowing is permitted within 150 feet of the pole outside of winter months. Only a conservation spray type of herbicide application (See Vegetation Section 3.1) may occur within 150 feet of the pole during June and July when pups could be present. Captures of northern long-eared bat in the Morristown sector occurred in existing ROWs over bodies of water. No roost trees are known nearby.

Pursuant to Section 7(a)(2) of the ESA, TVA entered into consultation with the USFWS in 2014 to programmatically assess the impact of 96 routine TVA actions on the four federally listed bat species known to occur in the TVA study area: Indiana bat, northern long-eared bat, gray bat and Virginia big-eared bat. This consultation included activities associated with transmission ROW vegetation management. TVA determined that none of the activities associated with ROW vegetation management have the potential to adversely affect gray bat or Virginia big-eared bat. Transmission ROW maintenance activities (primarily tree removal), were determined to be likely adversely affect Indiana bat and northern long-eared bat. The USFWS issued a Biological Opinion in April 2018, concurring with TVA's effects determinations and issued an Incidental Take Statement that authorizes TVA's ROW vegetation management practices over a 20-year term.

The southern bog turtle is listed as threatened in the northern part of its range, but is listed due to similarity of appearance in the southern part of the range, which includes Georgia, North Carolina, South Carolina, Tennessee, and Virginia. It is this southern part of the range that intersects the TVA study area. Species listed due to similarity of appearance are not subject to Section 7 consultation southern bog turtle would not be significantly impacted by the proposed actions.

3.4.7 Environmental Consequences for Threatened and Endangered Aquatic Animal

TVA reviews transmission ROWs prior to annual maintenance activities and identifies appropriate vegetation control methods, appropriate conservation activities, BMPs, and avoidance and minimization measures to guide vegetation maintenance actions based on the known or likely occurrence of sensitive species or habitats within TVA ROWs. While some methods of vegetation control could have significant impacts on individuals or populations of federally or state-listed threatened or endangered species (e.g., aerial herbicide application on a known population of federally endangered plants), TVA's screening process (O-SAR) identifies these potential impacts and identifies the appropriate vegetation control methods (hand clearing, mechanical clearing or spot application of herbicide) in this instance. Species- and/or group-specific (e.g. SMZs) restrictions and guidance have been developed for all federally listed and most state-listed resources in the study area. Therefore, no impacts are anticipated to aquatic animal species from the proposed FY21 work.

3.5 Surface Water

3.5.1 Affected Environment

The quality of the region's water is critical to protection of human health and aquatic life. Water resources provide habitat for aquatic life, recreation, domestic and industrial water supplies and other benefits. Major watersheds in the TVA study area (Figure 3-2) include most of the Tennessee River, the Cumberland River basins, portions of the lower Mississippi, Green, Pearl, Tombigbee, and Alabama/Coosa River basins, and a small portion of the lower Ohio River basin.

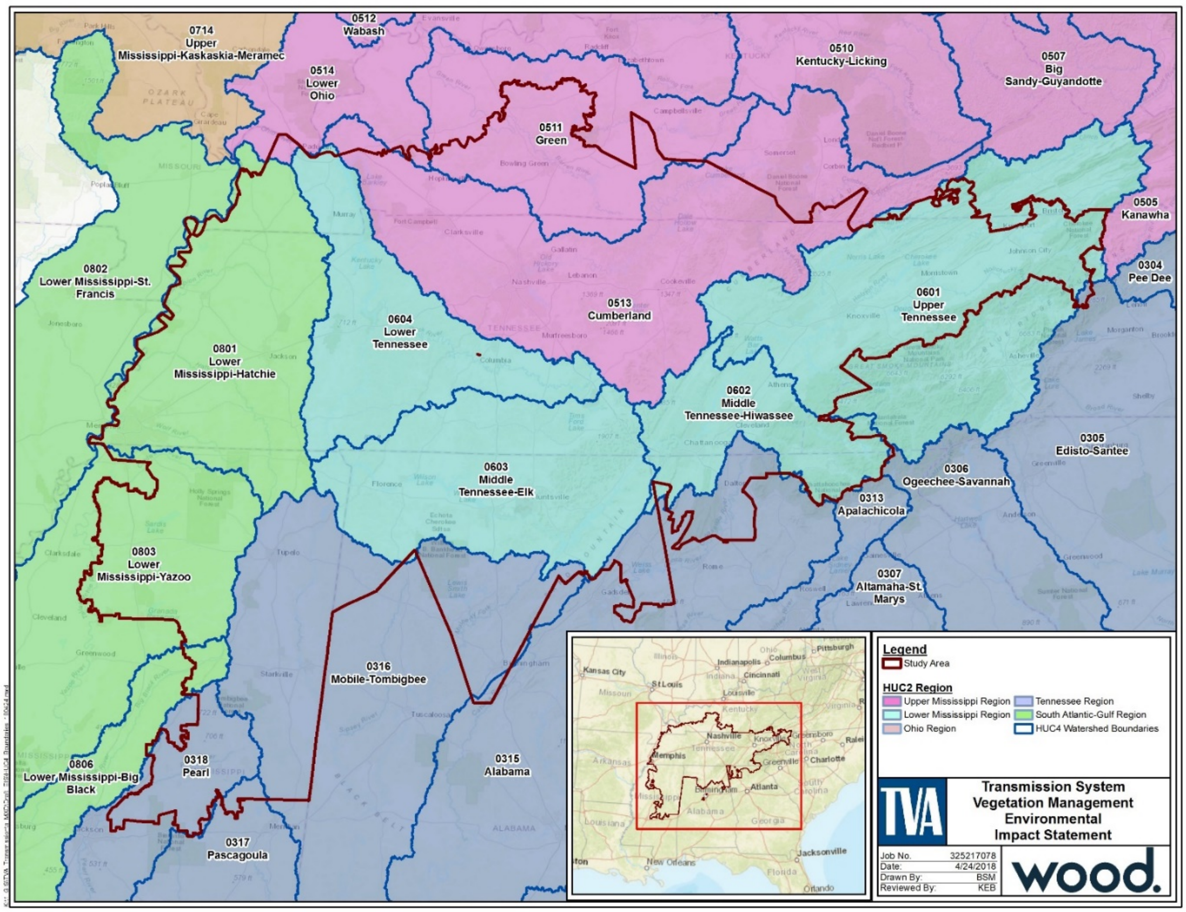


Figure 3-2. Major Watersheds of the TVA Study Area

The Tennessee River basin makes up a large centralized portion of the TVA study area (see Figure 3-2). The Tennessee River begins where the Holston and French Broad Rivers join in Knoxville, Tennessee, 652 river miles from where it empties into the Ohio River near Paducah, Kentucky. The Cumberland River is formed by the junction of the Poor and Clover Forks in Harlan County, Kentucky, about 693 miles above its confluence with the Ohio River near Smithland, Kentucky. The drainage area of the Cumberland is 17,598 square miles. The lower Ohio River receives drainage from a 204,000-square mile watershed, including 33,000 square miles in Kentucky. The lower Mississippi River in the reach that borders west Tennessee is one of the largest rivers in the world. Its drainage basin is 1,247,000 square miles and includes nearly all of the United States between the

Rocky Mountains and the Appalachian Mountains. The Green River Basin is located in south central Kentucky and north central Tennessee. The drainage area is 9,273 square miles, of which 377 are in Tennessee.

Fresh water abounds in much of the TVA study area and generally supports most beneficial uses, including fish and aquatic life, public and industrial water supply, waste assimilation, agriculture, and water-contact recreation, such as swimming. Water quality in the TVA region is generally good.

The federal Water Pollution Control Act, commonly known as the CWA, is the primary law that affects water quality. It establishes standards for the quality of surface waters and prohibits the discharge of pollutants from point sources unless a National Pollutant Discharge Elimination (NPDES) permit is obtained. NPDES permits also address CWA Section 316(b) requirements for the design, location, construction and capacity of cooling water intakes to reflect the best technology available for minimizing environmental impact. Section 404 of the CWA further prohibits the discharge of dredge and fill material to waters of the United States, which include most wetlands, unless authorized by a permit issued by the U.S. Army Corps of Engineers (USACE).

Several other environmental laws contain provisions aimed at protecting surface water, including the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation and Liability Act and the federal Insecticide, Fungicide, and Rodenticide Act, among others.

The seven states in the TVA power service area have enacted laws regulating water quality and implementing the CWA. As part of this implementation, the states classify water bodies according to their uses or designations and establish water quality criteria specific to these uses. Each state has also issued an anti-degradation statement containing specific conditions for regulated actions and designed to maintain and protect current uses and water quality conditions.

3.5.2 Environmental Consequences for Surface Water

The evaluation of potential impacts to surface water resources centers on the evaluation of alterations to surface water quality. The clearing of vegetative cover within the study area has the potential to cause minor and temporary effects on surface water quality, regardless of the methods used for clearing (TVA 2019). These alterations could be caused by small increases in sediment laden stormwater runoff, small increases in stream temperatures and decreases of dissolved oxygen from the loss of tree cover; the alteration of nutrient levels; small increases of pollutants, such as solid wastes from litter and chemical pollutants from leaking vehicles and heavy equipment; and the minor increase of concentrated stormwater flows from reduced vegetation cover. The evaluation of the surface water resources including designated uses and whether they are high quality or impaired (listed on the State 303(d) list) is considered to determine the appropriate control measures. Compliance with all applicable federal, state and local environmental laws and regulations would be followed including State Regulatory Stormwater Construction Permits, USACE 404/401 permitting, and Water Quality Certifications. A State-specific Stormwater BMP Plan, if required, would be drafted and would identify specific BMPs to address vegetation maintenance-related activities that would be adopted to minimize stormwater impacts per state guidelines. Appropriate BMPs (TVA 2017a) would be followed, and all proposed project activities would be conducted in a manner to ensure that waste materials are contained, and the introduction of pollutants to the receiving waters would be minimized.

In addition to the removal of vegetative cover, the use of herbicides for the control of vegetation has the potential to affect the water quality of streams. Therefore, any pesticide/herbicide use as part of vegetation maintenance activities would have to comply with the NPDES General Permit for Application of Pesticides, which also requires a pesticide discharge management plan if certain thresholds are met. In areas requiring chemical treatment, only EPA-registered and TVA approved herbicides would be used in accordance with label directions designed in part to restrict applications near receiving waters and to prevent unacceptable aquatic and water quality impacts. Proper implementation and application of these products would be expected to have no significant impacts to surface waters. No cumulative impacts are anticipated.

3.6 Wetlands

3.6.1 Affected Environment

Wetlands are those areas inundated or saturated by surface or groundwater such that vegetation adapted to saturated soil conditions is generally prevalent (USACE 33 Code of Federal Regulations [CFR] § 328(b); EPA 40 CFR § 230.3(t); (18 CFR 1318). Due to their landscape position, vegetation structure, and influence on downstream hydrology, wetlands provide a suite of benefits valued by society. These include toxin absorption and sediment retention for improved water quality, storm water impediment and attenuation for flood control, shoreline buffering for erosion protection, and provision of fish and wildlife habitat for commercial, recreational, and conservation purposes. Examples of wetland habitats would be bottomland forests, swamps, wet meadows, isolated depressions, and shoreline fringe along watercourses or impoundments.

Wetlands in the TVA power service area consist of two main systems: palustrine wetlands, such as non-tidal marshes, swamps and bottomland forests dominated by trees, shrubs, and persistent emergent vegetation, and lacustrine wetlands associated with lakes such as aquatic bed wetlands (Cowardin et al. 1979). Overall, palustrine wetlands are the predominant wetlands in the study area. These wetlands include bottomland hardwood forests (forested wetlands), scrub-shrub wetlands, beaver ponds (aquatic-bed or emergent wetlands), wet meadows and marshes (emergent wetlands), and highland bogs (forested, scrub-shrub, or emergent wetlands that have organic soils). The National Wetland Inventory (NWI) maps over two million acres of wetland across the TVA region, with 6,751 acres occurring on TVA transmission line ROWs (TVA 2019).

On TVA transmission ROWs where conductor clearance is necessary, management aims to maintain low-stature wetland vegetation. Therefore, wetland communities on TVA ROWs consist predominantly of emergent (erect, rooted, or floating) wetland plants. These typically include water lilies, cattails, grasses, rushes, bulrushes, sedges, smartweeds, reeds, and other hydrophytic (wet site) species. Emergent wetlands often occur along streams in poorly drained depressions and along the edges of water bodies, and experience varying water depths (EPA 2017b). Perennial plants typically dominate and remain present for most of the growing season, which can lead to a similar appearance of these wetlands year after year in areas with relatively stable climatic conditions (Federal Geographic Data Committee [FGDC] 2013).

Scrub-shrub wetlands contain woody plants less than 20 feet tall. These wetland communities may comprise woody vegetation with a limited growth potential, such as buttonbush or tag alder. Wetlands containing these or similar shrub species represent a relatively stable community and can be typical of shallow embayments or frequently inundated riparian areas. However, scrub-shrub wetlands can represent successional communities comprised of tree saplings (EPA 2017a). These communities develop when saplings invade emergent wetland habitat. However, TVA's ROW vegetation management program aims to deter threatening woody vegetation growth. Therefore, the presence of successional scrub-shrub wetland communities would be lacking on TVA ROWs.

Forested wetlands may persist on TVA ROWs in spanned valleys (deep ravines) or where the maintenance footprint does not extend to the full extent of the ROW. These forested wetland communities are commonly an extenuation of the adjacent maintained emergent wetland habitat within the ROW. They are typically characterized by an overstory of trees with species including red maple, oaks, willows, and cypress; an understory of young trees or shrubs; and an herbaceous layer comprised of shade tolerant species.

The vegetation maintenance cycle for FY21 comprises a total 78,855 acres of ROW, divided into 12 sectors. To evaluate wetland presence within these ROW sectors, TVA utilizes the National Wetland Inventory (NWI) (USFWS 1977-2017) coupled with O-SAR using higher resolution and more current aerial imagery, hydrology data, and soils information to map additional potential wetlands. In addition, the O-SAR dataset references all ground-truthed wetland delineations that have taken place within a ROW. Accordingly, a total of 7,478 acres of potential wetland area have been identified within the ROW sectors proposed for vegetation management activities in FY21. This wetland area represents nine percent of the total ROW footprint proposed for vegetation management (Table 3-5).

Table 3-5. National Wetland Inventory Data within TVA Transmission Line Rights-of-Way and TVA Study Area

ROW Sector	Ecoregion Location*	Total ROW Sector Acres	NWI Acres	O-SAR Acres	Ground Truthed Acres	Total Mapped Wetland Acres	Percent of ROW Sector Mapped Wetland
Centerville	IP	8,621	60	168	40	268	0.03
Cleveland	BR, R&V, SW App	7,126	36	212	26	274	0.04
Hickory Valley	MSV LP, SE Plains	5,100	232	356	132	720	0.14
Hopkinsville	IP, IRV&H, MSV LP	5,378	144	288	125	558	0.11
Madison	IP, R&V, SW App	5,191	67	255	70	392	0.08
Manchester	IP, R&V, SW App	4,869	105	280	29	414	0.09
Milan	IP,MS AP, MSV LP, SE Plains	7,866	502	553	273	1,328	0.17
Morristown	BR,R&V	7,217	18	167	40	225	0.03
Muscle Shoals	IP, SE Plains, SW App	9,088	507	535	132	1,054	0.12
Nashville	IP	1,736	16	111	6	133	0.08
Oak Ridge	IP, R&V, SW App	8,437	21	177	16	214	0.03
West Point	SE Plains	8,226	894	714	287	1,898	0.23
TOTAL		**78,855**	**2,602**	**3,816**	**1,176**	**7,478**	**0.09**

*Ecoregion Level III (EPA 2017a): BR=Blue Ridge; IP=Interior Plateau; IRV&H=Interior River Valley and Hills; R&V=Ridge and Valley; MS AP=Mississippi Alluvial Plan; MSV LP=Mississippi Valley Loess Plains; SE Plains= Southeast Plains; SW App=Southwestern Appalachians.

The Cleveland and Morristown sectors are located predominantly in east Tennessee, with portions in northeast Georgia, and some ROW area extending into western North Carolina. These sectors total 274 acres and 225 acres of mapped wetland area, which represents 3 percent and 4 percent of these ROW sectors, respectively. East Tennessee, northeast Georgia, and western North Carolina comprise portions of the Southwestern Appalachians, Blue Ridge, and Ridge and Valley ecoregions. The steep topography of the Blue Ridge Mountains is not conducive to wetland development due to the high rate of runoff; therefore, wetlands are relatively smaller in size and generally form along drainages or wherever runoff can otherwise pool for sufficient development of wetland habitat (Weakley and Schafale 1994). The Ridge and Valley region is characterized by gentler topography, with wetland habitat most common in floodplains of stream and river systems in the valley flats; although seepage fens containing rare species are known from this ecoregion as well. Wetlands in the Southwestern Appalachians are located in valley floors where undulating low mountain terrain allows for water retention. Due to the topography of the area crossed by these ROW sectors, wetlands in narrow valley bottoms can be spanned by conductors with structures located on upland rises between drainages. Wetlands in wider valley flats may contain structures to accommodate a longer ROW crossing.

The Oak Ridge, Madison, and Manchester sectors extend from east Tennessee into central Tennessee, south central Kentucky, and north central Alabama. These sectors total 214 acres, 392 acres, and 414 acres of mapped wetland area, which represents 3 percent, 8 percent and 9 percent of these ROW sectors, respectively. Central Tennessee, south central Kentucky, and north central Alabama comprise portions of the Southwestern Appalachians, as described above, and the Interior Plateau. The Interior Plateau ecoregion contains the entirely of the Centerville and Nashville ecoregions, as well. These sectors contains 268 acres and 133 acres of mapped wetland, comprising 3 percent and 8 percent of these ROW sectors, respectively. The Interior Plateau is characterized by karst geology underlying lower elevation hills and plains. ROW sectors crossing this ecoregion would encounter wetland habitat formed in sinkhole depressions, limestone seeps, and along river valleys. A portion of the Hopkinsville sector is located across southwest Kentucky and north central Tennessee in the Interior Plateau ecoregion, where similar wetland habitat and occurrence regime would be anticipated. This sector extends into the Mississippi Valley Loess Plains, described below. Hopkinsville sector contains 558 mapped potential wetland acres, comprising 11 percent of the ROW area.

The Muscle Shoals sector is located between northwest Alabama and northeast Mississippi, crossing the Interior Plateau and Southern Appalachians ecoregions, as described above, and extending across the Southeastern Plains. This sector contains 1,054 mapped wetlands acres, comprising 12 percent of the sector’s total ROW area. All of the West Point sector and portions of the Milan and Hickory Valley sectors are located in the Southeastern Plains across Mississippi, west Tennessee, and western Kentucky. Both Milan and Hickory Valley sectors extend into the Mississippi Valley Loess Plains, and Hickory Valley extends further west into the Mississippi Alluvial Plain ecoregion. West Point’s sector is comprised of 23 percent mapped potential wetland features, totaling 1,898 acres; 14 percent of Hickory Valley’s sector is comprised of mapped potential wetland features, totaling 720 acres; and 17 percent of Milan’s sector is mapped as potential wetland, totaling 1,328 acres. The higher percentage of wetland across these sectors is anticipated due to the flatter lands and lower gradient drainage basins typical of these ecoregions. Wetlands encountered in these ROW sectors would be extensive across the wide floodplain wetland complexes typical of these regions.

The mapped wetland location data generated for ROW vegetation management purposes is a guide to use for planning vegetation management activities in wetlands. The data sets capture identifiable potential for wetland occurrence within the ROW sectors proposed for maintenance. However, not all areas identified as wetland may be in need of maintenance. Wetlands on ROWs may be maintained at low stature through existing land use (farming, pasture) or may be inundated sufficiently to deter sapling establishment. Therefore, the true extent of affected wetlands would be determined on a case-by-case basis by ROW foresters who are informed by these datasets on the locations for potential wetland presence.

3.6.2 Environmental Consequences for Wetlands

Activities in wetlands are regulated by state and federal agencies to ensure no more than minimal impacts to the aquatic environment and no net loss of wetland resources. Under CWA §404, activities resulting in the discharge of dredge or fill material in jurisdictional wetlands, and any secondary wetland impacts, such as forested wetland clearing, must be authorized by the USACE through a Nationwide, Regional, or Individual Permit. CWA §401 mandates state water quality certification for projects requiring USACE approval and permitting. Lastly, EO 11990 requires federal agencies such as TVA to minimize wetland destruction, loss, or degradation, and preserve and enhance natural and beneficial wetland values, while carrying out agency responsibilities. Compliance with USACE permitting is required for regulated activities within jurisdictional waters of the U.S., which could include mitigation based on their review of TVA's proposed impacts.

As described in Section 3.6.1, wetland identification for the purpose of TVA's transmission ROW vegetation management program is conducted utilizing NWI data and supplemented with an O-SAR review that incorporates higher quality imagery and overlays indicative of wetland presence. The use of office-level materials for wetland identification runs the inherent risk of inaccuracies (Tiner 1997); therefore, limitations of this data must be considered. For example, there may be wetlands present for which no mapped evidence or other data currently exists and are, therefore, undetectable via office-level review. The presence or absence of these wetland resources could only be verified through field surveys to accurately determine the extent and condition. Wetland delineations are not performed for the purpose of planning transmission ROW vegetation maintenance activities; however, some ground surveyed wetland boundaries may be referenced in the O-SAR dataset. Because most of the wetland areas have only been identified through desktop resources, potential impacts due to transmission ROW vegetation maintenance activities may occur at wetlands not previously identified. Therefore, to ensure compliance with wetland regulations, wetland O-SAR data is only applicable to vegetation management activities occurring within the routinely cleared (three-year cycle) ROW corridor and associated access road work resulting in less than 0.1 acre of permanent disturbance.

Impacts over 0.1 acre commonly require agency notification and potential mitigation to ensure no more than minimal impacts to the aquatic environment, in accordance with state and federal wetland regulations. Thus, an environmental review separate from O-SAR is conducted for vegetation management outside of the routinely cleared (three-year cycle) ROW corridor and associated access road work where greater than 0.1 acre of permanent impact is proposed. In addition, as a general practice, vegetation maintenance crews remain alert to wetland "indicators" such as standing water, soil saturation, etc., and work accordingly to protect and identify previously unmapped wetland resources.

Most often, however, vegetation management activities may be conducted with minimal wetland disturbance and without regulated wetland impacts. The proposed methods for vegetation management on the affected ROW sectors include: mechanical mowing, hand clearing, herbicide application, and hazard tree removal. The NWI and O-SAR dataset provide a means of implementing avoidance strategies or BMPs when conducting these activities to ensure temporary or nominal impacts in areas identified as potential wetland.

Mechanical mowing using brush hogs or large mowers may accommodate floor work to maintain a meadow-like habitat. However, access to wetlands with inundated or saturated soils with mechanical equipment is limited due to the unstable substrate. Therefore, mowing in wetlands may only be conducted under dry conditions, such as the dry-season during which time soil saturation would be reduced. Under these conditions, mowers and brush hogs may be used to clear briars and/or small saplings within wetlands with minimal impacts. Additionally, it is anticipated that the existing wetland function would not change.

Hand clearing using hand held shears, clippers, brush saws, axes, and chainsaws to sever above ground vegetation of shrubs or saplings would maintain existing wetland function by promoting long-term emergent meadow-like wetland habitat. Manual clearing with hand tools can be used where inundated and saturated wetland soils constrain access precluding the use of other vegetation management strategies. Resprouting of manually cut or pulled woody wetland plants can ultimately lead to increased stem density, especially for invasive species that tend to resprout more aggressively. Seasonal timing of manual clearing and herbicide application to cut stems can help to reduce resprouting (Kays and Canham 1991; Wegner 1953). Therefore, the manual removal method is most effective when conducted during the appropriate season and/or in combination with herbicide.

Herbicide application in wetlands within the ROW sectors would be applied to target woody wetland vegetation of smaller stature in order to prevent tree growth on the open ROW floor. Therefore, there would not be a reduction or change in the wetland function or value. In combination with mechanical clearing, manual clearing, and reseeding practices, herbicide application can extend the necessary routine vegetation maintenance cycles due to its effectiveness for woody vegetation control. There is potential for this method to affect wetlands not identified during the O-SAR process or apparent to ROW management crews. Spot spray herbicide, localized herbicide, and broadcast herbicide, aerial herbicide application methods may be selected depending on the management needs. Consideration of site specific characteristics ensures potential herbicide runoff, leaching, or drift is contained when applied in or near a wetland (TVA 2019).

Hazard tree removal in wetlands may be conducted with hand held cutters, as described above, or accomplished with a feller-buncher. A feller-buncher is a machine that grasps the tree trunk while shearing it near the ground surface, then removing it to a suitable location outside the wetland. Both methods leave the root ball intact and result in minimal soil if access is conducted using wetland BMPs (TVA 2017a). Because hazard tree removal would only occur along ROW edges, and typically result in the removal of one or few trees in one location, no significant wetland impacts would be anticipated

The following Wetland BMPs (TVA 2017a) would be implemented within locations where mapped NWI and O-SAR wetlands are present and vegetation management activities are necessary:

- Work in wetland areas would occur on a dry season schedule (September to mid-November) when practicable.
- Soils ruts would not exceed 12 inches; if necessary, low ground pressure equipment would be used, such as rubberized tracks, wide tires, or lightweight ATVs in mapped wetlands to adequately minimize soil rutting/compaction/disturbance.
- Woody wetland vegetation should be cut less than 12 inches from ground level.
- Woody debris would be removed outside identified wetland area.
- Stumps would be left intact, no grubbing.
- Only aquatic approved herbicide would be permissible.
- Water flow into or out of mapped wetlands would not be restricted during work activities.
- Erosion control techniques would be implemented within 50 feet of identified wetland areas where soil disturbance is proposed.
- Existing contours within wetlands would be restored to preconstruction specifications.
- Disturbed and exposed wetland soils would be seeded upon completion of work (or within 14 days, whichever comes first).

The wetland review process provides locations for potential and known wetland locations across the entire ROW sectors proposed for management. This represents a total of 7,478 acres, or nine percent of the ROW footprint proposed for management in FY21. ROW crews will consult the wetland dataset and ensure wetland best management practices are followed at mapped wetland locations. The use of the wetland data, however, is restricted to specific actions or thresholds. If the proposed vegetation management activity exceeds the impact acreage threshold or involves otherwise regulated activities, a wetland delineation would be conducted to ensure appropriate wetland compliance is achieved. Therefore, with the wetland datasets used as a tool in vegetation management planning, use of those dataset subscribed to, and wetland delineations conducted for compliance purposes otherwise, the proposed ROW sector vegetation management activities are anticipated to have no significant wetland impacts.

3.7 Natural Areas

3.7.1 Affected Environment

Numerous areas across the TVA region are recognized and, in many cases, managed for their recreational, biological, historic and scenic resources. These areas are owned by 1) federal and state agencies 2) local governments 3) non-governmental organizations such as the Nature Conservancy 4) regional land trusts and private corporations and 5) private individuals.

Parks, managed areas and ecologically significant sites are typically managed for one or more of the following objectives:

- Recreation - managed for outdoor recreation or open space. Examples include national, state and local parks and recreation areas, reservoirs (TVA and other), picnic and camping areas; trails and greenways, and TVA small wild areas.

- Species/Habitat Protection - places with endangered or threatened plants or animals, unique natural habitats, or habitats for valued fish or wildlife populations. Examples include national and state wildlife refuges, mussel sanctuaries, TVA habitat protection areas and nature preserves.
- Resource Production/Harvest - lands managed for production of forest products, hunting and fishing. Examples include national and state forests, state game lands and wildlife management areas and national and state fish hatcheries.
- Scientific/Educational Resources - lands protected for scientific research and education. Examples include biosphere reserves, research natural areas, environmental education areas, TVA ecological study areas and federal research parks.
- Historic Resources - lands with significant historic resources. Examples include national battlefields and military parks, state historic sites and state archeological areas.
- Scenic Resources - areas with exceptional scenic qualities or views. Examples include national and state scenic trails, scenic areas, wild and scenic rivers, Nationwide Rivers Inventory (NRI) streams and wilderness areas.
- Agricultural Resources - lands with significant local agricultural production and open space value, often in areas where suburban development is increasing. Examples include working family farms protected by conservation easements

A May 2020 analysis of the TVA Regional Natural Heritage database indicated the twelve ROW vegetation management sectors include numerous parks, managed areas and ecologically significant sites. In general, natural areas are more concentrated in the eastern portion of the TVA region. A total of 360 natural areas are crossed by TVA transmission line ROW (Table 3-6)

Table 3-6. Natural Areas by TVA Transmission ROW Sector

Sector	Number of Natural Areas
Cleveland	40
Centerville	40
Hickory Valley	9
Hopkinsville	23
Manchester	32
Madison	39
Milan	19
Muscle Shoals	0
Morristown	64
Nashville	15
Oak Ridge	57
West Point	22
TOTAL	**360**

Appendix L includes a complete list of natural areas by Sector. Areas crossed by TVA transmission line ROW include NPS units, USFS areas, National Wildlife Refuges, and numerous state wildlife management areas, state parks, state forests, local parks, and conservation easements.

3.7.2 Environmental Consequences for Natural Areas

TVA maintains natural areas data in the TVA Regional Natural Heritage database. This data includes the type, location, management entity, and contact information for each site, and may include pertinent rare species and habitat information. TVA's O-SAR process uses this information, in conjunction with the transmission line ROW clearing spatial data, to develop site-specific guidance for each natural area that is to be used during scheduled ROW maintenance each year.

Mitigation measures to minimize impacts to natural areas include:

- Follow procedures outlined in TVA's *A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Construction and Maintenance Activities Revision 3-2017* (TVA 2017a).

- Contact the appropriate land manager before implementing vegetation maintenance activities to coordinate timing of the ROW maintenance such to minimize impacts to visitors, park operations, scheduled hunting, etc.

- Seek opportunities to partner with natural area managers to plan and conduct vegetation management that will meet multiple natural resource management objectives.

- Where available, utilize existing site-specific vegetation management plans for transmission ROWs that cross managed lands.

Prior to implementing the FY21 vegetation management activities, ROW crews review the natural areas O-SAR dataset and ensure standard BMPs are followed within all natural areas. Where indicated, the crew would consult with natural areas land managers, and coordinate activities as warranted. Utilizing the mitigation measures listed above no significant impacts to natural areas are associated with the FY21 vegetation maintenance activities.

3.8 Archaeological and Historic Resources

3.8.1 Affected Environment

3.8.1.1 Regulatory Framework

Federal agencies, including TVA, are required by the NHPA (16 USC 470) and by NEPA to consider the possible effects of their undertakings on historic properties. Additional cultural resource laws that protect historic resources include the Archaeological and Historic Preservation Act (16 USC 469-469c), Archaeological Resources Protection Act (16 USC 470aa-470mm) and the Native American Graves Protection and Repatriation Act 925 USC 3001-3013).

TVA executed a PA with the Advisory Council on Historic Preservation, seven SHPOs and all federally recognized Indian tribes with an interest in the region. The PA establishes a program alternative for compliance with the NHPA that would allow compliance to be achieved more efficiently through consultation at the programmatic level. The PA would set forth procedures and criteria for an alternative process for all existing TVA operation and maintenance activities that are similar and repetitive in nature. The majority of the activities associated with transmission ROW vegetation management are covered within this PA.

3.8.1.2 Archaeological Resources

3.8.1.2.1 Background

The history of human activity throughout the study area spans thousands of years. The earliest groups to leave a definitive material record of their presence were early Paleoindians who entered the region during the Late Pleistocene glacial epoch at least 12,000 years ago. Their descendants and the descendants of other Native American groups who migrated to the area occupied the region for the next 11 millennia. This long prehistoric era lasted until the arrival of Europeans explorers in the sixteenth and seventeenth centuries. Cultural change is a slow and continual process. Archaeological researchers divide the prehistoric human history of the study area into six distinct cultural periods; Paleoindian (10,000-8000 B.C.), Archaic (8000-1000 B.C.), Gulf Formational/Early Woodland (1000-100 B.C.), Middle-Late Woodland (100 B.C.-A.D. 900), Mississippian (A.D. 900-1540), and Contact/Protohistoric period (A.D. 1540-1672) (Anderson and Sullivan 2013; Hudson 2002). The modern historic era includes activities taking place from the eighteenth, nineteenth, and early twentieth centuries.

The Paleoindian period is characterized by small nomadic groups who exploited a variety of resources across the landscape including the hunting of now extinct mega-fauna. Artifacts attributed to this period often include large fluted stone projectiles of the Clovis tradition. The Archaic period spans approximately seven millennia in which many cultural changes occurred. The early part of the Archaic period was much like that of the Paleoindian; mobile groups exploiting an increasing number of new environmental niches as the climate began to warm at the end of the ice age. Then the archaeological record became more diverse. Lithic projectile point forms recovered include those of the Eva, Morrow Mountain, White Springs, and Benton clusters (Justice 1987). Groundstone tools became more complex with the development of grooved axes, bannerstones and netsinkers during the Middle Archaic period. The first evidence of the spear thrower also appeared in the form of atlatl weights (Sassaman 1996). Deep storage pits, post molds (structures), and burials as well as evidence of the collection of arboreal nut crops and other cultigens, such as hickory nuts and wild plant remains such as goosefoot, maygrass, and knotweed are present at later Archaic sites (Gremillion 1996).

A main attribute that separates the Gulf Formational/Early Woodland period from the Archaic is the introduction of ceramics or pottery. The first pottery appeared in the western portion of the Middle Tennessee Valley between 1,000 and 800 B.C. largely in the form of undecorated fiber- and sand-tempered wares. Smaller lanceolate shaped, notched, and stemmed projectile of the Adena Stemmed, Gary Contracting Stemmed, Motley, and Wade types have been recovered from Early and Middle Woodland period sites (Justice 1987). Later Woodland period sites include undecorated and decorated chert-, quartz-, and more prominently grog- and limestone-tempered pottery (Faulkner 2002). More complex varieties of structural and storage features indicating increased emphasis on horticulture of native plants and sedentary lifeways also are evident at later Woodland sites. Small triangular

Hamilton and small notched projectile types occur and mark the introduction of bow and arrow technology, a key cultural marker throughout the Tennessee Valley.

The Mississippian period throughout the TVA study area was dominated by chiefdom level societies, which influenced the surrounding tribal groups, arguably the most radical shift in social organization in the prehistoric era (Harle et al. 2013). Elaborate mortuary practices involving burial pits, mounds, and more extravagant grave goods evolved during this time. Large planned villages are often fortified. The villages contain extensive midden deposits and a high density of features. Rectangular, wall trenched dwellings with raised clay fire basins are also evident. In addition, many inhabitants were dispersed into farming hamlets throughout the landscape.

The beginning of the Contact/Protohistoric period in the Southeast is commonly marked by the de Soto expeditions deep into interior portions of the Southeast (A.D.1544-1543). From the period of initial European contact to the Historic period, the archaeological and ethnohistoric record indicates a steady decline of the Native American population and extensive movement of many tribes. Introduced disease, especially smallpox, may have been a major catalyst for this decline (Smith 2002). The Mississippian pattern of large towns surrounded by smaller hamlets continued to operate in some areas even during the latter part of the Protohistoric when there were influxes of Native Americans from outside groups who were displaced by Euroamerican encroachment (Davis 1990). Eventually, these villages declined in number, population, and overall size and were ultimately abandoned.

European influx only increased throughout the eighteenth century, and following the Revolutionary War, settlement further west beyond the Appalachian Mountains began in earnest. This resulted in the forced cessation of Native American lands throughout the Tennessee River Valley, including those belonging to the Chickasaw, Choctaw, Muscogee-Creek, Seminole, and Cherokee to name a few. In 1830, Congress passed the Indian Removal Act resulting in the forced removal of tens of thousands of Native Americans westward, known as the ‘Trail of Tears.’ The American Industrial Revolution occurred within subsequent decades, resulting in marked growth of urban centers, large plantations, and smaller subsistence farming homesteads throughout the study area. The construction of railroads furthered the growth of industry in the Valley. The Civil War played a significant role in the development of the region. The Reconstruction Era of the late nineteenth century and the influx of European immigrants during the turn of the nineteenth and early twentieth century also had a major impact to settlement and the economy of the Valley.

Archaeological investigations in the study area began in the early 19th century with the explorations of Cyrus Thomas, C.B. Moore, and the Smithsonian Institute. These early investigations focused on larger sites such as mound complexes. The earliest TVA related archaeological surveys occurred in the 1930s and 1940s, prior to inundation of Norris, Wheeler, Guntersville, Chickamauga, Douglas, Pickwick, and Kentucky Reservoirs among others (Webb 1939; Lewis and Kneberg 1995). These surveys, staffed by New Deal public works programs, were opportunistic in nature focusing on the excavation of large village sites. Following the passage of the NHPA in 1966 TVA has implemented numerous archaeological investigations throughout the study area as they consider effects to cultural resources by their undertakings in compliance with Sections 106 and 110.

Only portions of the ROWs subject to this EA have undergone systematic Phase I archaeological surveys since the mid-1990s in association with compliance with Section 106. As a result, numerous archaeological sites within the transmission ROWs have been identified and evaluated with respect to their eligibility status for listing on the National Register of Historic Places (NRHP). Much of the survey work is conducted at the planning stages and prior to new construction of transmission lines.

3.8.1.2.2 Archaeological Sites

Prehistoric Archaeological sites located within the TVA study area can take many forms. These can range from low-density lithic artifact scatter to extensive and complex village sites. Prehistoric sites are most often discovered within sub-surface deposits or below ground. Near surface deposits have often been previously disturbed by historic plowing activities, but intact cultural deposits can occur below what is termed the 'plowzone.' Earlier prehistoric sites, namely Paleoindian and earlier Archaic sites, are less common and are characterized by low density lithic artifact scatters across a variety of topographical settings; both upland and along lower elevated landforms along river drainages. In general, Middle and Late Archaic sites are more numerous across the study area landscape. Later Woodland and Mississippian period as well as Protohistoric sites are common along terrace sequences of major rivers, including the Tennessee River. These sites can represent long-term villages and contain rich archaeological deposits. Lithic resource procurement sites are also prehistoric archaeological sites types that can occur within the study area.

Historic era archaeological sites throughout the study area are predominately associated with industrial, military, and domestic activities dating to the late eighteenth, nineteenth, and early twentieth centuries. Historic sites often contain both above- and below-ground cultural remains. Above-ground remains can be represented by structural remnants, wells and cisterns, and chimney remains mainly for industrial and domestic sites and various earthwork forms associated with Civil War military sites. Below-ground deposits can be represented by structure floors and layouts, storage cellars, and privies. Examples of industrial sites within the study area can include anything business related including mill complexes, iron furnaces, plantation operations, blacksmith shops, and taverns to name a few. Worker camp complexes can also occur within the study area. These can be associated with mill operations as well as early twentieth century TVA dam construction. Civil War military historic sites involve different types of sites, including battlefields, training camps, bivouacs (encampments), earthen fortifications, masonry fortifications, and other strictly military features on the landscape. Domestic sites are the most prevalent historic site within the study area. These sites are dotted across the landscape and can occur as small communities or individual farmstead complexes. Associated out buildings can also occur. In addition, historic cemeteries have been located within transmission line corridors and can represent themselves by single or multiple grave markers that may or may not be fenced off and maintained. In many cases, only a few grave markers remain, but depressions representing unmarked graves may be present.

The study area represents a diverse cultural landscape that held special meaning to its past inhabitants and to their descendants. Some of these places can be considered Traditional Cultural Properties (TCP). A TCP is defined as a property that is eligible for inclusion on the NRHP because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community (Parker and King 1998). Similarly, a cultural landscape is defined as "a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values" (Birnbaum 1996). It should be noted that TVA does not disclose to the public any sensitive information regarding the location or other information such as sacred sites or TCPs identified by consulting tribes. Some examples of TCPs within the study area include mound sites, segments of the Trail of Tears, as well as stacked stone features. The Congressionally designated Trail of Tears National Historic Trail is a prominent cultural resource within the study area. The Trail of Tears consisted of many routes and sub-routes that involved the removal of Native Americans from their ancestral homelands. In some locations intact, original segments of this part of the trail may be present such as the Unicoi Turnpike or Overhill Path, located in southeastern Tennessee, western North Carolina, and northern Georgia. This is a transportation route of great antiquity and a landscape of historical and cultural significance to the consulting tribe. Stone stacked features often appear as single or a group of cylindrically stacked limestone. The origin and purpose of these stone features is uncertain, but a Resolution passed by the United South and Eastern Tribes, Inc. (USET) in 2007 recommended all federal agencies involved in the Section 106 process consider stacked stone features not conclusively linked to a historic origin be considered a TCP under NRHP Criterion A (USET 2007).

3.8.2 Environmental Consequences for Archaeological and Historic Resources

As described above a range of cultural resources have the potential to be present within the transmission line ROW including prehistoric Native American archaeological sites, historic era archaeological sites, and TCPs including intact original Unicoi Turnpike/Trail of Tears segments. The majority of vegetation maintenance activities within the TVA transmission ROW have little to no potential to affect cultural resources. Vegetation maintenance activities that have the potential to cause disturbance of soil can disturb sub-surface cultural deposits related to both prehistoric and historic era archaeological sites. However, this potential effect would be low as vegetation maintenance activities are focused on maintaining vegetation within an established transmission ROW. The use of spot or localized herbicides as a method to control vegetation within the study area, would not adversely affect cultural resources. However, broadcast and aerial spray, which is rarely used, have the potential to affect culturally significant and traditionally used native plants should they be present. Methods involving manual vegetation activities include the use of hand tools for either pulling or cutting vegetation and have a low potential for disturbance of subsurface cultural resources given that vegetation would be cut and not actually removed from the soil. The use of machinery within the transmission line ROW has the potential to disturb sensitive above-ground historic resources, if present.

TVA executed a PA in consultation with the Advisory Council on Historic Preservation, seven SHPOs, and federally recognized Indian tribes with an interest in the region. The purpose of the PA is to establish a program alternative for compliance with Section 106 of the NHPA that would allow compliance to be achieved more efficiently through consultation at the programmatic level. The PA set forth procedures and criteria for an alternative process for existing TVA operation and maintenance activities that are similar and repetitive in nature. The majority of the activities associated with transmission ROW vegetation management are covered within the PA.

3.8.2.1 Mitigation Measures for Impacts to Archaeological and Historic Resources

TVA executed a PA with the seven state SHPOs and all federally recognized Indian tribes with an interest in the region. TVA released the PA for public comment in December 2018. The PA covers the majority of TVA vegetation management activities that are subject to the EIS (TVA 2019), categorizing them in the PA into Appendix A and B activities. Appendix A activities are those activities that have been determined through the PA consultation process as being unlikely to affect historic properties and are therefore excluded from further Section 106 review. Appendix A activities include the "*use of herbicides (except for aerial applications), brush hog, mulcher, mower, and other light-duty equipment to control vegetation and establish or maintain ROW width that involve no new ground disturbance, with the exception of activities occurring within cemeteries or other previously flagged sensitive archaeological sites*." Archaeologically sensitive areas (including known trail of tear routes with the potential for intact deposits) and cemeteries would be restricted to hand clearing only and no mechanized equipment would be allowed within the boundaries. If such activities are proposed that fall outside of those described in the PA's Appendix A then TVA would follow the Section 106 process as set forth by the PA for those portions of the transmission line ROW.

3.9 Summary of Method Impacts and Mitigation Measures

As described in each of the preceding sections, and in TVA's PEIS (TVA 2019) which is incorporated by reference, each aspect of TVA's vegetation management program (vegetation control, debris management, restoration) vary with respect to their impact to environmental resources. A summary of impacts associated with each of the vegetation methods is provided in Appendix J.

TVA employs standard practices when constructing, operating, and maintaining transmission lines, structures, and the associated ROW and access roads. These can be found on TVA's transmission website (TVA 2020). Some of the more specific routine measures would be applied to reduce the potential for adverse environmental effects during the proposed vegetation management of ROW are as follows:

- O-SAR Process
- To minimize the introduction and spread of invasive species in the ROW, access roads and adjacent areas, TVA would follow standard operating procedures consistent with EO 13112 (Invasive Species) for revegetating with noninvasive plant species (TVA 2017a).
- Only EPA-registered and TVA approved herbicides determined to be safe for use near aquatic environments would be used in accordance with label directions.

The following O-SAR buffers would be applied near sensitive wildlife resources associated with the FY21 vegetation management actions:

- Cave - 200 feet - No herbicide use within 200 feet of cave due to potentially sensitive subterranean aquatic resource. Hand clearing or small machinery clearing only (i.e.: chainsaws, brush hog, mowers). Vehicles and equipment confined to existing access roads. Avoid entering cave.

- Osprey nest - 660 feet - Either 1) Assume presence. No broadcast spraying. Only use brush hogs or mowers for vegetation removal or selective herbicide spraying between March 1 and July 31 within 660 feet of nest site; OR 2) Request seasonal field survey to determine if nest is active.
- Heronry - 660 feet - Either 1) Assume presence. No broadcast spraying. Only use brush hogs or mowers for vegetation removal or selective herbicide spraying between February 1 and July 15 within 660 feet of nest site; OR 2) Request seasonal field survey to determine if nests are active.
- Bald Eagle nest - 660 feet - Either 1) Assume presence. No disturbance, spraying, or vegetation clearing would occur between December 1 and July 1 within 660 feet of nest site; OR 2) Request seasonal field survey to determine if nest is active.
- In rare instances in which restricted actions need to take place while osprey or heron nests are active, TVA would coordinate with U.S. Department of Agriculture Wildlife Services (USDA-WS) to ensure any actions comply with the conditions specified under USDA's "Take" permit.

Wetland BMPs (TVA 2017a) would be implemented within locations where mapped NWI and O-SAR wetlands are present and vegetation management activities are necessary:

- Work in wetland areas would occur on a dry season schedule (September to mid-November) when practicable.
- Soils ruts would not exceed 12 inches; if necessary, low ground pressure equipment would be used, such as rubberized tracks, wide tires, or lightweight ATVs in mapped wetlands to adequately minimize soil rutting/compaction/disturbance.
- Woody wetland vegetation should be cut less than 12 inches from ground level.
- Woody debris would be removed outside identified wetland area.
- Stumps would be left intact, no grubbing.
- Only aquatic approved herbicide would be permissible.
- Water flow into or out of mapped wetlands would not be restricted during work activities.
- Erosion control techniques would be implemented within 50 feet of identified wetland areas where soil disturbance is proposed.
- Existing contours within wetlands would be restored to preconstruction specifications.
- Disturbed and exposed wetland soils would be seeded upon completion of work (or within 14 days, whichever comes first).

Natural Areas mitigation measures to minimize impacts to include:

- The appropriate land manager would be contacted before implementing vegetation maintenance activities to coordinate timing of the ROW maintenance such to minimize impacts to visitors, park operations, scheduled hunting, etc.
- Opportunities would be sought to partner with natural area managers to plan and conduct vegetation management that would meet multiple natural resource management objectives.
- Where available, existing site-specific vegetation management plans would be utilized for transmission ROWs that cross managed lands.

Archaeologically sensitive areas (including known trail of tear routes with the potential for intact deposits) and cemeteries would be restricted to hand clearing only and no mechanized equipment would be allowed within the boundaries. If such activities are proposed that fall outside of those described in the PA's Appendix A, then TVA would follow the Section 106 process as set forth by the PA for those portions of the transmission line ROW.

3.10 Environmental Consequences Summary of the Proposed Vegetation Management Alternative

Under both the No Action Alternative and the Action Alternative there would be no change to the current process authorized by the *Sherwood* injunction by which TVA manages vegetation along the transmission line ROW.

Under the Action Alternative, TVA would manage vegetation along the transmission line ROWs with an IVM approach to promote the establishment of a low-growing herbaceous plant community (end-state) that is compatible with the safe and reliable operation of the transmission system. Routine vegetation maintenance would include identification and removal of vegetation within the transmission ROW that is incompatible with TVA's desired end-state condition (herbaceous). Floor work planned for FY21 within the 12 sectors would result in plant communities of variable composition that are managed in a low height existing condition. TVA would also use an approach that is condition based for identification and removal of trees deemed as hazardous that would use LiDAR and other assessment techniques. Due to the *Sherwood v. TVA* litigation, TVA has stopped removing woody vegetation in the buffer zone of ROWs (except for trees that are an immediate hazard). As a result, buffer zones within the existing ROW continue to contain vegetation incompatible with TVA's transmission system. The volume of non-compatible woody vegetation is also increasing within the previously-cleared ROWs due to the court injunction order.

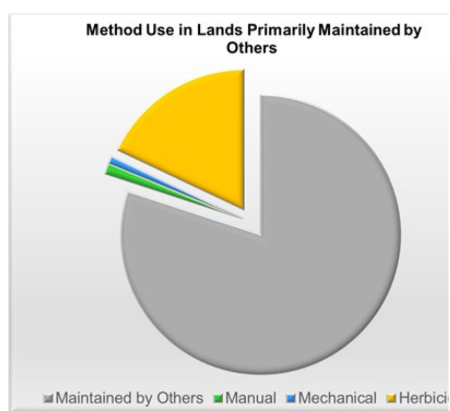
As part of this alternative, TVA must leave existing trees in the maintained area of the transmission ROW so long as they do not pose an immediate hazard to the transmission lines. TVA may remove or trim any trees in the maintained area of the transmission ROW, or in the non-maintained areas of the transmission ROW, or any danger tree outside the ROW, in accordance with its contract rights, that it deems to present an immediate hazard to its transmission lines. No removal of woody vegetation or trees that either remained or have redeveloped within the transmission ROW since the initial construction period would be conducted.

As a result of the regular cycle of floor work, vegetation would be controlled using a range of techniques. Plant communities within the transmission ROW would be maintained in the existing condition and the larger expanses of lands that may be subject to vegetation removal would remain forested. Woody vegetation would establish within the existing maintained transmission ROW by either sprouting from existing root stocks or by germination and growth of propagules that are dispersed to the corridor from seed sources. Because TVA utilizes an IVM approach to manage vegetation on a site-specific basis, some localized impacts may be expected to result from the selection and application of methods of each tool as described for each of the resources described in the preceding sections. However, impacts of this alternative within a broader context (sector or study area) can be evaluated in consideration of:

- The frequency and context of tool application.
- TVA's O-SAR methodology (see Section 2.2.2 and Appendix I) for identification of sensitive resources that represent a BMP-approach to guiding vegetation management methods and minimizing environmental impacts.
- PAs and related agreements with other agencies including USFWS, USFS, NPS, SHPOs and tribes.
- Long-term cost effectiveness.
- Effect on system reliability and safety.
- Assessment approach.

Within lands actively managed and maintained by TVA, herbicide methods would be the primary tools used to maintain the floor in its existing condition. In general, vegetation within the transmission ROW would be controlled using a mix of approximately 90 percent herbicide, 6 percent mechanical and 4 percent manual methods. The resulting end-state consisting of a mix of herbaceous and low-growing shrub species is more compatible and expected to provide improved habitat value that over time is expected to minimize intensity of floor work. For large public lands (NPS, USFS, etc.) methods would be subject to the terms of any special agreements and authorizations with each agency. Tree removal would be the focus of vegetation management within the transmission ROW where such trees present an immediate hazard to the transmission system. Mechanical and manual methods would be used as the primary tools for controlling or removing such incompatible woody vegetation including trees in the maintained area or in the non-maintained areas of the transmission ROW, or any danger tree that is outside the ROW.

Within lands primarily maintained by others but managed by TVA, it is expected that the approximately 80 percent of floor and buffer areas would be maintained by others using mechanical or manual methods. TVA would perform limited treatments of fence rows, towers, and other areas using primarily herbicide techniques. Additionally, TVA would use mechanical and manual methods as the primary tools for controlling or removing incompatible woody vegetation including trees in the maintained area or in the non-maintained areas of the transmission ROW, or any danger tree outside the ROW.



Method Use in Lands Primarily Maintained by Others

As such, direct impacts to herbaceous plant communities' vegetation with this alternative would continue to exert a recurring impact on plants within the ROW. Such effects would include crushing, damaging, accidental treatment or removal of both target and non-target vegetation. However, because this is part of an existing management program it would not result in in widespread alteration of the overall plant community. Therefore, overall impacts to vegetation are considered to be moderate as the routine maintenance of vegetation would periodically impact plant communities across the broader transmission system, but they would not destabilize the general plant communities of the study area.

As described in the PEIS (TVA 2019), other potential natural resource impacts of this disturbance within the transmission ROW include the following:

- Limited disturbance and erosion of soils resulting from vegetation removal, traffic of maintenance equipment, and localized manual clearing activities.
- Potential for small, localized and short-term alteration of water quality from runoff including residual herbicides and sedimentation through erosion from disturbed surfaces are mitigated by use of O-SAR process and adherence to BMPs.
- Potential for small, localized and short-term effects on aquatic biota are minimized are mitigated by use of O-SAR process and adherence to BMPs to absence of measurable effects.
- Potential removal of bat roost trees.
- Potential inadvertent spraying or damage to listed or sensitive plant species and communities.
- Potential for recruitment of sensitive herbaceous plant species within suitable areas of the transmission ROW
- Potential for increased habitat and support for pollinator species.
- Disturbance and displacement of wildlife (disturbance or removal of habitats).
- Relatively increased long-term habitat quality associated with ROW floor end-state.
- Potential for generation of woody debris that may impede or alter flood flows.
- Potential for reduced frequency of vegetative controls in localized areas of the transmission ROW that are established by inherently more compatible herbaceous and shrub communities.

However, sound planning and the incorporation of TVA's O-SAR process as a BMP measure and the incorporation of other established TVA transmission ROW Management BMPs (TVA 2017a) and established transmission-related environmental protection practices (Appendix H) would minimize the effects to sensitive resources (Appendix K) from this alternative. Each of the above effects would be localized and short-term disturbances that are not expected to result in notable or destabilizing effects on any of the above resources. As such, impacts from this alternative on the natural environment are minor.

Impacts on factors related to the human environment (land use, socioeconomics, air, noise, cultural resources, solid/hazardous waste, public and worker safety, etc.) and landowners/managers (residential, recreational, agricultural, commercial, industrial, NPS, USFS, city, county, and state) specific to this vegetation management approach would occur as a result of the repetitive and intensive maintenance disturbance on the transmission ROW. Periodic recurring vegetation control of the floor would be conducted in conjunction with other vegetation management actions within buffer zones and along the edges of the transmission ROW where danger trees may represent a risk to reliability and safety. The potential impacts of this repeated disturbance within the transmission ROW to elements of the human environment include the following:

- Periodic presence of work crews on private and public lands within project areas.
- Transient movement of equipment and work crews on the associated roadway network.
- Localized air, greenhouse gas and noise emissions from equipment operated within the transmission ROW.
- Visual intrusion of workers and equipment.
- Disturbance of cultural resource sites.
- Periodic intrusions into the immediate viewshed of sacred sites.
- Management of debris.
- Need for access and local coordination efforts with affected landowners.
- Exposure of the public and workers to herbicides and other safety hazards.

Each of the above effects would be localized and short-term and are not expected to result in notable or destabilizing effects on any of the above resources. Additionally, impacts to cultural, historic and TCPs would be minimized by sound planning and the incorporation of mitigation measures such as TVA transmission ROW Management BMPs (TVA 2017a) and the executed Section 106 PA (Appendix E). They also may be minimized by adhering to any conditions or program alternative established in the Section 106 process. As such, impacts from this alternative on the elements of the human environment are minor.

Under this alternative, vegetation maintenance activities within transmission ROWs would continue within the safety-conscious culture in accordance with applicable standards or specific TVA guidance. TVA would continue to address and manage reduction or elimination of public and worker safety hazards through implementation of safety practices, training and control measures. Debris and wastes generated in conjunction with vegetation management would be managed in accordance with federal, state, and local requirements. Worker and public health and safety during vegetation management operations including material transportation would be maintained, and impacts to public health and safety would, in general, be minor.

3.11 Cumulative Impacts

The CEQ regulations (40 CFR 1500-1508) implementing the procedural provisions of the NEPA of 1969, as amended (42 USC 4321 et seq.) define cumulative impact as:

> …the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR § 1508.7).

Baseline conditions reflect the impacts of past and present actions. The impact analyses summarized in preceding sections are based on baseline conditions and either explicitly or implicitly considers cumulative impacts.

3.11.1 Geographic Area of Analysis

The appropriate geographic area over which past, present and future actions could reasonably contribute to cumulative effects is variable and dependent on the resource evaluated. Actions related to vegetation management within the existing transmission corridors vary with respect to location and timing. However, they are unified under this cumulative effects analysis as “similar” actions. Therefore, for this EA cumulative effects analysis TVA’s study area is considered to be the appropriate context for analysis of cumulative effects of TVA vegetation management for most resource areas. The TVA study area is a more than 82,000 square mile area that is inclusive of all areas where TVA maintains transmission ROW.

3.11.2 Identification of “Other Actions”

TVA recognizes that many types of state, private and non-federal activities within the TVA PSA have potential to occur in the foreseeable future, and that these would have varying levels of impact on environmental resources. Such actions may include state highway maintenance and improvement projects, airport operations and expansions, rail development projects, and industrial and mining operations.

Other actions may include routine maintenance and/or improvement of public lands by state and local agencies or an influx of new companies that leads to new infrastructure.

There also could be cumulative effects that result from implementation of a TVA activity or activities that is as yet unforeseen, such as the transfer of land from TVA to another landowner. Under this situation, TVA may or may not know what is planned for the land following the transfer as such potential future development is not reasonably foreseeable. Therefore, the potential impacts cannot be incorporated into this cumulative effects assessment. Future routine operations and including vegetation maintenance activities conducted by TVA have the potential to trigger state, private and non-federal actions. Those actions cannot be identified sufficiently to take them into account in TVA’s analyses other than in the broadest sense. Therefore, for this analysis TVA considered its broader program activities within the study area, coupled with other past and ongoing vegetation maintenance activities (across all land uses) as representing the baseline conditions within the study area. As such this baseline is the predominant and appropriate context for analysis against the proposed vegetation maintenance activities.

3.11.3 Analysis of Cumulative Effects

To address cumulative impacts, the existing affected environment surrounding the proposed action was considered in conjunction with the anticipated environmental impacts as described. Effects to natural and human resources under the Action Alternative would be localized and short-term and are not expected to result in notable or destabilizing effects. TVA would still develop new transmission ROW, resulting in the clearing of additional vegetation, including forests. Future transmission line development would result in additional conversion of forest or tree dominated communities to herbaceous communities. However, because TVA’s transmission line ROWs are linear in nature and spread out over a large geographical area, the construction of future transmission corridors in combination with the proposed vegetation management method would contribute relatively minor impacts when viewed in the context of the study area. In addition, when considered together with other actions in the region, including farming, logging, or industrial/commercial development, vegetation maintenance activities by TVA are not considered to have significant cumulative impacts on natural resources.

3.12 Unavoidable Adverse Impacts

Unavoidable adverse impacts are the effects of the proposed action on natural and human resources that would remain after mitigation measures or BMPs have been applied. Mitigation measures and BMPs are typically implemented to avoid, minimize or compensate for potential environmental impacts. Managing vegetation requires controlling the growth of plants within the transmission ROW, which is an adverse effect. However, this adverse effect is needed to promote the safe, efficient and reliable operation of the existing transmission system. Sound planning, the incorporation of TVA's O-SAR process as a BMP measure, and the incorporation of other established TVA transmission ROW Management BMPs identified in this EA would reduce adverse effects associated with vegetation management practices.

The presence of humans and noise from vegetation maintenance activities has the potential to temporarily disturb wildlife located within the transmission ROW. However, it is anticipated that wildlife would avoid areas when work is underway and TVA employs mitigation measures as described in Section 3.2.2 for specific animals and habitats. These adverse effects would be temporary, short-term and localized.

Additional unavoidable adverse impacts would be dependent on the specific vegetation control method selected. Although each vegetation control method creates unavoidable adverse impacts, TVA considers the environmental setting as well as cost effectiveness in its selection of control method.

With the application of appropriate BMPs and adherence to permit requirements, these unavoidable adverse effects would be minor.

3.13 Relationship of Short-Term Uses to Long-Term Productivity

NEPA requires a discussion of the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. For the purposes of this EA, vegetation maintenance activities including controlling vegetation within TVA transmission line ROWs are considered a short-term use of the environment. Long-term productivity relates to converting the natural productivity of the land to some developed use including transmission lines.

Under the Action Alternative, TVA would manage vegetation height within the transmission ROW. The long-term productivity of lands within TVA transmission ROWs has already been affected by construction of the existing facilities. The use of transmission line ROWs for transmitting power precludes the use of the land for some activities (e.g., mining, timber production) and the implementation of a vegetation management program would not affect long-term productivity.

3.14 Irreversible and Irretrievable Commitments of Resources

A resource commitment is considered irreversible when impacts from its use would limit future use options and the change cannot be reversed, reclaimed, or repaired. Irreversible commitments generally occur to nonrenewable resources such as minerals or cultural resources and to those resources that are renewable only over long time spans, such as soil productivity. A resource commitment is considered irretrievable when the use or consumption of the resource is neither renewable nor recoverable for use by future generations until reclamation is successfully applied. Irretrievable commitments generally apply to the loss of production, harvest, or natural resources and are not necessarily irreversible.

Resources required by vegetation maintenance activities, including labor and fossil fuels for vehicles and equipment, would be irreversibly lost regardless of the alternative selected. However, it is unlikely that their limited use in TVA’s vegetation management program would adversely affect the overall future availability of these resources.

Land and natural resources within TVA’s transmission ROWs were previously committed to uses compatible with safe and reliable electric transmission at the time the transmission lines were constructed. While this commitment is considered to be long-term, it is not irretrievable as transmission lines may be decommissioned and lands re-committed to other uses. Additionally, uses of lands primarily maintained by others would be unaltered with any alternative as the productivity of croplands, orchards and other related lands would not be modified. No new transmission lines would be constructed as part of the No Action or the proposed action alternative. Vegetation management would not impact potential future uses of the land should the transmission lines be removed. Therefore, no additional areas of land or natural resources would be irretrievably committed under any alternative.

CHAPTER 4 – LIST OF PREPARERS

4.1 NEPA Project Management

J. Taylor Cates

Education:	M.S., Environmental Science; B.S., Biochemistry
Project Role:	NEPA Coordinator, NEPA Compliance, Document Preparation
Experience:	5 years in NEPA Compliance and Project Management

Anita E. Masters

Education:	M.S., Biology/Fisheries; B.S., Wildlife Management
Project Role:	NEPA Project Manager, NEPA Coordinator, NEPA Compliance, Document Preparation, and Technical Editor
Experience:	33 years in Project Management, Managing and Performing NEPA Analyses; ESA Compliance; CWA Evaluations; Community/Watershed Biological Assessments

4.2 Other Contributors

Ricky L. Brannon

Education:	M.S., Natural Resources Systems Management; B.S., Ag Science and Natural Resources
Project Role:	Environmental Scientist, Transmission Environmental Support
Experience:	20 years in environmental science, plant and soil science, and natural resources management

Colin Colverson

Education:	B.A., Environmental Policy; J.D.
Project Role:	Counsel
Experience:	11 years of environmental law practice, including NEPA litigation and documents of all varieties

Adam Dattilo

Education:	M.S., Forestry
Project Role:	Vegetation, Threatened and Endangered Plants
Experience:	15 years botany, restoration ecology, threatened and endangered plant monitoring/surveys, invasive species control, as well as NEPA and Endangered Species Act compliance

Christopher Shea Gaither

Education:	B.S., Wildlife and Fisheries Management
Project Role:	Environmental Scientist, Transmission Environmental Support
Experience:	20 years fisheries biology, monitoring/surveys, erosion control, streambank restoration

Brenda Lee Hall

Education:	B.S., Civil Engineering
Project Role:	Sr. Manager, Transmission ROW
Experience:	23 years in Transmission utility including 2 years in Right-of-Way

Kim Pilarski-Hall

Education:	M.S., Geography, Minor Ecology
Project Role:	Natural Areas
Experience:	21 years expertise in wetland assessment, wetland monitoring, watershed assessment, wetland mitigation, restoration as well as NEPA and Clean Water Act compliance

Elizabeth B. Hamrick

Education:	M.S., Wildlife and B.S. Biology
Project Role:	Terrestrial Ecology (Animals), Terrestrial Threatened and Endangered Species
Experience:	18 years conducting field biology, 12 years technical writing, 9 years compliance with NEPA and ESA.

Michaelyn Harle

Education:	Ph.D., Anthropology
Project Role:	Archaeologist
Experience:	16 years in archaeology and cultural resources management

Britta P. Lees

Education:	M.S., Botany-Wetlands Ecology Emphasis; B.A., Biology
Project Role:	Wetlands
Experience:	18 years in Wetlands Assessments, Botanical Surveys, Wetlands Regulations, and/or NEPA Compliance

Craig L. Phillips

Education:	M.S., and B.S., Wildlife and Fisheries Science
Project Role:	Aquatic Ecology; Threatened and Endangered Aquatic Animals
Experience:	15 years Sampling and Hydrologic Determinations for Streams and Wet-Weather Conveyances; 10 years in Environmental Reviews

A. Chevales Williams

Education:	B.S., Environmental Engineering
Project Role:	Surface Water and Soil Erosion
Experience:	16 years of experience in water quality monitoring and compliance; 14 years in NEPA planning and environmental services

CHAPTER 5 – LITERATURE CITED

Allan, J.D. and M.M. Castillo. 2007. Stream Ecology: Structure and Function of Running Waters. Springer Science & Business Media.

American National Standards Institute (ANSI). 2012. American National Standard for Tree Care Operations – Tree, Shrub, and Other Woody Plant Management Standard Practices (IVM 1. Utility Rights-of-way). ANSI A300 (Part 7)-2012.

Anderson, D. G. and L. P. Sullivan. 2013. Tennessee Archaeology: A Synthesis. Retrieved from https://anthropology.utk.edu/tennessee_archaeology-a_synthesis/ (accessed December 2017).

Annett, R., H.R. Habibi, and A. Hontela. 2014. Impact of Glyphosate and Glyphosate-Based Herbicides on the Freshwater Environment. Journal of Applied Toxicology, 34(5): 458-479.

Birnbaum, C. A. 1996. Protecting Cultural Landscapes: Planning, Treatments and Management of Historic Landscapes.

Cornell Lab of Ornithology. 2019. All About Birds. Cornell Lab of Ornithology, Ithaca, New York. https://www.allaboutbirds.org Accessed on July 9, 2020.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deep Water Habitats of the United States. U.S. Fish and Wildlife Service.

Davis, R.P. Stephen, Jr. 1990. Aboriginal Settlement Patterns in the Little Tennessee River Valley. Publications in Anthropology No. 54. Tennessee Valley Authority, Knoxville.

Dennis, S.D. 1984. Distributional Analysis of the Freshwater Mussel Fauna of the Tennessee River System, with Special Reference to Possible Limiting Effects of Siltation. Dissertation. Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

EPA (U.S. Environmental Protection Agency). 2017a. Ecoregions of North America. Retrieved from https://www.epa.gov/eco-research/ecoregions-north-america (accessed June 2020).

_____. 2017b. Current Nonattainment Counties for All Criteria Pollutants. Retrieved from https://www3.epa.gov/airquality/greenbook/ancl.html#TN (accessed June 2020).

_____. 2017b. Wetlands Classification and Types. Retrieved from https://www.epa.gov/wetlands/wetlands-classification-and-types#marshes (accessed June 2020).

Etnier, D.A. and W.C. Starnes. 1993. The Fishes of Tennessee. University of Tennessee Press. Knoxville, Tennessee.

Faulkner, C. H. 2002. Woodland Cultures of the Elk and Duck River Valleys, Tennessee: Continuity and Change. In: *The Woodland Southeast, edited by D. G. Anderson and R.C. Mainfort, Jr., pp. 185-203*. The University of Alabama Press, Tuscaloosa.

Federal Geographic Data Committee (FGDC). 2013. Classification of Wetlands and Deepwater Habitats of the United States. FGDC-STD-004-2013. Second Edition. Wetlands Subcommittee, Federal Geographic Data Committee and U.S. Fish and Wildlife Service, Washington, DC.

Gregory, S.V., F.J. Swanson, W.A. McKee, and K.W. Cummins. 1991. An Ecosystem Perspective of Riparian Zones. BioScience 41(8): 540-551. Hubbert, K.R.; M. Busse, S. Overby, C. Shestak, R. Gerrard. 2015.

Gremillion, K. J. 1996. Early Agricultural Diet in Eastern North America: Evidence from Two Kentucky Rockshelters. American Antiquity 61:520-536.

Harle, M. S., S. D. Koerner, and B. R. Braly. 2013. The Late Mississippian Period (A.D. 1350-1500) – Draft. In *Tennessee Archaeology: A Synthesis, edited by D. G. Anderson and L. P. Sullivan. Electronic document*, Retrieved from http://web.utk.edu/~anthrop/research/TennesseeArchaeology/.

Hudson, C. 2002. Introduction. The Transformation of the Southeastern Indians 1540-1760, edited by Robbie Ethridge and Charles Hudson, pp. 3-20. The University Press of Mississippi, Jackson.

Justice, N. D. 1987. Stone Age Spear and Arrow Points of the Midcontinental and Eastern United States. Indiana University Press, Bloomington.

Kays, J.S., and C.D. Canham. 1991. Effects of Time and Frequency of Cutting on Hardwood Root Reserve and Sprout Growth. Forest Science 37(2): 524-539.

Lewis, T.M. and M. Kneberg. 1995. Prehistory of the Chickamauga Basin in Tennessee. Edited by Lynne P. Sullivan. Tennessee Anthropological Papers 1. Department of Anthropology, University of Tennessee, Knoxville.

McDonough, T.A. and G.D. Hickman. 1999. Reservoir Fish Assemblage Index Development: a Tool for Assessing Ecological Health in Tennessee Valley Authority impoundments in *Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities.* T.P. Simon (Ed.). CRC Press: 523-540 pp.

Meyer, J.L., D.L. Strayer, J.B. Wallace, S.L. Eggert, G.S. Helfman, and N.E. Leonard. 2007. The Contribution of Headwater Streams to Biodiversity in River Networks. Journal of the American Water Resources Association 43(1): 86-103.

National Geographic. 2002. Field Guide to the Birds of North America (Fourth Edition). National Geographic Society, Washington D.C. 480 pp.

NatureServe. 2020. NatureServe Explorer: An Online Encyclopedia of Life. Arlington, VA. U.S.A. Retrieved from http://explorer.natureserve.org (accessed July 10, 2020).

Neves, R.J. 1999. Conservation and Commerce: Management of Freshwater Mussel (Bivalvia: Unionoidea) Resources in the United States. Malacologia 41(2): 461-474. Retrieved from https://www.researchgate.net/publication/279908881_Conservation_and_Commerce_Management_of_Freshwater_Mussel_Bivalvia_Unionoidea_Resources_in_the_United_States (accessed December 2017).

North Carolina State University-Water Quality Group. 1976. Benthic Macroinvertebrates. Retrieved from http://www.water.ncsu.edu/watershedss/info/macroinv.html (accessed December 2017).

Noss, R. F. 2013. Forgotten Grasslands of the South: Natural History and Conservation. Island Press.

Omernik, J. M. 1987. Ecoregions of the Conterminous United States. Annals of the Association of American Geographers.

Parker, P. and T. King. 1998. (revised) Guidelines for Evaluation and Documenting Traditional Cultural Properties. National Register Bulletin N. 38.

Parmalee, P.W. and A.E. Bogan. 1998. The Freshwater Mussels of Tennessee. University of Tennessee Press, Knoxville.

Petranka, J. W. 1998. Salamanders of the United States and Canada. Smithsonian Press, Washington. 587 pp.

Powell, R., R. Conant, and J. T. Collins. 2016. Field Guide to Reptiles and Amphibians of Eastern and Central North America (Fourth Edition). Peterson Field Guide, Houghton Mifflin Harcourt, Boston, Massachusetts. 494 pp.

Rolando, C.A., B.R. Baillie, D.G. Thompson, and K.M. Little. 2017. The Risks Associated with Glyphosate-Based Herbicide Use in Planted Forests. Forests 8(6): 208.

Samoray, Steve. 2011. 2011 White-nose Syndrome Monitoring and Bat Population Survey of Hibernacula in Tennessee. Prepared by: Steve Samoray for The Tennessee Chapter of The Nature Conservancy.

Sassaman, K. E. 1996. Technological Innovations in Economic and Social Contexts. In Archaeology of the Mid-Holocene Southeast, edited by K.E. Sassaman and D.G. Anderson, pp. 57-74. University of Florida Press, Gainesville.

Scarbrough, S.L., C.R. Jackson, S. Marchman, G. Allen, J. Louch, and M. Miwa. 2015. Herbicide Concentrations in First-Order Streams after Routine Application for Competition Control in Establishing Pine Plantations. Forest Science 61(3): 604-612.

Schilling, E. M. and J. D. Williams. 2002. Freshwater Mussels (Bivalvia: Margaritiferidae and Unionidae) of the Lower Duck River in Middle Tennessee: A Historic and Recent Review. Southeastern Naturalists 1(4):403-414.

Schlosser, I.J. 1987. A Conceptual Framework for Fish Communities in Small Warmwater Streams. In: *Community and Evolutionary Ecology of North American Stream Fishes, W.J. Matthews, and D.C. Heins (Eds.)*. University of Oklahoma Press, Norman, Oklahoma, pp. 17-32.

Scott, A. F. and W. H. Redmond. 2019. Atlas of Reptiles in Tennessee. The Center for Field Biology. Austin Peay State University. Clarksville, Tennessee. Available at https://www.apsubiology.org/tnreptileatlas/.

Sickel, J.B., M.D. Burnett, C.C. Chandler, C.E. Lewis, H.N. Blalock-Herod, and J.J. Herod. 2007. Changes in the Freshwater Mussel Community in the Kentucky Portion of Kentucky Lake, Tennessee River, since Impoundment by Kentucky Dam. Journal of Kentucky Academy of Science 68(1): 68-80.

Smith, M. T. 2002. Aboriginal Population Movements in the Postcontact Southeast. In The Transformation of the Southeastern Indians 1540 to 1760, edited by Robbie Etheridge and Charles Hudson, pp. 3-20. University Press of Mississippi, Jackson.

Tatum, V.L., C.R. Jackson, M.W. McBroom, B.R. Baillie, E.B. Schilling, and T.B. Wigley. 2017. Effectiveness of Forestry Best Management Practices (BMPs) for Reducing the Risk of Forest Herbicide Use to Aquatic Organisms in Streams. Forest Ecology and Management 404: 258-268.

Tennessee Valley Authority (TVA). 1997. *Line Maintenance, Right-of-way, and Inspections.* Tennessee Valley Authority. Transmission Operations and Maintenance Transmission Support. Chattanooga, Tennessee.

_____. 2004. Final Programmatic Environmental Impact Statement for the Reservoir Operations Study. Knoxville, Tennessee.

_____. 2008. Power System Operations. Line Maintenance Manual. TOM-LLM-6-ROW-001, Right of Way Maintenance. Revision 0000. Level o0f Use: Reference Use.

_____. 2011a. Final Environmental Impact Statement. Natural Resource Plan, Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee, and Virginia. July 2011.

_____. 2011b. Natural Resource Plan. Knoxville, Tennessee. Retrieved from https://www.tva.gov/file_source/TVA/Site%20Content/Environment/Environmental%20Stewardship/Environmental%20Reviews/NRP/nrp_complete.pdf (accessed December 2017).

_____. 2015. Integrated Resource Plan 2015 Final Supplemental Environmental Impact Statement Volume 1- Main Text. July 2015. Knoxville, Tennessee. Retrieved from https://tva.com/Environment/Environmental-Stewardship/Integrated-Resource-Plan (accessed October 2016).

______. 2017a. A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Construction and Maintenance Activities, Revision 3. Edited by G. Behel, S. Benefield, R. Brannon, C. Buttram, G. Dalton, C. Ellis, C. Henley, T. Korth, T. Giles, A. Masters, J. Melton, R. Smith, J. Turk, T. White, and R. Wilson. Chattanooga, TN. Retrieved from https://tva-azr-eastus-cdn-ep-tvawcm-prd.azureedge.net/cdn-tvawcma/docs/default-source/energy/transmission/a-guide-for-environmental-protection-and-best-management-practices-for-tva-construction-and-maintenance-activities.pdf?sfvrsn=60c6b80d_2 (accessed June 2020).

______. 2017b. Programmatic Biological Assessment for Evaluation of the Impacts of Tennessee Valley Authority's Routine Actions on Federally Listed Bats. September 2017.

______. 2019. Transmission System Vegetation Management: Final Programmatic Environmental Impact Statement. Chattanooga, TN. Retrieved from https://www.tva.com/environment/environmental-stewardship/environmental-reviews/nepa-detail/Transmission-System-Vegetation-Management-Program (accessed July 2020).

______. 2020. Transmission: Current TVA Transmission System Projects – Related Guidelines and Specifications. https://www.tva.com/energy/transmission.

Thorp, J.H. and A. P. Covich. 2001. Ecology and Classification of North American Freshwater Invertebrates. Academic Press, New York, New York.

Tiner, R.W. 1997. NWI Maps: What They Tell Us. National Wetlands Newsletter 19(2): 7-12.

Tennessee Wildlife Resources Agency. 2020. Tri-colored Bat, Perimyotis subflavus. Retrieved from <https://www.tn.gov/twra/wildlife/mammals/mammals-bats/tri-colored-bat.html> (accessed July 2020).

United South and Eastern Tribes. 2007. Sacred Ceremonial Stone Landscapes found in the Ancestral Territories of USET member Tribes. 2007:037. https://www.usetinc.org/resources/resolutions/culture-heritage/ (accessed June 2029).

U.S. Fish and Wildlife Service (USFWS). 1977-2017. National Wetlands Inventory website. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. http://www.fws.gov/wetlands/.

______. 2015. Threatened Species Status for *Platanthera integrilabia* (White Fringeless Orchid): Proposed rule. 80 FR 55304 55321.

______. 2017a. Information for Planning and Consultation (IPaC). Retrieved from https://ecos.fws.gov/ipac/ (accessed July 2020).

Warren, N., I.J. Allan, J.E. Carter, W.A. House, and A. Parker. 2003. Pesticides and Other Micro-organic Contaminants in Freshwater Sedimentary Environments—a Review. Applied Geochemistry 18(2): 59-194.

Warrington, B.M., W.M. Aust, S.M. Barrett, W.M. Ford, C.A. Dolloff, E.B. Schilling, T.B. Wigley, and M.C. Bolding. 2017. Forestry Best Management Practices Relationships with Aquatic and Riparian Fauna: A Review. Forests, 8(9): 331.

Weakley, A.S. and M. P. Schafale. 1994. Non-alluvial wetlands of the southern Blue Ridge: Diversity in a threatened ecosystem. Water, Air, and Soil Pollution 77:359-383.

Webb, William S. 1939. An Archaeological Survey of the Wheeler Basin on the Tennessee River in Northern Alabama. Smithsonian Institution Bureau of American Ethnology, Bulletin 122. United States Government Printing Office, Washington, D.C.

Wegner, K.F. 1953. The Sprouting of Sweetgum in Relation to Season of Cutting and Carbohydrate Content. Plant Physiology 28(1): 35-49.

Appendix A – *TVA v. Sherwood* Injunction Order

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TENNESSEE

DONNA W. SHERWOOD, et al.,	)	
	)	
Plaintiffs,	)	
	)	
v.	)	No.: 3:12-CV-156-TAV-HBG
	)	
TENNESSEE VALLEY AUTHORITY,	)	
	)	
Defendant.	)	

INJUNCTION ORDER

For the reasons discussed in the Memorandum Opinion and Order entered contemporaneously with this Injunction Order, and for good cause being shown, it is hereby ordered, adjudged, and decreed as follows:

IT IS ORDERED that TVA is **ENJOINED** from further implementing the transmission line right-of-way vegetation management practice that has come to be known in this litigation as the "15-foot rule" until TVA has prepared and published an environmental impact statement pursuant to the National Environmental Policy Act ("NEPA"), 42 U.S.C. §§ 4321–4370m12. TVA shall submit a request for dissolution of the injunction after completion of the procedural steps necessary to comply with NEPA. Plaintiffs will then have the opportunity to state their position with respect to the dissolution of the injunction.

IT IS FURTHER ORDERED that the terms of this injunction will remain in effect until the Court grants TVA's request for dissolution of the injunction.

IT IS FURTHER ORDERED that TVA will maintain buffer zones on the edges of its rights-of-way as described in TVA's 1997 and 2008 Line Maintenance Manuals:

a. When re-clearing 500-kV transmission lines on ROWs that are 200 feet wide, TVA will re-clear 150 feet, that is, 75 feet from centerline to outside edges, leaving a 25-foot buffer zone on each side.

b. On the more recently purchased 500-kV transmission line ROWs where 175 feet is all that is purchased, TVA will re-clear 150 feet, that is, 75 feet from centerline to outside edges, leaving a 12.5-foot buffer zone on each side.

c. When re-clearing 161-kV transmission lines, the structure type and height will determine the width.

i. On multiple-pole structures and single- and double-circuit steel tower lines where TVA has 150 feet of easement, TVA will re-clear 100 feet, that is, 50 feet from centerline to outside edges, leaving a 25-foot buffer zone on each side. Where TVA only has 100 feet of ROW, the entire 100 feet is re-cleared.

ii. On lines that utilize single-pole structures where TVA has an easement of 75 feet, the entire 75 feet will be re-cleared.

iii. On 69-kV transmission lines, re-clearing will be accomplished.

d. On easements with multiple transmission lines, the "centerline to outside edges" will apply to the transmission line nearest the outside boundary.

TVA will leave the existing trees in the wire zone so long as they do not pose an immediate hazard to the transmission lines.

TVA may remove or trim any trees in the wire zone of the right-of-way, or in the buffer zones of the right-of-way, or any danger tree outside the right-of-way, in accordance with its contract rights, that it deems to present an immediate hazard to its transmission lines.

In using the term "re-clearing" in this Order the Court is simply utilizing the terminology that TVA has used in its Line Maintenance Manuals and is making no determination as to whether TVA either has or has not cleared the right-of-way previously.

IT IS FURTHER ORDERED that where TVA has previously allowed a given landowner to trim his or her own trees, TVA shall continue to do so, except that TVA will have the right to immediately remove or trim any tree that it deems to present an immediate hazard to its transmission lines.

The Court accepts TVA's representations that it has budgeted $15 million for its yearly vegetation management and $14 million for vegetation management during Fiscal Year 2018 through 2020. TVA shall report its quarterly and cumulative annual spending levels to plaintiffs when those figures are reasonably available through its accounting department.

IT IS FURTHER ORDERED that TVA shall post a copy of this Order and any subsequent substantive Order in a prominent location on its website to inform the public and in particular the landowners on the right-of-way that TVA has been enjoined from further implementing the 15-foot rule, and to inform the public and landowners as to the practices that TVA is being ordered to follow pursuant to this Order.

IT IS FURTHER ORDERED that TVA is required to pay plaintiffs' reasonable attorney's fees and costs in this litigation related to the NEPA and mootness issues pursuant to the Equal Access to Justice Act ("EAJA") with reasonableness to be determined by the Court in accordance with the EAJA if the parties cannot agree on the amount.

TVA will inform the Court within **thirty (30) days** after entry of this Order of the measures taken to inform TVA employees and contractors involved in transmission line right-of-way vegetation management of the terms of this injunction.

If a party seeks to modify any provision of the injunction, the parties must first meet and confer, in order to attempt to reach agreement before applying to the Court.

The Court retains continuing jurisdiction to enforce this Order through contempt or otherwise, to clarify the injunction should the need arise, to determine whether the injunction should be dissolved, and for such other proceedings as may be appropriate.

IT IS SO ORDERED.

s/ Thomas A. Varlan
CHIEF UNITED STATES DISTRICT JUDGE

Appendix B – Federal and State Agencies, and Federally Recognized Native American Tribes Represented in the TVA Power Service Area

AGENCIES AND TRIBAL RECIPIENTS OF THE PROGRAMMATIC TRANSMISSION SYSTEM VEGETATION MANAGEMENT ENVIRONMENTAL IMPACT STATEMENT

Following is a list of the federal and state agencies, and federally recognized Native American tribes represented in the TVA power service area who received copies of the Transmission System Vegetation Management EIS (PEIS) or notices of its availability with instructions on how to access the PEIS on the project web page.

Federal Agencies

USDA Forest Service, Region 8, Atlanta, GA
U.S. Environmental Protection Agency, Washington, DC
U.S. Environmental Protection Agency, Region 4, Atlanta, GA
Department of Interior, Atlanta, GA
U.S. Fish and Wildlife Service, Southeast Region Office, Atlanta, GA
U.S. Fish and Wildlife Service, Frankfort, KY
U.S. Fish and Wildlife Service, Asheville, NC
U.S. Fish and Wildlife Service, Abingdon, VA
U.S. Fish and Wildlife Service, Cookeville, TN
U.S. Fish and Wildlife Service, Gloucester, VA
U.S. Fish and Wildlife Service, Daphne, AL
U.S. Fish and Wildlife Service, Athens, GA
U.S. Army Corps of Engineers, Savannah District
U.S. Army Corps of Engineers, Nashville District
U.S. Army Corps of Engineers, Memphis District
U.S. Army Corps of Engineers, Wilmington District
U.S. Army Corps of Engineers, Vicksburg District
U.S. Army Corps of Engineers, Mobile District
Economic Development Administration, Atlanta, GA
Advisory Council on Historic Preservation

Federally Recognized Tribes

Cherokee Nation
Eastern Band of Cherokee Indians
United Keetoowah Band of Cherokee Indians in Oklahoma
The Chickasaw Nation
Muscogee (Creek) Nation of Oklahoma
Poarch Band of Creek Indians
Alabama-Coushatta Tribe of Texas
Alabama-Quassarte Tribal Town
Kialegee Tribal Town
Thlopthlocco Tribal Town
Choctaw Nation of Oklahoma
Jena Band of Choctaw
Mississippi Band of Choctaw
Seminole Tribe of Florida
Seminole Nation of Oklahoma
Absentee Shawnee Tribe of Oklahoma
Eastern Shawnee Tribe of Oklahoma
Shawnee Tribe

State Agencies

Alabama
Department of Agriculture and Industries
Department of Conservation and Natural Resources
Department of Economic and Community Affairs
Department of Environmental Management
Department of Transportation
Alabama Historic Commission
Top of Alabama Regional Council of Governments
North-Central Alabama Regional Council of Governments
Northwest Alabama Council of Local Governments

Georgia
Georgia State Clearinghouse
Historic Preservation Division

Kentucky
Department for Local Government
Department for Environmental Protection
Energy and Environment Cabinet
Department for Energy Development and Independence
Department for Natural Resources
Kentucky Heritage Council

Mississippi
Northeast Mississippi Planning and Development District
Department of Finance and Administration
Department of Environmental Quality
Department of Wildlife, Fisheries, and Parks
Historic Preservation Division

North Carolina
North Carolina State Clearinghouse
Office of Archives and History

Tennessee
Department of Environment and Conservation
Office of Policy and Planning
Tennessee Historical Commission
Tennessee Wildlife Resources Agency
First Tennessee Development District
East Tennessee Development District
Southeast Tennessee Development District
Upper Cumberland Development District
South Central Tennessee Development District
Greater Nashville Regional Council
Southwest Tennessee Development District
Memphis Area Association of Governments
Northwest Tennessee Development District

Virginia
Office of Environmental Review
Department of Historic Resources

Appendix C – Agency Correspondence and Consultation on Federally Listed Bat Species on Routine TVA Actions

United States Department of the Interior

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

April 12, 2018

Ms. Holly LeGrand
Program Manager, Endangered Species Policy
Tennessee Valley Authority
400 West Summit Hill Drive, WTK11-C
Knoxville, TN 37902-1499

Subject: Biological Opinion - Evaluation of impacts of Tennessee Valley Authority's Routine Actions on Four Federally Listed Bats, FWS Log #: 04ET1000-2018-F-0017.

Dear Ms. LeGrand:

This letter transmits the enclosed biological opinion (BO) of the U.S. Fish and Wildlife Service (Service) for the Evaluation of the Impacts of Tennessee Valley Authority's (TVA) Routine Actions on Four Federally Listed Bats (the Action). The TVA proposes to implement ten overarching actions and 96 routine activities in 1.015-million acres throughout its 82.8-million acre service area. On October 2, 2017, we received your letter requesting formal consultation for the Action, and associated Biological Assessment. You determined that the Action is likely to adversely affect the federally endangered Indiana bat (*Myotis sodalis*) and federally threatened northern long-eared bat (*Myotis septentrionalis*).

You also determined that the Action is not likely to adversely affect the gray bay (*Myotis grisescens*), Virginia big-eared bat (*Corynorhinus townsendii virginianus*), and designated critical habitats for the Indiana bat. The Service previously concurred with these determinations by letter dated March 8, 2018.

The enclosed BO answers your request for formal consultation, and concludes that the Action is not likely to jeopardize the continued existence of the species listed above. This finding fulfills the requirements applicable to the Action for completing consultation under §7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended.

The BO includes an Incidental Take Statement that requires the TVA to implement reasonable and prudent measures that the Service considers necessary or appropriate to minimize the impacts of anticipated taking on the listed wildlife species. Incidental taking of listed wildlife species that is compliance with the terms and conditions of this statement is exempted from the prohibitions against taking under the ESA.

Reinitiating consultation is required if the TVA retains discretionary involvement or control over the Action (or is authorized by law) when:

a. the amount or extent of incidental take is exceeded;
b. new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;
c. the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
d. a new species is listed or critical habitat designated that the Action may affect.

A complete administrative record of this consultation is on file at the Tennessee Field Office. If you have any questions about the BO, please contact Todd Shaw by phone at 931/525-4985 or via email at *ross_shaw@fws.gov*.

Sincerely,

Robert W. Tawes
Acting Field Supervisor

Enclosure: Biological Opinion - Evaluation of the Impacts of Tennessee Valley Authority's Routine Actions on Four Federally Listed Bats

Biological Opinion

Programmatic Strategy for Routine Actions that May Affect Endangered or Threatened Bats

FWS Log #: 04ET1000-2018-F-0017

Prepared by:

U.S. Fish and Wildlife Service
Tennessee Ecological Services Office
446 Neal Street
Cookeville, Tennessee 38501

4/12/18

Robert Tawes, Acting Field Supervisor   Date

TABLE OF CONTENTS

CONSULTATION HISTORY

This section lists key meetings and correspondence (events) during the course of this consultation. A complete administrative record of this consultation is on file in the Service's Tennessee Ecological Services Field Office (TNFO).

Date	Event	Participants	Discussion Topic
Sept. 23, 2014	TVA Office, Knoxville, TN/Conference call	Staff from TVA, Service SE Region Office (RO), and TN FO	Discussion on development of a region-wide programmatic consultation (*e.g.*, pros/cons, components, limitations, time frame).
Jan. 23, 2015	TVA office, Knoxville, TN	Staff from TVA and TN FO	Initiation of informal programmatic consultation
Feb. 10, 2015	Conference call	TVA staff; Service SE and Midwest ROs and TN FO staff	Framework and aspects in development of modeling approach to determine potential presence of Indiana bat and northern long-eared bat within TVA's Action Area.
Apr. 22, 2015	Conference call	Staff from TVA and TN, NC, KY, AL, MS, GA, and VA FOs	TVA shared focus and framework, discussion on what to focus on moving forward.
July 22, 2015	TN FO, Cookeville, TN/Conference call	Staff from TVA, Service SE RO, and TN, AL, KY, and MS FOs	Status Meeting (discussed routine actions, acreage estimates, data/modeling, avoidance and minimization measures).
Aug. 20, 2015	TVA Office, Knoxville, TN	TVA staff; Geographic information system (GIS) staff from TN and NC FOs	GIS Modeling and Analysis.
Dec. 16, 2015	GA FO, Athens, GA	TVA staff; staff from GA FO	Overview, status, and questions and answers regarding consultation with GA FO staff.
Jan. 6, 2015	TN FO, Cookeville, TN	TVA staff; TN FO staff	Checkpoint.
Jan. 14, 2016	Service SE RO, Atlanta, GA	TVA staff; staff from Service SE RO and TN FO	Overview and status.
Jan. 22, 2016	E-mail correspondence	TVA staff; TN FO staff	Provided BA Chapters 1-2 for Service review.
Feb. 1, 2016	TVA Office, Chattanooga, TN	TVA staff; AL FO staff	Overview, status, and questions and answers regarding consultation with AL FO staff.

Date	Event	Participants	Discussion Topic
Feb. 16, 2016	MS FO, Jackson, MS / Conference call	TVA staff; MS FO staff	Overview, status, and questions and answers of consultation with MS FO staff.
Feb. 22, 2016	KY FO, Frankfort, KY / Conference call	TVA staff; KY FO staff	Overview, status, and questions and answers of consultation with KY FO staff.
June 18, 2017	E-mail correspondence	TVA staff; staff in Service SE RO, AL, GA, TN, MS, KY, NC, and VA FOs	TVA provided draft BA for final review and comments to the Service SE RO and AL, GA, TN, MS, KY, NC, and VA FOs.
June 30, 2017	E-mail correspondence	TVA staff; staff in Service SE RO, and AL, GA, MS, KY, NC, TN, and VA FOs	TN FO forwarded request to staff in Service SE RO, and AL, GA, MS, KY, NC, and VA FOs by July 19, 2017.
July 17, 2017	E-mail correspondence	TN FO staff; TVA staff	TN FO sent e-mail to TVA indicating that additional time was needed for Service SE RO, and AL, GA, MS, KY, NC, TN and VA FOs review and comments of draft BA; the RO and FOs agreed to provide comments to the TN FO by August 4, 2017. The TN FO indicated to TVA that comments would be provided to TVA by August 21, 2017.
Aug. 11, 2017	E-mail correspondence	TVA staff; staff in Service SE RO, and AL, GA, MS, KY, NC, TN, and VA FOs	TVA sent e-mail to SE RO, and AL, GA, MS, KY, NC, TN, and VA FOs indicating that they would hold a conference call from the TN FO on September 15, 2017, to address comments submitted on draft BA.
Sept. 7, 2017	TN FO, Cookeville	TVA staff, TN FO staff	TVA held meeting with TN FO staff to discuss comments provided by KY, NC, TN, and VA FOs review of draft BA.
Sept. 15, 2017	Conference call	TVA staff, staff in Service SE RO, AL, GA, TN, MS, KY, NC, and VA FOs	TVA addressed comments submitted by FOs regarding the draft BA.
Sept. 15 – Oct. 1, 2017	E-mail correspondence, Phone calls	TVA staff, staff in KY, NC, and VA FOs	TVA continued coordinating with KY, NC, and VA FOs to further address their questions and comments on the draft BA.

Date	Event	Participants	Discussion Topic
Oct. 2, 2017	Mail	TVA staff, TN FO staff	TVA provided hard copy of final BA to TN FO.
Oct. 13, 2017	E-mail correspondence	TVA staff, TN FO staff	TVA provided electronic copy of final BA to TN FO.
Oct. 13, 2017	Mail	TN FO staff, TVA staff	The TN FO initiated formal consultation and indicated that the final subject programmatic biological opinion would be provided to TVA no later than Feb. 28, 2018.

BIOLOGICAL OPINION

1. INTRODUCTION

A Biological opinion (BO) is the document that states the opinion of the U.S. Fish and Wildlife Service (Service) under the Endangered Species Act (ESA) of 1973, as amended, as to whether a Federal action is likely to:

- jeopardize the continued existence of species listed as endangered or threatened; or
- result in the destruction or adverse modification of designated critical habitat.

The Federal action addressed in this BO is the Tennessee Valley Authority's (TVA) proposed programmatic strategy for routine actions that may affect endangered and threatened bats (the Action). TVA provided a Biological Assessment (BA) for the Action, which described how 10 overarching actions and 96 routine activities that TVA authorizes, funds, or carries out, may affect ESA-listed bats and their designated critical habitat during the next 20 years. The BA does not address the effects of the 96 routine activities on other listed species and critical habitats, and these activities are subject to the consultation requirements of ESA §7(a)(2). As necessary, TVA must consider the effects of these activities on other listed species and critical habitats through additional programmatic or project-level consultations.

The TVA determined that 21 of the 96 routine activities have no effect on the listed bat species or their critical habitat. Unless these activities may affect other listed species and critical habitat, consultation is not required. The TVA determined that the other 75 routine activities may affect, but are not likely to adversely affect, the gray bat, Virginia big-eared bat, and designated critical habitat for the Indiana bat (Ibat). Of these 75 activities, TVA determined that 72 (all but 3) may affect, but are not likely to adversely affect, the Ibat and northern long-eared bat (NLEB). By letter dated March 8, 2018, the Service concurred with TVA's "not likely to adversely affect" determinations, which concluded the consultation relative to these species, critical habitats, and activities. Until new information warrants a reinitiation of the consultation that supported these activity-specific findings, projects that are fully consistent with the activity description in the BA do not require further consultation with the Service regarding the species and critical habitats for which the Service provided programmatic concurrence. TVA proposes to report annually all project-level activities that complied with ESA §7(a)(2) by relying on the programmatic consultation.

Accordingly, this BO is limited in scope to evaluating the effects of the three proposed routine activities that TVA determined are likely to adversely affect the Ibat and the NLEB. The Action does not affect, or is not likely to adversely affect, any designated critical habitat for listed bat species; therefore, this BO does not further address critical habitat.

A BO evaluates the effects of a Federal action along with those resulting from interrelated and interdependent actions, and from non-Federal actions unrelated to the proposed Action (cumulative effects), relative to the status of listed species and the status of designated critical habitat. A Service opinion that concludes a proposed Federal action is *not* likely to jeopardize species and is *not* likely to destroy or adversely modify critical habitat fulfills the Federal agency's responsibilities under §7(a)(2) of the ESA. "*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

2. PROPOSED ACTION

TVA proposes a Bat Programmatic Strategy (the Action) to streamline the manner in which the agency fulfills its responsibilities under ESA §7 relative to ESA-listed bat species. TVA's BA for the Action describes various routine activities that may affect listed bat species and the conservation measures that TVA will apply to avoid and minimize adverse effects. The BA also describes various ongoing activities, such as monitoring, habitat enhancement, and public education, that promote the recovery of one or more listed bat species. Addressing these activities programmatically is intended to promote consistency, predictability, and efficiency of project-level consultations, and to more effectively address the conservation needs of listed bats at local and landscape scales.

The Action is comprised of 96 routine activities under the following 10 general action categories that TVA authorizes, funds, or carries out:

1) manage for biodiversity and public use;
2) protect cultural resources;
3) manage land use and disposal;
4) manage permitting under section 26a of the TVA Act;
5) operate, maintain, retire, construct, and expand power plants;
6) maintain existing transmission line assets;
7) convey electric transmission property;
8) expand or construct new transmission assets;
9) promote economic development; and
10) promote solar sites.

The Action does *not* include activities associated with:

- construction of, or purchase of power from, a wind farm;
- utility-scale solar projects (*i.e.,* projects that generate and feed solar power directly into the grid, supplying a utility with energy);
- TVA's ownership of mineral reserves; and
- nuclear power plant relicensing (the Nuclear Regulatory Commission typically serves as lead agency).

Of the 96 routine activities that occur under the 10 general action categories listed above, TVA determined that 75 may affect listed bats or their designated critical habitats. Of these 75 activities, only three are likely to adversely affect the Ibat or NLEB:

1) removal of hazardous trees or tree branches (Activity #33);
2) mechanical vegetation removal that includes trees or tree branches 3 inches or greater in diameter (Activity #34); and
3) prescribed burns (Activity #23);

In this BO, we do not further address the 93 activities described for the Action that TVA determined have no effect on, or are not likely to adversely affect, listed bats or their critical habitat. The scope of the BO is limited to the three activities listed above that are likely to adversely affect the Ibat and NLEB, and to the proposed conservation actions that are relevant to these species. Because the effects of hazardous tree removal and other tree removal on bats are similar, we combine these two activities in our description of the proposed action in section 2.2 and in our effects analyses.

The BA estimates the spatial extent of tree removal and prescribed burning activity during a calendar year and cumulatively over the next 20 years (2018–2037), but does not identify the location or timing of such activity at the project level. In the context of consultation under ESA §7(a)(2), the Action is consistent with the regulatory definition at 50 CFR §402.02 of a "framework programmatic action," which is a Federal action that approves a framework for the development of future actions that are authorized, funded, or carried out at a later time, and are subject to further consultation.

2.1. Action Area

For purposes of consultation under ESA §7, the action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.02). The 96 activities of the programmatic Action will occur on lands associated with the 10 general action categories listed in the previous section. Table 2-1 reports the ownership, approximate total acreage, and estimated annual acreage affected by project activity on these lands.

Table 2-1. Ownership, total acreage, and annual affected acreage of the 96 activities described for the Action (source: BA Table 3-1).

Ownership	Acres	Annual Affected Acres
TVA Retained Land: *Reservoir Land*	293,000	12,782
TVA Retained Land: *Power Property*	38,000	1,089
TVA Transmission Easements: *Existing ROW[a] & Maintenance Buffer*	545,201	79,186–80,935
TVA Transmission Easements: *New ROW*	23,800	1,190
Public Land: *Economic Development Sites*	75,220	3,761
Private Land: *Solar Sites*	40,000	2,000
Total	**1,015,221**	**100,008–101,757**

[a] Right-of-Way

The 1.015-million acres reported in Table 2-1 are distributed throughout the 82.8-million acre TVA Region (Figure 2-1) in Tennessee, northern Alabama, northern Georgia, southern Kentucky, eastern Mississippi, western North Carolina, and southwestern Virginia. The BA does not provide maps delineating Action lands within the TVA Region, because some are not yet identified (*e.g.*, future solar sites on private land, new transmission substations), and many are difficult to display effectively at a regional scale (*e.g.*, the existing transmission ROW network). Although the Action Area is large, it represents only 1.23 percent of the total area within the TVA Region.

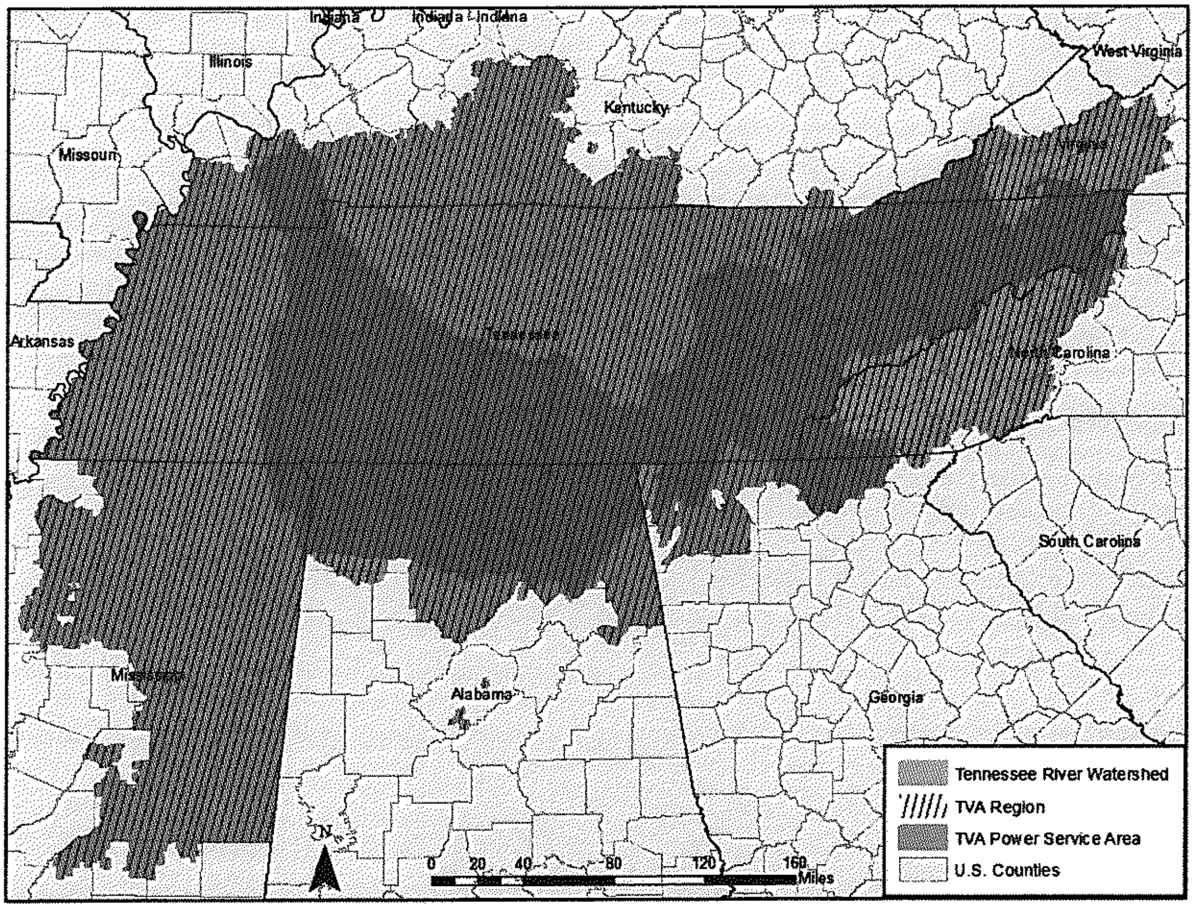


Figure 2-1. The 1.015-million acre Action Area is distributed throughout the 82.8-million acre TVA Region, which is comprised of the Tennessee River Watershed and the TVA Power Service Area (source: BA Figure 2-1).

The BA does not provide a project-specific schedule or map of activities over the 20-year Action duration. Annually, TVA estimates that about one-tenth (100,008–101,757 acres) of the lands for which the programmatic Action is formulated will receive direct and indirect effects from project activity. Cumulatively over 20 years, TVA estimates that the routine activities described for the Action will affect about 45.5 percent of the Action lands; therefore, more than half of the 1.015-millon acres will receive no effects. Some lands may receive project activity on multiple occasions (*e.g.*, prescribed burning, ROW vegetation management). Recognizing the variable and uncertain distribution of the routine activities, TVA describes the 1.015-million acres of lands that may receive effects of project activity at any time during the next 20 years as the "Action Area" for this consultation. Although it includes areas that the Action will not affect, the Service adopts the TVA definition of the Action Area for the purposes of this programmatic consultation.

Chapter 2 of the BA, "Description of the Action Area," provides data about land cover and other characteristics of the 82-million-acre TVA Region, which contains the 1-million-acre Action

Area distributed in patches (e.g., TVA reservoirs, power plants) and linear corridors (e.g., transmission ROWs) throughout the region. About 36 million acres (44 percent) of the Region has forest cover that is potentially suitable habitat for tree-roosting bats (BA pg. 24). The Action Area is proportionally less forested than the Region as a whole, with 240,103 acres (23.65 percent) of forest cover (H. LeGrand, pers. comm., 2017).

2.2. Tree Removal Activities

Eight of the ten of the general TVA action categories identified in section 2 routinely involve a need to remove trees, either to eliminate a hazard to human life or property (Activity #33) or to manage the structure and composition of the plant community on a site (Activity #34). Action category #2, "protect cultural resources," and category #7, "convey electric transmission property," do not involve tree removal.

The BA described three general sideboards for TVA's anticipated routine tree removal activity. First, TVA estimated the total acreage of routine tree removal annually and cumulatively over the next 20 years (2018–2037). Second, TVA estimated the proportion of tree removal that would result in a permanent alteration of local habitat conditions, *i.e.,* the percentage of the acreage in which trees are not planted or allowed to regenerate following tree removal. Third, TVA estimated the temporal distribution of tree removal acreage (either permanent or temporary) relative to three functional seasons of the bat life cycle:

- Inactive season, hibernation (mid-November to mid-March or April)
- Active season, all bats are volant (able to fly).
- Active season, bat pups are non-volant (June and July).

Table 2-2 summarizes these estimates of tree removal activity by action category.

The 20-year cumulative estimates in Table 2-2 are exactly or approximately 20 times a single annual acreage estimate reported for each action category except #6, "maintain existing transmission line assets," for which TVA provided two annual estimates. TVA anticipates a substantial reduction in tree removal from 1,835 to 86 acres per year beginning in the year 2022, when TVA expects it will have removed taller trees from the border zones along the majority of existing ROWs. Thereafter, TVA plans to maintain its ROWs in an early-successional state on a 3-year maintenance rotation. Removing trees from 1,835 acres per year for 4 years and from 86 acres per year for 16 years results in a 20-year cumulative estimate of 8,716 acres for existing transmission line maintenance. The cumulative acreage of tree removal for all action categories is 47,204 acres, of which 92 percent is permanent removal.

2.2.1. Tree Removal Settings and Methods

Section 3.2 of the BA describes two of the 96 activities included under the programmatic Action as tree removal:

Activity #33, "Removal of hazardous trees or tree branches," occurs as necessary throughout the year to address immanent threats to public safety, facilities, or private property. Settings for hazardous tree removal include, but are not limited to, campgrounds, day use areas, access

Table 2-2. Extent (acres) of TVA tree removal activity (annual, permanent, seasonal, and cumulative) for 2018–2037 (data source: BA Table 3-2). Percentages are relative to values in the same row under "Annual Total Tree Removal," except in the last row, where the percentages are relative to 47,204 acres ("Total Cumulative Tree Removal").

Action Category		Annual Total Tree Removal	Permanent Tree Removal	Seasonal Distribution			Cumulative Total Tree Removal 2018-2037
				Inactive Season	Active Season; All Bats Volant	Active Season; Pups Non-Volant	
1. Manage for Bio-diversity, Public Use		59	35 (60%)	12 (20%)	30 (50%)	18 (30%)	1,186
3. Manage Land Use, Disposal		630	504 (80%)	315 (50%)	189 (30%)	126 (20%)	12,600
4. Manage 26a Permitting (Shoreline)		104	73 (70%)	83 (80%)	10 (10%)	10 (10%)	2,080
5a. Operate and Maintain Plants		35	35 (100%)	28 (80%)	5 (15%)	2 (5%)	700
5b. Retire, Construct, Expand Plants		75	75 (100%)	60 (80%)	11 (15%)	4 (5%)	1,500
6. Maintain Existing TL[a] Assets:	2018–2021	1,835	1,835 (100%)	734 (40%)	459 (25%)	642 (35%)	8,716
	2022–2037	86	86 (100%)	34 (40%)	22 (25%)	30 (35%)	
8. Expand or Construct New TL Assets		595	595 (100%)	357 (60%)	119 (20%)	119 (20%)	11,900
9. Promote Economic Development		376	376 (100%)	338 (90%)	38 (10%)	0 (0%)	7,522
10. Promote Solar Generation		50	50 (100%)	40 (80%)	10 (20%)	0 (0%)	1,000
Annual Total	2018–2021	3,759	3,578 (95%)	1,967 (52%)	871 (23%)	921 (25%)	N/A[b]
	2022–2037	2,010	1,829 (91%)	1,267 (63%)	434 (22%)	309 (15%)	
Cumulative Total 2018–2037		N/A	43,576 (92%)	28,140 (60%)	10,428 (22%)	8,628 (18%)	47,204

[a] TL = transmission line

[b] N/A = not applicable

corridors between private property and TVA reservoirs, and transmission line ROWs. Hazardous tree removal may involve the use of a feller buncher, bulldozer, bush-hog, chainsaw, and other hand tools.

Activity #34, "Mechanical vegetation removal, includes trees or tree branches three inches or greater in diameter," serves a variety of purposes and occurs during daylight hours throughout the year, with a possible duration of days to weeks at a particular location. The physical settings for non-hazardous tree removal include, but are not limited to, public/recreational use areas, natural areas (*e.g.,* to create openings for wildlife habitat enhancement), lawn maintenance, and areas for the construction of new buildings, roads, transmission lines, or substations. TVA removes trees along existing ROWs and access roads to ensure the integrity of operations and reduce risks to human safety. The equipment employed may include a feller buncher, bulldozer, track or bucket hoe, scrapper, bush-hog, mower, logging and boom trucks, chainsaw, and hand tools.

2.2.2. Conservation Measures for Tree Removal

To avoid or reduce adverse effects to bats resulting from tree removal, TVA proposes to apply several conservation measures when conducting Activities #33 and #34. Generally, these measures are intended to reduce the intensity of, or the probability of exposure to, stressors caused by tree removal that may affect bats or their habitat resources, including the elimination of roost trees (while currently occupied or not), and the introduction of sediment or other pollutants to waters that bats drink or that support bat prey resources.

The BA also identifies noise as a stressor caused by tree removal activity. The "noise/vibration" conservation measure that TVA assigns to tree removal (labeled as NV1; BA pg. 114) states:

> NV1 = Noise is expected to be short-term, transient, and not significantly different from urban interface or natural events (*i.e.,* thunderstorms) that bats are frequently exposed to when present on the landscape; bats thus are unlikely to be disturbed.

This statement suggests that the noise associated with tree removal activity is unlikely to disturb bats due to its brief duration and similarity to ambient noise. However, TVA indicates that Activity #34 may include the use of various large or loud equipment (*e.g.,* bulldozer, chainsaw) "with [a] possible duration of days to weeks" (BA pg. 44). Because this measure does not specify actions or conditions that will have any effect on when, where, or how noise associated with tree removal will occur, it is not relevant to the analysis in this BO.

<u>General Measures</u>

TVA proposes nine conservation measures (TR1–TR9; BA section 5.2.4) for tree removal activity. Some deal with the timing and location of tree removal activity relative to the seasonal life cycle and known occurrences of the listed bats. The proposed measures are (copied from the BA):

- TR1 = Removal of potentially suitable summer roosting habitat during time of potential occupancy has been quantified and minimized programmatically. TVA will track and document alignment of activities that include tree removal (*i.e.,* hazard trees, mechanical vegetation removal) with the programmatic quantitative cumulative estimate of seasonal removal of potentially suitable summer roost trees for Indiana bat and northern long-eared bat.

- TR2 = Removal of suitable summer roosting habitat within 0.5 mile of Priority 1/Priority 2 Indiana bat hibernacula, or 0.25 mile of Priority 3/Priority 4 Indiana bat hibernacula or any northern long-eared bat hibernacula will be prohibited, regardless of season, with very few exceptions (*e.g.,* vegetation maintenance of TL ROW immediately adjacent to Norris Dam Cave, Campbell County, TN).
- TR3 = Removal of suitable summer roosting habitat within documented habitat (*i.e.,* within 10 miles of documented Indiana bat hibernacula, within 5 miles of documented northern long-eared bat hibernacula, within 2.5 miles of documented Indiana bat summer roost trees, within five miles of Indiana bat capture sites, within one mile of documented northern long-eared bat summer roost trees, within three miles of northern long-eared bat capture sites) will be tracked, documented, and included in annual reporting.
- TR4 = Removal of suitable summer roosting habitat within potential habitat for Indiana bat or northern long-eared bat hibernacula will be tracked, documented, and included in annual reporting.
- TR5 = Removal of any trees within 150 ft of a documented Indiana bat or northern long-eared bat maternity summer roost tree during non-winter season, range-wide pup season or swarming season (if site is within known swarming habitat), will first require a site-specific review and assessment. If pups are present in trees to be removed (determined either by mist netting and assessment of adult females, or by visual assessment of trees following evening emergence counts), TVA will coordinate with the USFWS to determine how to minimize impacts to pups to the extent possible. This may include establishment of artificial roosts before loss of roost tree(s).
- TR6 = Removal of a documented Indiana bat or northern long-eared bat roost tree that is still suitable and that needs to occur during non-winter season, range-wide pup season, or swarming season (if site is within known swarming habitat) will first require a site-specific review and assessment. If pups are present in trees to be removed (determined either by mist netting and assessment of adult females, or by visual assessment of trees following evening emergence counts), TVA will coordinate with the USFWS to determine how to minimize impacts to pups to the extent possible. This may include establishment of artificial roosts before loss of roost tree(s).
- TR7 = Tree removal within 100 ft of existing transmission ROWs will be limited to hazard trees as defined in Section 3-2.
- TR8 = Requests for removal of hazard trees on or adjacent to TVA reservoir land are inspected by staff knowledgeable in identifying hazard trees per International Society of Arboriculture and TVA's checklist for hazard trees. Approval is limited to trees with a defined target.
- TR9 = Internal controls will be in place to further reduce potential for site-specific direct adverse effects to Indiana bat and northern long-eared bat associated with tree removal. This includes promoting presence/absence surveys (mist netting or emergence counts) that allows for positive detections but without resulting in increased constraints in cost and project schedule. Internal controls are intended to facilitate willingness and financial feasibility to conduct surveys amidst increasing budget constraints without the risk for increased financial penalty if Indiana bat or northern long-eared bat individuals are caught. This enables TVA to

contribute to increased knowledge of bat presence on the landscape while continuing to carry out TVA's broad mission and responsibilities.

Sedimentation, Spills, Pollutants, and Contaminants (SSPC)

Six conservation measures (SSPC1–5, and SSPC7) deal with protecting water quality while conducting tree removal activities, which are described in section 5.2.6 of the BA. These measures are standard TVA best management practices (BMPs) that avoid or minimize inputs of sediment and other pollutants into waterways and cave/cave-like entrances. Although TVA determined that tree removal activity under the programmatic Action is likely to adversely affect the Ibat and NLEB, TVA concluded that the stressors causing such adverse effects do not include sediments and contaminants (BA pg. 123). The Service agrees that implementing SSPC1–5 and SSPC7 during tree removal activities will limit any adverse effects to bats via changes in water quality to an insignificant scale or discountable probability. Therefore, we do not further address the SSPC conservation measures in this BO.

2.3. Prescribed Burning

Of the ten general TVA action categories listed in the introduction to section 2 of this BO, only "manage for biodiversity and public use" involves prescribed burning (Activity #23). This activity is limited to portions of TVA Reservoir Lands. TVA uses fire to maintain and establish high quality wildlife habitat, reduce the risk of wildfires, stimulate growth of targeted vegetation, and recycle nutrients back into the soil.

During the last 5 years, TVA has burned about 750 to 1,000 acres each year, of which 60 percent was on open lands and 40 percent on forested lands. The annual extent of burning will rarely exceed 1,500 acres. TVA estimates that 26,247 acres of its reservoir lands could use prescribed fire over the next 20 years. Of this total, 17,677 acres (86 parcels that range in size from 2–4,649 acres) are identified for prescribed burning (potential burn sites), but are not currently included in a burn plan due to budget and staff limitations. The remaining 8,570 acres (66 parcels that range in size from 2–1,659 acres) are currently managed with fire (active burn sites) or are slated for fire management within the next 5 years (planned burn sites).

2.3.1. Prescribed Burning Methods

TVA intends to conduct most burns in early winter to early spring (approximately November–April). Weather conditions that are not conducive to controlled burning generally preclude burns during September and October. Burn season and frequency on a parcel ranges from 1–5 years, depending on site-specific objectives. Table 2-3 provides examples of the objectives associated with burns conducted at various times of year.

Table 2-3. Seasonality and example objectives of prescribed burning on TVA lands (source: BA Table 3-3).

SEASON	OBJECTIVES
Fall-Winter-Spring; Spring	Invasive control - conversion to native early successional - maintain early successional (in partnership with state agency at some locations)
Fall-Winter; Winter-Spring; Spring	Maintain early successional seral stage (*e.g.,* dam safety level protection; hay/row crop production; Native warm season grass production; research partnership with local university, state agency or non-profit organization; reduce encroaching canopy - expanding barrens habitat; reduction of density coverage; understory maintenance- shortleaf pine initiative)
Fall-Winter	Maintain Pine-savannah - early successional seral stage
Winter-Spring	Mix upland hardwood selective thinning and understory control-Partnership research with Mississippi State University
Fall-Winter-Spring	Mixed hardwood-pine local wildfire suppression-understory maintenance-Shortleaf Initiative
Spring	Pine-Cedar local wildlife suppression-invasive and woody suppression-revert to early succession
Fall-Winter-Spring	Pine-hardwood local wildfire suppression-understory maintenance-hardwood regeneration
Fall-Winter-Spring; Fall-Winter	Pine-Oak local wildfire suppression (invasive understory control; early succession maintenance; shortleaf initiative; afforestation preparation)
Fall-Winter-Spring	Planted shortleaf (understory maintenance; maintain early successional seral stage
Winter-Spring	Site prep (conversion to native, early successional stage; maintain early successional seral stage
Fall-Winter-Spring	Undesirable woody suppression - desirable woody regeneration maintenance; early-successional conversion and maintenance)
Fall-Winter; Spring	Upland hardwood local wildfire suppression (undesirable woody control; understory maintenance; invasive control)

TVA has previously established BMPs for conducting prescribed burns, which are appended to the BA as Appendix C ("BMPs for Silviculture Activities on TVA Lands"), and which apply to this Action. The description of Activity #23 in section 3-2 of the BA lists the following guidance (conditions and considerations) for prescribed burning that specifically deal with caves and bats (paraphrased from BA pg. 40):

1) Caves are smoke-sensitive environments. TVA assumes that federally listed bats use a cave until surveys show otherwise.
2) Considering relevant site-specific conditions, prescribed burn managers must ensure that smoke does not enter caves or cave-like structures when bats are present.

3) Where feasible, burn larger acreages in smaller units at a time to reduce the risk of smoke entering sensitive sites.
4) Tractor-constructed fire breaks, mechanical site preparation, vegetation cutting, and construction of new roads (including temporary roads) are prohibited within 200 feet of cave portals, cave collapse areas, mines and sinkholes. Use site-specific data to determine whether wider buffers are necessary to protect water and air quality in caves and mines.
5) Use existing barriers (*e.g.,* streams, lakes, wetlands, roads, and trails) as fire lines whenever possible.
6) Prescribed burning in known and potential maternity roosting habitat is prohibited from June 1–July 31, except where site-specific data indicate that Ibats and NLEBs are not likely present.

TVA has provided a seasonal breakdown of the 20-year cumulative extent of prescribed burning relative to the three bat life-cycle seasons: inactive season (winter), non-volant pups (June and July), and the remainder of the active season (H. LeGrand, pers. comm., 2018a). Although not listed as an avoidance and minimization measure applicable to burning, this breakdown specifies no burning during June and July, 90 percent during the inactive season, and 10 percent in the remainder of the active season.

2.3.2. Conservation Measures for Prescribed Burning

In addition to the burning BMPs and the methods described in section 2.3.1, TVA proposes nine conservation measures to avoid and minimize the adverse effects of smoke and heat from prescribed burning on bats. Some of these measures, listed below (copied from BA section 5.2.3), overlap with the proposed methods.

- SHF1 = Fire breaks are used to define and limit burn scope.
- SHF2 = Site-specific conditions (*e.g.,* acres burned, transport wind speed, mixing heights) are considered to ensure smoke is limited and adequately dispersed away from caves so that smoke does not enter cave or cave-like structures.
- SHF3 = Acreage is divided into smaller units to keep the amount of smoke at any one time or location to a minimum and reduce risk for smoke to enter caves.
- SHF4 = Planned timing for prescribed burns minimally overlaps with time of potential occupancy by bats (See BA Table 3-3). If burns need to be conducted during April and May, when there is some potential for bats to present on the landscape and more likely to enter torpor due to colder temperatures, burns will only be conducted if the air temperature is 55° or greater, and preferably 60° or greater.
- SHF5 = Fire breaks are plowed immediately prior to burning, are plowed as shallow as possible and are kept to minimum to minimize sediment.
- SHF6 = Tractor-constructed fire lines are established greater than 200 ft from cave entrances. Existing logging roads and skid trails are used where feasible to minimize ground disturbance and generation of loose sediment.
- SHF7 = Burning will only occur if site specific conditions (e.g. acres burned, transport wind speed, mixing heights) can be modified to ensure that smoke is adequately dispersed away from caves or cave-like structures. This applies to prescribed burns and burn piles of woody vegetation.

- SHF8 = Brush piles will be burned a minimum of 0.25 mile from documented, known, or obvious caves or cave entrances and otherwise in the center of newly established ROW when proximity to caves on private land is unknown.
- SHF9 = A 0.25-mile buffer of undisturbed forest will be maintained around documented or known gray bat maternity and hibernation colony sites, documented or known Virginia big-eared bat maternity, bachelor, or winter colony sites, Indiana bat hibernation sites, and northern long-eared bat hibernation sites. Undisturbed forest is important for gray bats to regulate temperatures at the mouth of the cave, and provide cover for bats as they emerge from the cave. Prohibited activities within this buffer include cutting of over-story vegetation, construction of roads, trails or wildlife openings, and prescribed burning. Exceptions may be made for maintenance of existing roads and existing ROW, or where it is determined that the activity is compatible with species conservation and recovery (*e.g.,* removal of invasive species).

The BA (pg. 39) reports that 74 caves occur within 1 mile of the active, planned, and potential burn sites on TVA reservoir lands. Of these, 11 have documented bat occupancy (current or historic), 25 are within 500 feet of active burn sites, and 15 are within the boundaries of potential burn sites (3 of the 15 have documented bat occurrence). TVA determined that prescribed burning conducted in a manner consistent with the proposed Action, which includes the BMPs and the conservation measures listed above, is not likely to adversely affect listed bats while they inhabit caves.

The Service previously concurred with this TVA determination relative to the gray bat and Virginia big-eared bat (see Consultation History), which roost in caves year-round. We agree also that the BMPs and proposed conservation measures will limit any adverse effects of burning on Ibats and NLEBs while they inhabit caves to an insignificant scale or discountable probability. Therefore, we do not further address in this BO the effects of burning on these two species while they inhabit caves, which is during their inactive winter (hibernation) season. Further analysis of the effects of prescribed fire is limited to burns conducted during the active season of these two bat species.

2.4. Additional Conservation Measures

In addition to the impact avoidance and minimization measures specified for each of the 96 activities, section 5.3 of the BA describes various ongoing TVA efforts that promote the recovery of listed bats in the TVA Region. These efforts include:

- monitor gray bat caves on TVA-managed lands;
- collaborate with partners to survey bridges and potential summer use (e.g., maternity colonies) areas;
- support bat ecology research (*e.g.*, spring migration radio tagging and tracking, location and assessment of roost trees);
- monitor bat use following habitat enhancement and artificial roost projects on TVA lands;
- install, monitor, and maintain gates and signage at bat caves on TVA lands;
- serve on State white-nose syndrome planning committees (*e.g.*, AL, TN);

- maintain a database of listed bat occurrences within the TVA Region (*i.e.*, mist net captures, cave, bridge, and tree roosts, *etc.*) to inform project-specific environmental reviews and BAs;
- manage invasive plants that threaten rare species habitats (*e.g.*, cave entrances); and
- conduct bat habitat identification workshops for TVA staff.

TVA also addresses listed bat conservation needs to some extent in the following plans and policies:

- 2015 Integrated Resource Plan (IRP), which guides TVA's electricity generation planning;
- 2011 Natural Resource Plan (NRP), which guides management and stewardship activities on TVA lands;
- 2006 Land Policy, which guides management of the reservoir system and surrounding reservoir lands; and
- 1999 Shoreline Management Policy (SMP), which guides the protection of shoreline and aquatic resources while allowing reasonable access to the water by adjacent property owners.

Lastly, the BA expresses TVA's commitment to a rigorous environmental review process at multiple levels to ensure compliance with the National Environmental Policy Act, ESA, and other environmental laws. The Action of this consultation is an example of such review at a regional programmatic level for ESA compliance purposes with respect to listed bats. The programmatic Action addresses multiple routine activities that are common components of actions funded, authorized, or carried out with additional project-level environmental review as necessary and appropriate.

The BA does not provide data about the various additional conservation measures listed above that would inform an analysis of their beneficial effects on listed bat numbers, reproduction, or distribution. The Service recognizes the inherent value of these efforts to the recovery of listed bats. Several provide information that is critical to formulating effective conservation actions, but do not improve directly the status of listed bats. Therefore, lacking data that would allow us to determine the scale of their beneficial effects relative to those of the proposed activities that are likely to adversely affect the Ibat and NLEB, we do not further address the "additional conservation measures" in this BO.

2.5. Project-Level Process

Chapter 6 of the BA describes the procedures TVA proposes for activities funded, authorized, or carried out under the programmatic Action to rely on this programmatic consultation for ESA compliance with respect to the listed bats that such activities may affect. These procedures specify a sequence of TVA project-specific determinations using best available data, and the documentation, notification, and reporting processes that are associated with these determinations. Table 2-4 reiterates these procedures.

Table 2-4. Proposed steps to document and report alignment of TVA activities with the bat programmatic consultation (source: BA Table 6-1).

#	Step
1.	Site-specific project will be screened via TVA's environmental review process.
2.	Project will be reviewed to determine if associated activities are within the scope of TVA's bat programmatic consultation (BPC).
3a.	Projects with activities that are outside BPC scope will be subject to project-specific consultation if warranted. ***END***
3b.	Projects with activities that are within BPC scope will be reviewed for potential to impact covered species. ***Go to 4.***
4a.	Project-specific activities that are determined in the BPC to have No Effect will be documented as aligning with the BPC and documented in TVA's environmental management system. ***END***
4b.	Project-specific activities determined in the BPC to have potential to NLAA[a] covered species will be reviewed further to determine if project exposes covered species to stressors. If so, conservation measures identified in the BPC will be implemented and documented. If no exposure to stressors will occur as part of the project, activity will be documented as having no effect on covered species. In either case, TVA will notify the appropriate USFWS FO (via email or letter) of proposed project, alignment with BPC, and project-specific determination. This notification will serve as documentation in the TVA's administrative record. All projects with effects determinations of these types will be summarized in annual reporting associated with the BPC. ***END***
4c.	Project-specific activities determined in the BPC to have potential to LAA[b] covered species will be reviewed further to determine if project exposes covered species to stressors. ***Go to 5.***
5a.	If no exposure to stressors will occur as part of this project-specific activity, activity will be documented as aligning with the BPC, having no effect on covered species, and will be included in annual reporting associated with the BPC. ***END***
5b.	If project-specific activity aligns with LAA determination, project conducts presence/ absence surveys, and detections are negative, TVA will document a NLAA determination and alignment with BPC. TVA will notify the appropriate USFWS FO (via email or letter) of the proposed project, alignment with BPC, survey outcome, and determination. This notification will serve as documentation in TVA's administrative record. All projects with effects determinations of these types will be summarized in BPC annual reporting. ***END***
5c.	If project-specific activity aligns with LAA determination, project assumes presence, or project conducts presence/absence surveys and detections are positive, TVA will document a LAA determination and alignment with BPC. TVA will notify the appropriate USFWS FO (via email or letter) of the proposed project, alignment with BPC, survey outcome (if surveys conducted), and determination. This notification will serve as documentation in TVA's administrative record. All projects with effects determinations of these types will be summarized in annual reporting associated with the BPC. ***END***

[a] NLAA = may affect; not likely to adversely affect.
[b] LAA = may affect; likely to adversely affect.

2.6. Interrelated and Interdependent Actions

A BO evaluates the effects of a proposed Federal action. For purposes of consultation under ESA §7, the effects of a Federal action on listed species or critical habitat include the direct and indirect effects of the action, plus the effects of interrelated or interdependent actions.

> "Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR §402.02).

The 96 activities addressed in this programmatic Action are routine components of projects that serve one or more of the 10 general action categories listed in section 2 of this BO. Projects authorized, funded, or carried out under these 10 action categories may or may not involve interrelated or interdependent actions. Section 5.1 of the BA indicates that TVA will consider in project-level environmental review whether interrelated or interdependent activities associated with one or more of the activities covered under this programmatic Action may affect listed bats and other listed species, and if so, enter a project-specific consultation with the Service. We agree with TVA that any assessment of interrelated and interdependent activities at the program level of this Action would be speculative, given its activity-level focus. Therefore, we do not further address the topic of interrelated or interdependent actions in this BO.

3. STATUS OF THE SPECIES

This section summarizes best available data about the biology and current condition of the Indiana bat (*Myotis sodalis*) (Ibat) and the northern long-eared bat (*Myotis septentrionalis*) (NLEB) throughout their range that are relevant to formulating an opinion about the Action.

The Ibat was among several animals identified in 1967 (32 FR 4001) as threatened with extinction under the Endangered Species Preservation Act of 1966, and subsequently classified as endangered when the ESA of 1973 superseded the earlier statute. The Service approved a recovery plan for the Ibat on October 14, 1983 (USFWS 1983), and issued a draft first revision, on April 13, 2007 (USFWS 2007). Critical habitat is designated for the Ibat, but is not relevant to this consultation.

The Service has issued the following decisions regarding ESA protections for the NLEB:

Date	Federal Register	Decision
04/02/2015	80 FR 17973–18033	Threatened species status with interim 4(d) rule
01/14/2016	81 FR 1900–1922	Final 4(d) rule
04/27/2016	81 FR 24707–24714	Determination that designation of critical habitat is not prudent

The Service has not yet approved a recovery plan for the NLEB.

3.1. Species Description

The Ibat is a medium-sized bat that closely resembles the little brown bat (*Myotis lucifugus*), but has a darker brown to black pelage. Adults weigh about one-quarter of an ounce (the weight of three pennies), and have a wingspan of 9 to 11 inches.

The NLEB is also a medium-sized bat, also weighing about one-quarter of an ounce. As indicated by its common name, the NLEB is distinguished from other *Myotis* species by its large ears, which extend beyond the nose when laid forward.

3.2. Life History

The Ibat and NLEB are both insectivorous migratory species that hibernate in caves and mines during winter and forage in wooded areas during summer. Foraging activity and travel is mostly nocturnal. Ibat average life span is 5–10 years, but recapture of banded individuals has documented Ibats up to 15 years old (Humphrey and Cope 1977). NLEB longevity is up to 18.5 years (Hall *et al.* 1957). Prior to the arrival of white-nose syndrome, Caceres and Pybus (1997) attributed the highest age-specific annual mortality rates for the NLEB and many other species of bats to the juvenile stage. Hall (1962), Myers (1964), and LaVal and LaVal (1980) report sex ratios of 1:1 for the Ibat. NLEB sex ratios at the population level are not reported in the literature, but as a species similar to the Ibat in many other respects, a 1:1 ratio is likely.

The key phases in the Ibat and NLEB annual life cycle are:

- hibernation;
- spring staging and migration;
- pregnancy and lactation;
- pup volancy (able to fly); and
- fall migration and mating (swarming).

Although the timing varies with latitude and weather conditions, both bat species generally hibernate from mid-fall to mid-spring each year. Upon emerging from hibernation, bats forage for a few days or weeks near their hibernaculum (spring staging). Spring migration occurs from mid-March to mid-May. Females depart shortly after emerging from hibernation and are pregnant when they reach summer areas. Males tend to stay closer to hibernacula during summer. Adult females give birth to a single pup in late May to early June. Pups are weaned from nursing shortly after becoming volant in mid- to late-July. Fall migration occurs from mid-August to mid-October. Upon arriving at hibernacula, both species exhibit the "swarming" behavior. Large numbers of bats fly in and out of hibernacula entrances from dusk to dawn, roosting during the day in trees, but occasionally within the hibernacula. Swarming continues for several weeks and mating occurs during the latter part of the period. After mating, females enter hibernation, but not necessarily at the same hibernaculum where mating occurred. Most individuals of both sexes are hibernating by the end of November (by mid-October in northern areas).

The following subsections discuss in greater detail the aspects of the Ibat and NLEB life history that are most relevant to this consultation. We do not further discuss hibernation or hibernacula, because the Action is not likely to affect this life stage or habitat.

3.2.1. Summer Habitat and Ecology

Summer habitats for Ibat and NLEB bat consists of a wide variety of forested areas where they roost, forage, and travel. These habitats may include portions of adjacent and interspersed non-forested areas such as wetlands, the edges of agricultural fields, old fields, and pastures. Areas containing potential roosts include forests and woodlots, as well as linear features such as fencerows, riparian forests, and other wooded corridors. Tree density and canopy cover in areas used for roosting or foraging is variable. NLEBs are typically associated with upland forests with generally greater cover than Ibats, and appear to favor mature upland forests (Caceres and Pybus 1997), but occasionally forage over forest clearings, water, and along roads. However, most NLEB hunting occurs on forested hillsides and ridges, rather than along riparian areas preferred by the Ibat (Brack and Whitaker 2001; LaVal *et al.* 1977).

Wing morphology of both species suggests they are adapted to moving in cluttered habitats. Many species of bats, including the Ibat and NLEB, consistently avoid crossing or foraging in large open areas, choosing instead to use tree-lined pathways or small openings (Patriquin and Barclay 2003; Yates and Muzika 2006). Therefore, small patches of trees are unlikely to provide suitable foraging or roosting habitat unless connected to other patches by a wooded corridor.

Many male Ibats appear to remain at or near the hibernacula in summer with some fanning out in a broad band around the hibernacula (Whitaker and Brack 2002). Because males typically roost individually or in small groups, the average size of their roost trees is generally smaller than the roost trees used by female maternity colonies, which we discuss in the following subsection. Males may occasionally roost in caves. Males exhibit summer site fidelity and have been recaptured in foraging areas from prior years (USFWS 2007).

Maternity Colonies and Roosts

Following a variable-length period of foraging near hibernacula in the spring, females seek suitable habitat for maternity colonies, which appear essential for reproductive success. The size of NLEB maternity colonies is variable, but most are comprised of 30-60 females (USFWS 2014). Ibat maternity colonies are generally larger, but most contain fewer than 100 adult females (USFWS 2007). The mean maximum emergence count from Ibat maternity roosts after young began to fly (measured in 12 studies) was 119 bats (Kurta 2005), suggesting a colony size of 60–70 adult females (assuming that most adult females successfully raise one pup to volancy).

For purposes of this programmatic BO, we use 60 adult Ibat females per colony as the basis for estimating the number of Ibat colonies on the summer landscape. For each colony, we assume the local Ibat population is comprised of 60 adult females, 60 sympatric adult males, and 60 juveniles following parturition. Similarly, we use 45 adult NLEB females (the mid-point of the 30–60 range), and assume that the local population is comprised of 45 adult females, 45 sympatric adult males, and 45 juveniles following parturition.

Both species exhibit a degree of inter-annual fidelity to particular roost trees and/or maternity areas (Ibat: Humphrey *et al.* 1977; Gardner *et al.* 1991a, 1991b; Gardner *et al.* 1996; Callahan *et al.* 1997) (NLEB: Perry 2011; Johnson *et al.* 2009; Jackson 2004; Foster and Kurta 1999). Males are occasionally found with females in NLEB maternity colonies, but only rarely in Ibat maternity colonies. Maternity colonies of both species use networks of roost trees often centered around one or more primary (Ibat) or central-node (NLEB) roost trees. Ibat maternity colonies use a minimum of 8–25 roost trees per season (Callahan *et al.* 1997; Kurta *et al.* 2002). NLEB roost networks also include multiple alternate roost trees. Male and non-reproductive female NLEBs may also roost in caves and mines (Barbour and Davis 1969; Amelon and Burhans 2006).

Roost tree preferences vary between the two species. Ibats are known to use a wide variety of tree species ≥ 5 inches diameter at breast height (dbh) that have cracks, crevices, or peeling bark. A typical Ibat primary roost is located under the exfoliating bark of a dead ash, elm, hickory, maple, oak, or poplar, but any tree that retains large, thick slabs of peeling bark is potentially suitable. Primary Ibat roosts are usually in trees that are in early-to-mid stages of decay. NLEBs use a wider variety of trees for roosts. NLEBs roost in cavities, underneath bark, crevices, or hollows of both live and dead trees and/or snags that are ≥ 3 inches dbh. Ibats and NLEBs (more frequently) occasionally roost in barns and sheds, particularly when suitable tree roosts are unavailable.

3.2.2. Migration

Males and non-reproductive females may remain near hibernacula, or migrate to summer habitat some distance from their hibernaculum. Female Ibats commonly migrate hundreds of miles from their hibernacula (USFWS 2007), whereas NLEBs typically migrate 40-50 miles (USFWS 2014). Long-distance migration is energetically demanding. Fall migration occurs following months of summer foraging and building fat reserves. Spring migration occurs when fat reserves are depleted from hibernation, prey abundance is low, and females are pregnant; therefore, spring migration is possibly the most stressful period in the Ibat and NLEB life cycle.

3.2.3. Fall Swarming/Spring Emergence Habitat

The area around a winter hibernaculum necessarily serves as the location for the spring emergence from hibernation and the fall return from summer habitats. During spring staging and fall swarming, Ibat and NLEB roost in trees and forage in habitats that are similar to their summer habitats (see section 3.2.1), typically within 5 miles of their hibernaculum. Fall swarming activity lasts for several weeks. The duration of spring staging is more variable. Individual bats may spend a few days or a few hours around their hibernacula following emergence, or may migrate immediately to summer habitat.

3.2.4. Home Range

Ibats and NLEBs are migratory species that establish seasonal residency within a distinct home range. Summer home range includes roosting, foraging, and drinking areas, and the travel pathways between those habitats for a duration of several months. Fall home range includes the hibernaculum entrance for swarming behavior, but must also include roosting, foraging, and drinking areas for a duration of several weeks. For individuals (most females) that migrate to more distant summer habitats, spring home range is likely a subset of the areas used in the fall, but only for a few hours or days.

Studies using radio telemetry tagging and various analysis methods (e.g., mean convex polygons, 95% adaptive kernel, 95% fixed kernel) have estimated average individual Ibat summer home range sizes of 205–917 acres (Jachowski *et al.* 2014; Kniowski and Gehrt 2014; Menzel *et al.* 2005; Sparks *et al.* 2005; Watrous *et al.* 2006). One study near a hibernaculum during spring and fall (Rommé *et al.* 2002), and two during fall (Brack 2006; Kiser and Elliot 1996), estimated average home range sizes of 156–3,825 acres. Average individual NLEB summer home range size appears smaller than Ibat, with estimates of 161 and 179 acres (Owen *et al.* 2003, Lacki *et al.* 2009, respectively). No published studies have examined spring or fall home range sizes of NLEB. The average home range sizes reported in the studies cited above are each associated with substantial variability among the sample of individuals tracked in a particular study area. The sample size ranges from 3–32 bats. None reported the collective spatial extent of bat activity of all individuals tracked, and none attempted to track all members of a maternity colony or all bats engaged in fall swarming at a hibernaculum.

Depending on local habitat conditions, the home ranges of members of a maternity colony may or may not overlap substantially outside of the immediate area around shared roost trees. Some studies have documented summer habitat movements exceeding 1 mile (e.g., NLEB travel between roost tree and foraging area of 5,640 feet, Sasse and Pekins 1996), which imply a home range larger than a few hundred acres. For these reasons, the Service conservatively advises using a radius of 2.5 miles (Ibat) and 1.5 miles (NLEB) around a summer survey detection to delineate the area in which foraging and roosting activity of a maternity colony may occur. The area of a circle with a 2.5-mile radius is 12,566 acres, which is about 14 times larger than the largest Ibat individual summer home range reported in the literature. Similarly, a 1.5-mile circle (4,524 acres) is 25 times larger than the largest NLEB individual summer home range reported in the literature. A radius of 2.5 and 1.5 miles is likely to encompass all the roosts and foraging areas associated with a summer Ibat and NLEB detection, which is the purpose of this guidance, but likely exceeds the area on the landscape that a maternity colony actually uses regularly, which is not its purpose.

Likewise, the home ranges of very large numbers of individuals swarming at a hibernaculum probably do not overlap substantially much beyond the hibernaculum entrance, unless suitable habitat in the vicinity is very limited. To delineate potential foraging and roosting activity around known Ibat hibernacula, the Service uses a 10-mile radius for Priority 1 and 2 hibernacula, and a 5-mile radius for Priority 3 and 4 hibernacula. This recognizes the importance of these areas in bat conservation, and the variability associated with larger (P1 and P2) and smaller (P3 and P4) numbers of bats. For all known NLEB hibernacula, the radius is 5-miles, because NLEB winter aggregations are comparable to or less than Ibat numbers at P3 and P4 hibernacula.

Ibat males and females generally roost separately in the summer, but NLEB males are known to roost with females in maternity colonies to some extent. Some of the studies cited above suggest differences in summer home range size between males and females, both Ibat and NLEB. Despite some differences, male and female NLEB may share a large fraction of their foraging habitat within the occupied forested landscape. An analysis of mist net survey data in Kentucky (USFWS 2015a) shows that most NLEB males and non-reproductive females are captured in the same locations as reproductively active females (1,712 of 1,825 capture records, or 94 percent), suggesting substantial overlap in the summer home range of reproductive females and other individuals.

3.3. Numbers, Reproduction, and Distribution

3.3.1. Indiana Bat

Ibats are concentrated in relatively few hibernacula during the winter. Biennial winter surveys in 2017 estimated a total of 530,705 Ibats in 229 hibernacula in 17 states (USFWS 2017). Four states accounted for 96 percent of the total population estimate: Missouri (41.1%), Indiana (34%), Kentucky (11%), and Illinois (9.9%).

Emerging from hibernation, female Ibats disperse across a broad range in 19 States (Figure 3-1). Males are found during the summer throughout the range of the species, but most commonly in areas near known hibernacula (Gardner and Cook 2002). Males typically roost alone in the summer, but occasionally with maternity colonies. The Recovery Plan (USFWS 2007) reports 269 known extant maternity colonies in 16 states. Of these, 54 percent were discovered between 1997 and 2007, mostly using mist-netting surveys. Surveys continue to discover maternity colonies, but the Service has not compiled a range-wide tally since 2007. Using a 1:1 female/male sex ratio and an average maternity colony size of 60 adult females (see section 3.2.1), the 2017 winter survey population estimate yields an estimate of $530{,}705 \div (2 \times 60) = 4{,}423$ extant maternity colonies. The 269 Ibat maternity colonies known as of 2007 represents only 6 percent of this possible total.

The 2017 range-wide population estimate of 530,705 Ibats is a 3.5 percent decrease from the 2015 estimate of 550,224 bats (Figure 3-2). The biennial population estimates had been increasing from 2001 to 2007, suggesting that the species' long-term decline had been reversed (USFWS 2017). The decline since 2007 is likely attributable to WNS (see section 3.4 under "Threats"), especially in the Northeast Recovery Unit.

3.3.2. Northern long-eared bat

The range of the NLEB extends across much of the eastern and north central US (37 states), and all Canadian provinces west to the southern Yukon Territory and eastern British Columbia (Figure 3-3). Before the onset of WNS, the species was most frequently observed in the northeastern US and the Canadian Provinces of Quebec and Ontario. The species was less common in the southern and western portions of the range. The NLEB still occurs across much of the historical range, but with many gaps where the species is apparently extirpated or sparse due to WNS.

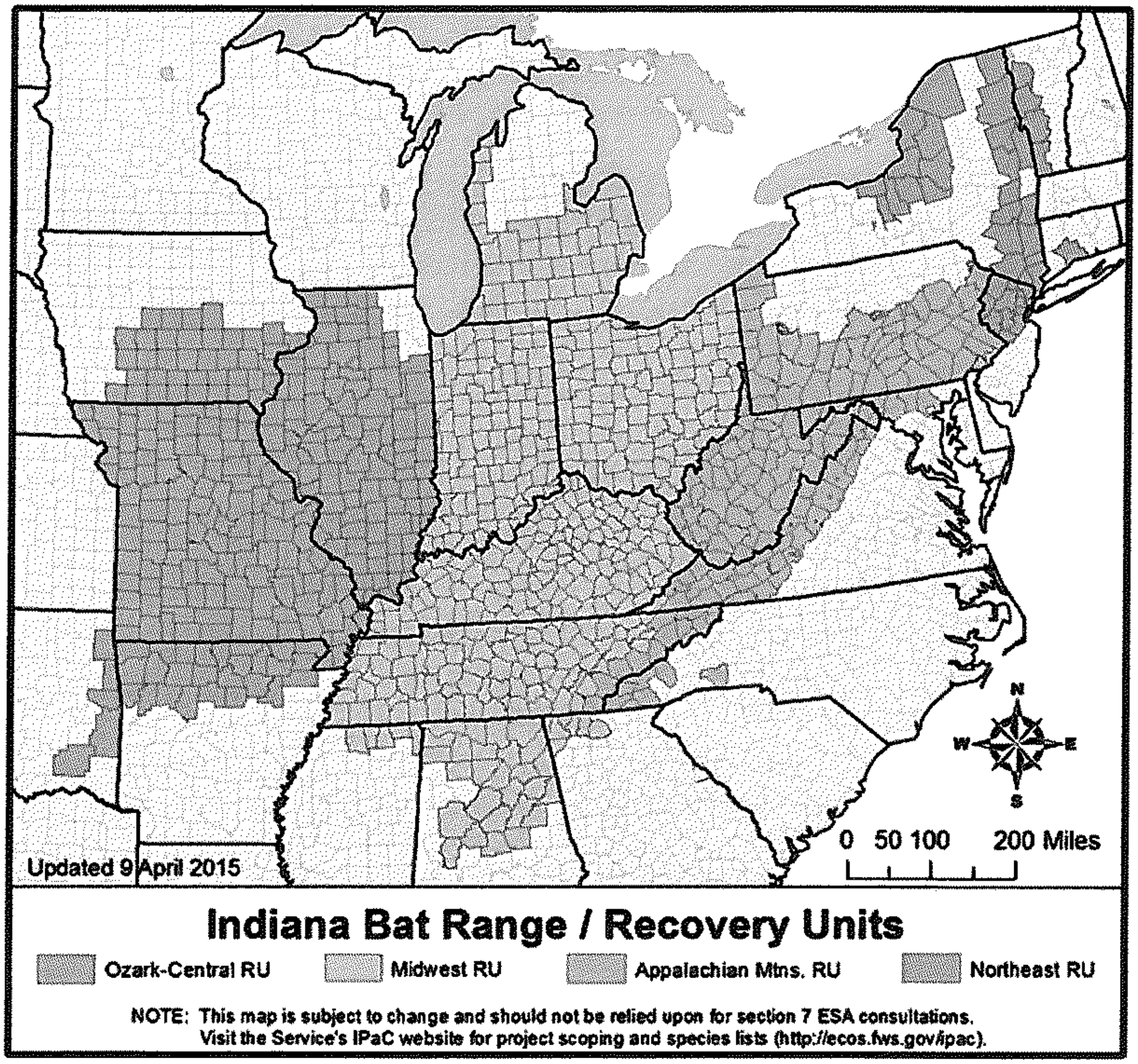


Figure 3-1. Range of, and Recovery Units for, the Indiana bat.

Most historical records of NLEBs are from winter hibernacula surveys (Caceres and Pybus 1997). The Service's "Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-Eared Bat and Activities Excepted from Take Prohibitions" (USFWS 2016) reported 1,508 known hibernacula in the United States, most in the eastern and mid-western portions of the US range. Even prior to WNS, surveys of many these hibernacula detected only a few individuals (Whitaker and Hamilton 1998). There are likely many more unknown hibernacula. The 2016 Biological Opinion also reported 1,744 known NLEB maternity roost trees in 19 US states. Prior to the introduction of WNS, the NLEB was considered common in the northern portion of its range, uncommon in the south, and rare in the west. Recent surveys in upland areas have revealed that this species is more common in Arkansas, Kentucky, Missouri, and Tennessee than indicated by previous work, which was focused primarily on detecting Ibats, and also more common in the Piedmont and Coastal Plain of North Carolina (NatureServe Explorer 2017).

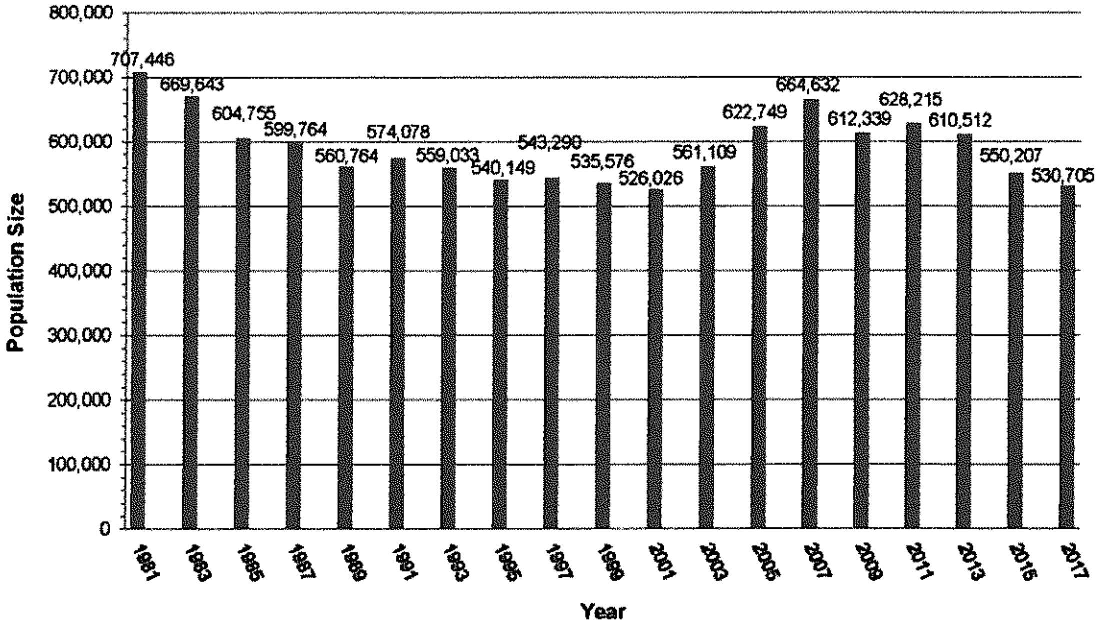


Figure 3-2. Indiana bat range-wide population estimates from 1981–2017 (source: USFWS 2017)

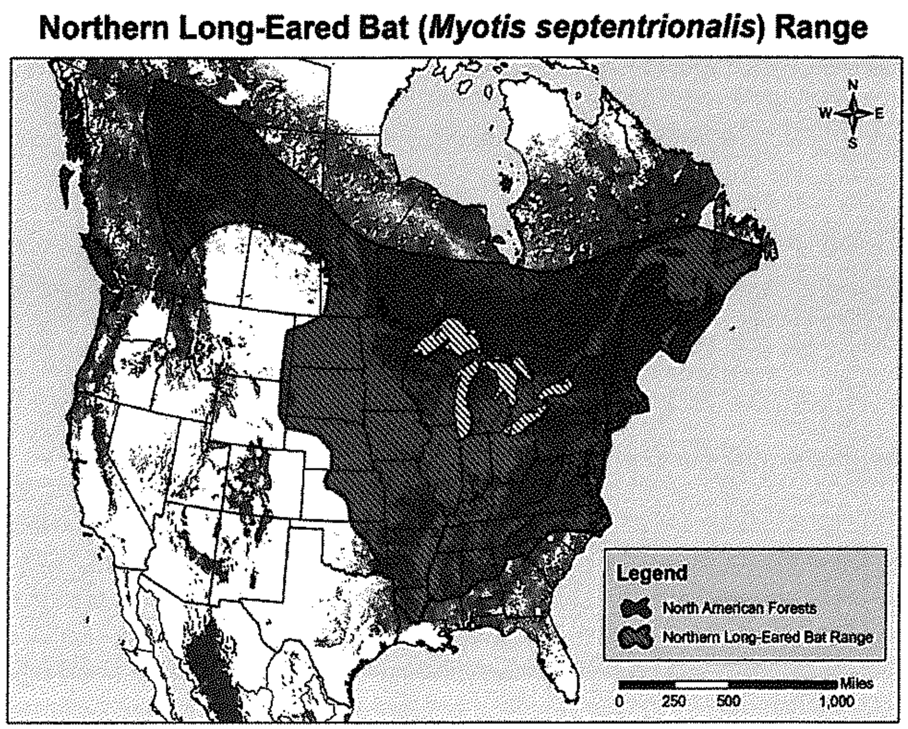


Figure 3-3. Range of the NLEB (Source: 80 FR 17976).

Hibernacula counts are the preferred census method for bats that hibernate. However, the NLEB uses many hibernacula, rarely in numbers greater than 300, is difficult to detect in hibernacula, moves between hibernacula during the winter, and most of its hibernacula are likely not known. Therefore, hibernacula counts are unlikely to provide a reliable metric for the species' range-wide abundance.

The 2015 final listing rule for the NLEB (80 FR 17979) summarized the limited abundance data available for each major region within the range, and noted that a range-wide population estimate for the species was not available at that time. The Service calculated a rough range-wide population estimate of about 6.5 million NLEB in the intra-Service BO for the final 4(d) rule that excepted various activities from take prohibitions (USFWS 2016). The Service based this estimate on the extent of forested habitat in the species range, observed detection rates in summer surveys, and the characteristics of summer NLEB colonies (e.g., home range size, number of individuals per colony). Although WNS continues to kill and weaken individuals in most of the species' range, NLEB populations may still number in the millions.

3.4. Conservation Needs and Threats

The conservation needs of and threats to the Ibat are discussed in detail in the 2007 Draft Recovery Plan (USFWS 2007) and the most recent 5-Year Review (USFWS 2009). These documents describe habitat loss and degradation, forest fragmentation, hibernacula disturbance and alteration, and environmental contaminants as the greatest threats to Ibats. The Draft Recovery Plan also identified collisions with wind turbines as an emerging threat. The Service has not yet approved a recovery plan for the NLEB.

In recent years, no other threat is more severe and immediate for the both the Ibat and NLEB than the disease known as white-nose syndrome (WNS). It is unlikely that NLEB populations would be declining so dramatically without the impact of WNS. Since first observed in New York in 2006, WNS has spread rapidly in bat populations from the Northeast to the Midwest and Southeast. NLEB numbers have declined by 99 percent in the Northeast, which along with Canada, was considered the core of the species' range. WNS-related declines in Ibat populations are estimated at up to 75 percent, with the disease recently moving into the Midwest core of the species' range. It appears likely that WNS will spread throughout most of the range of both species, and addressing the threat of WNS is their first and foremost conservation need. Additional information on WNS, which is constantly evolving, is available at http://whitenosesyndrome.org/.

The coastal plain of North Carolina is a possible refuge from the WNS epidemic for the NLEB. Studies using radio telemetry are revealing seasonal behavior that is different from other portions of the species' range. These coastal plain bats are not migrating to hibernacula in the fall (caves do not occur in this part of North Carolina), are active during most of the winter, and do not yet show any symptoms of WNS.

WNS is the clear cause of significant NLEB population declines and the recent downturn in Ibat numbers. However, other stressors that had no discernable population-level impacts previously, combined with the impact of the disease, could become factors influencing Ibat and NLEB probability of persistence in particular areas or regions. In general, smaller populations are more vulnerable to extirpation resulting from direct impacts or adverse habitat changes than larger populations, especially those that rely on colonial behaviors for critical life history functions. A single bat maternity colony, for example, reduced in size by WNS-related mortality and with the remaining individuals weakened by the disease, is much less likely to adapt to the loss or reduction of suitable roosting trees and foraging habitat in its traditional home range than a larger and healthier colony. Repeating this scenario with multiple colonies across a landscape could accelerate the population-level declines caused by WNS alone.

The USDA Forest Service summary of forest trends (USFS 2014) reported a decline in forest acreage from 1850 to the early 1900s. Thereafter, the conversion from forest to other land cover types was balanced with the conversion of other land cover types (mostly cropland) to forest through tree planting or old-field succession until 2001. From 2001 to 2006, the U.S. lost 1.2 percent of its total forest acreage, mostly in the southeast and west. Interior forest (40-acre parcels comprised of at least 90% forest cover) experienced a net loss of 4.3 percent.

The construction and operation of wind turbines represent an emerging concern for bat conservation, as bats appear particularly vulnerable to mortality and injury associated with the rotating turbine blades, either by collision or barotrauma (pressure-change injury). Ibat and NLEB mortality has been documented at multiple wind turbines installations. The Service is working with the wind industry to develop and implement measures that avoid and minimize the take of bats incidental to turbine operations, and to assess the magnitude of this threat.

Bats are sensitive to changes in temperature, humidity and precipitation (Adams and Hayes 2008), especially in their hibernacula. Climate change may affect bats through changes in food availability, timing of hibernation and reproductive cycles, frequency and duration of torpor, rates of energy expenditure, and rates of juvenile bat development (Sherwin *et al.* 2013). Clawson (2002) suggested that climate change may shift Ibats from southern to northern hibernacula. At this time, however, the Service has no evidence linking climate change to any population-level changes for either Ibats or NLEB. The rapid spread of WNS across the range of both species is likely to mask any effects of climate change on their status.

4. ENVIRONMENTAL BASELINE

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Ibat and the NLEB, their habitats, and ecosystem within the Action Area. The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review.

4.1. Action Area Numbers, Reproduction, and Distribution

4.1.1. Indiana Bat

Figure 4-1 shows the outline of the TVA Region on a map of the range of the Ibat. About 64 percent of the 82-million acre TVA Region (52,947,795 acres) is within the Ibat's range, and that portion represents about 17 percent of the Ibat range. The 1.015-million acre Action Area is

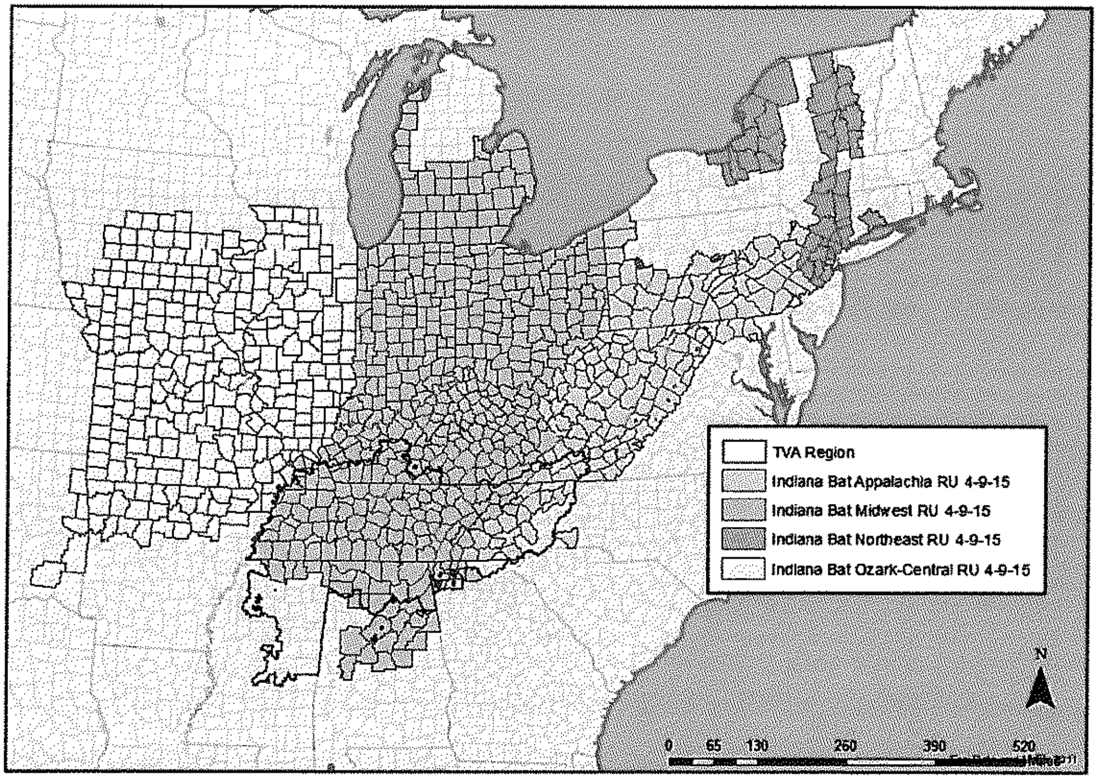


Figure 4-1. Range of the Indiana bat showing the TVA Region (source: BA Figure 4-1).

distributed throughout the TVA Region (see section 2.1); however, the BA does not partition the Action Area relative to the range of the Ibat. For purposes of describing the Ibat baseline and analyzing action-caused effects to Ibat in this BO, TVA proposes that we use the proportion of the TVA Region that is within the Ibat range (63.93 percent) as the proportion of the Action Area that is within the Ibat range (H. LeGrand, pers. comm., 2018b). We agree. This is a conservative approach that errs on the side of overestimating effects, because TVA anticipates that a disproportionate share of Action activity during the next 20 years will occur in portions of Mississippi that are outside the Ibat range.

TVA reports that 240,103 acres of the Action area are forested (see section 2.1). We assume that this forest cover is distributed uniformly or nearly so both within and outside the range of the Ibat; therefore, the distribution of forest cover within and outside the Ibat range is the same as the distribution of the Action Area as a whole within (63.93 percent) and outside the Ibat range. Forested acreage of the Action Area within the Ibat range is 0.6393 × 240,103 acres = 153,498 acres.

Figure 4-2 shows documented Ibat occurrence records within and near the TVA Region, including numerous hibernacula. Based on the 2013 winter surveys of hibernacula within the TVA Region, TVA reported (BA Table 4-2) that 25,434 Ibats (4.4 percent of the 2013 range-wide population) hibernated within the TVA region. Hibernacula counts provide the best census method for Ibat numbers (see section 3.3.1). Although adults disperse widely from hibernacula,

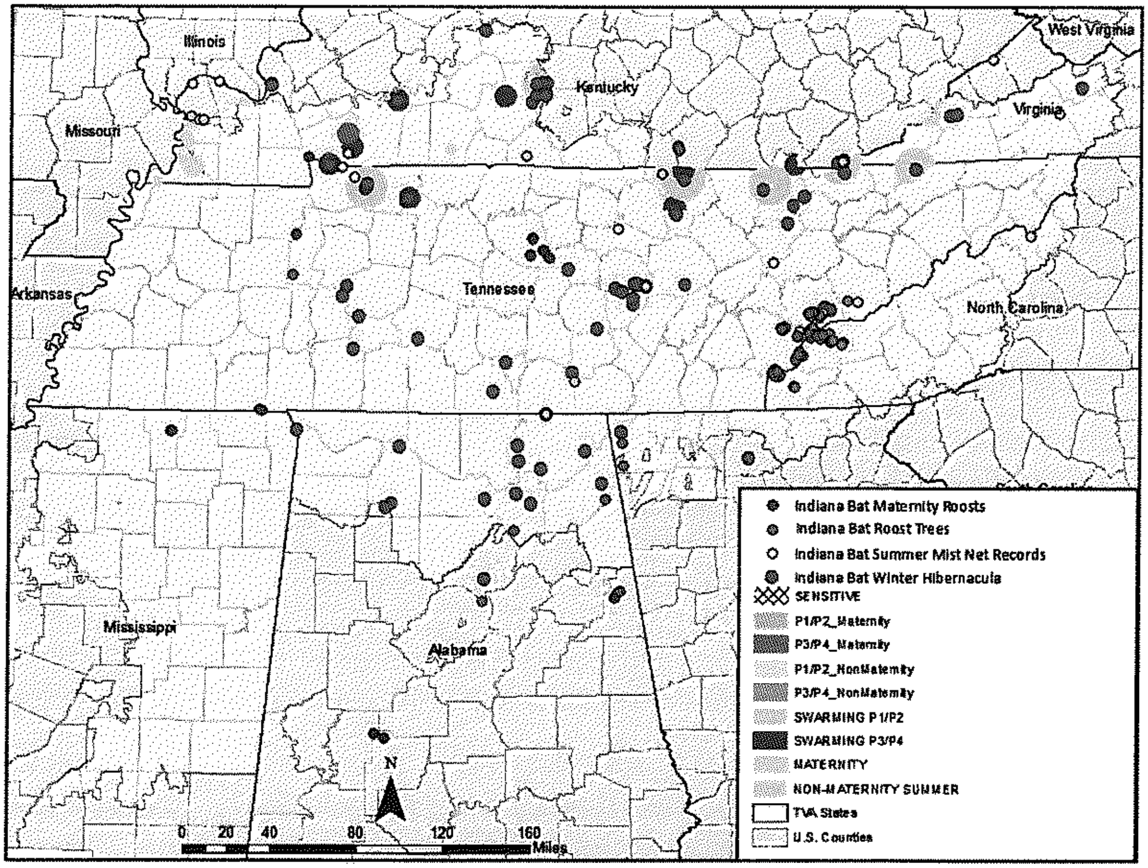


Figure 4-2. Documented occurrences of Indiana Bat in the TVA Region (source: BA Figure 4-2).

hibernacula counts are likely a reasonable approximation of Ibat numbers within the TVA Region. Ibat hibernacula are widely distributed in the portion of the Ibat range that is within the TVA Region and occur in every TVA state except Mississippi.

Hibernacula-specific counts from the 2015 or 2017 winter surveys, which each reflected a decline in range-wide total numbers relative to the previous biennial survey, are not yet compiled in a report that is available for use in this consultation. Therefore, for purposes of this consultation, we consider that the TVA region supports the same percentage observed for the 2013 range-wide census (4.4 percent) relative to the 2017 census total (530,705), or 23,244 adult Ibats. Assuming a 1:1 sex ratio, and 60 adult females per maternity colony (see section 3.2.1), the Ibats hibernating within the TVA Region would form about 194 maternity colonies ($23{,}244 \div (2 \times 60) = 194$).

As discussed in the first paragraph of this section, we assume that the Action Area and its forested acreage are uniformly distributed in the TVA Region. This means that the fraction of the Action Area that is within the range of the Ibat is same as the fraction of the Action Area in the TVA Region as a whole: 1.015 million acres in 82 million acres, or 1.226 percent. We do not assume that the Action Area supports a disproportional share (more or less) of the TVA Region's Ibat population. Therefore, the Action Area supports 1.226 percent of TVA Region's Ibat population, or 0.01226 × 23,244 = 285 adult Ibats. Assuming a 1:1 sex ratio, and 60 adult females per maternity colony, these bats would constitute about 2–3 colonies (285 ÷ (2 × 60) = 2.375), which we round up to 3 colonies.

The size of the area that all individuals belonging to an Ibat colony use for roosting and foraging is not reported in the literature. As we discussed in section 3.2.4, studies using radio telemetry tagging have estimated average *individual* Ibat summer home range sizes of 205–917 acres. Callahan (1993) reported a range of 0.81–1.48 km (0.5–0.9 mile) for minimum-radius circles that encompassed all roost trees of four Ibat colonies in MO, which corresponds to areas of 509–1,700 acres. The Service uses a radius of 2.5 miles around an Ibat summer survey detection to delineate the area in which the foraging and roosting activity of a maternity colony may occur. This corresponds to and area of 12,566 acres, which is several orders of magnitude greater than individual home range or the area encompassing documented roost trees reported in the literature. For purposes of this BO, we use 1,700 acres (the largest roost-tree area reported by Callahan 1993) as the area in which a single Ibat colony roosts and forages. Three non-sympatric Ibat colonies residing fully within the Action Area would occupy 3 × 1,700 = 5,100 acres. Forested habitat of the Action Area within the range the Ibat is about 153,498 acres (see second paragraph of this section). We expect that three Ibat colonies would occupy 5,100 ÷ 153,498 = 3.3 percent of the Action Area's forested habitat within the Ibat range.

Relatively narrow (75–200 feet) transmission line ROWs represent about 80 percent of the Action Area (see section 2.1), and the remainder is patchy and widely dispersed throughout the TVA Region (e.g., power plants, TVA reservoir lands). Therefore, it is unlikely that the home range of an Ibat maternity colony lies fully within the Action Area, except perhaps on TVA Reservoir lands. It is more likely that the Action Area overlaps a portion of the home range of several of the 194 Ibat colonies that we estimate may occur in the TVA Region based on hibernacula counts. However, it is still useful to treat the programmatic Action Area as a unit that we expect to support the equivalent of 3 whole Ibat maternity colonies.

4.1.2. Northern Long-Eared Bat

The TVA region lies at southern limits of, but entirely within, the broad range of the NLEB. Figure 4-3 (taken from the BA) shows documented NLEB hibernacula and summer detection records that are within and near the TVA Region. The BA states (pg. 104) that "occurrence data for maternity roost trees [are] not available for anywhere in the TVA Region." However, the Service reported a total of 387 known maternity roost trees for the six States that are partially within the TVA Region, and 50 for the State of Tennessee, which is wholly within the TVA Region (USFWS 2016, BO for the 4(d) rule; Table 2.1).

Hibernacula counts, such as those described previously for the Ibat, are not a reliable means of estimating NLEB population size, either range-wide or in the Action Area (see section 3.3.2). To estimate NLEB numbers, we must instead make inferences based on the extent of forested habitats, observed detection (occupancy) rates from summer surveys, and the characteristics of NLEB summer colonies. TVA reports that the 1.015-million acre Action Area contains 240,103

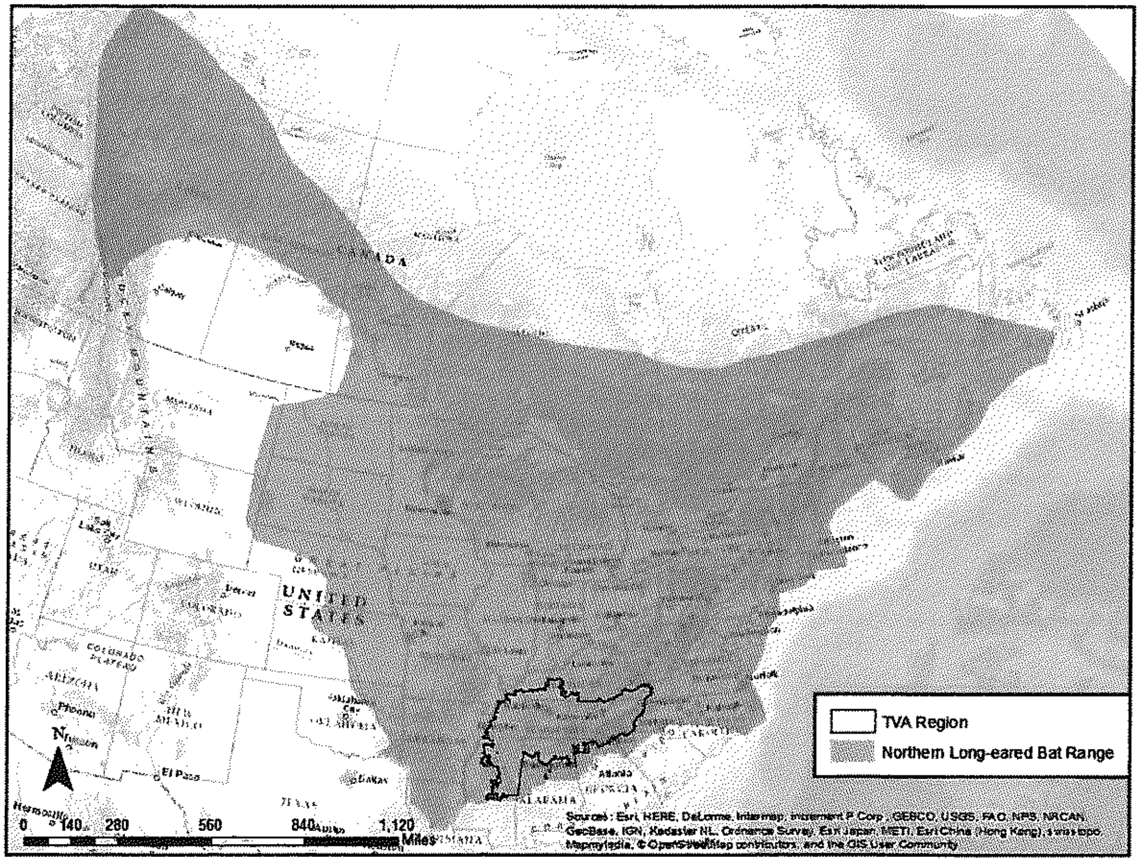


Figure 4-3. Range of the northern long-eared bat showing the TVA Region (source: BA Figure 4-3)

acres of forest cover (see section 2.1). The following paragraphs describe the occupancy rates and colony characteristics that we apply to this forest acreage to estimate NLEB numbers in the Action Area.

Occupancy Rates

The Service compiled data for post-WNS NLEB occupancy rates (percentage of survey sites in forested habitats that detected NLEB) in its 2016 BO for the 4(d) rule. Data for six of the seven TVA region states were either not available or available only from surveys on National Forests. Conditions on National Forests are not representative of the Action Area for this consultation, which is only 24 percent forested, and several of the Forests that provided data for the 2016 BO lie outside the TVA Region. Only Kentucky had occupancy data compiled from surveys conducted statewide, including the portion of the state within the TVA Region. The Service estimated the post-WNS NLEB occupancy rate from all 2013–2014 surveys in Kentucky as 14 percent (USFWS 2015a). The Service relied on this Kentucky occupancy estimate as best available data in evaluating the Tennessee Field Office's statewide bat conservation strategy (USFWS 2015b). Tennessee constitutes about half of the area of the TVA Region. Therefore, for purposes of this consultation, we also rely on the Kentucky-based estimate of 14 percent as the occupancy rate in the Action Area. We expect that the NLEB occupies 14 percent of the 240,103 forested acres of the Action Area, or 33,614 acres.

Estimated Number of NLEB Colonies

Summer home range includes both roosting and foraging areas, and range size may vary by sex. Studies of maternity roosting areas have reported sizes that vary from a mean of 21–179 acres (Owen *et al.* 2003; Broders *et al.* 2006; Lacki *et al.* 2009) to a maximum of 425 acres (Lacki *et al.* 2009). Foraging areas are six or more times larger (Broders *et al.* 2006; Henderson and Broders 2008). The distance traveled between consecutive roosts varies widely from 20 ft (Foster and Kurta 1999) to 2.4 miles (Timpone *et al.* 2010). Likewise, the distance traveled between roost trees and foraging areas in telemetry studies varies widely, e.g., a mean of 1,975 ft (Sasse and Perkins 1996) and a mean of 3,609 ft (Henderson and Broders 2008). Circles with a radius of these distances have an area of 281 and 939 acres.

Based on reported maximum individual home range (425 acres) and travel distances between roosts and foraging areas described above (corresponding to circular areas up to 939 acres), we use 1,000 acres for purposes of this BO as the area a NLEB colony uses. Within this 1,000-acre area, one or more members of a maternity colony and sympatric adult males/non-reproductive females would likely appear in mist net or acoustic surveys. Such appearance is the basis for the 14 percent occupancy rate we use to estimate the acreage of available forested habitat that we expect NLEB to use during the active season in the Action Area (33,614 acres).

The literature we have reviewed reports no information about the degree of spatial overlap between NLEB maternity colonies. We believe a 14 percent occupancy rate for the Action Area is appropriate; therefore, it is unlikely that limited habitat availability would contribute to substantial colony-range overlap in the Action Area. However, mist net survey data in Kentucky indicate that there is substantial overlap in the summer home range of reproductive females and that of males and non-reproductive females (J. Garland, pers. comm., 2015). Of 909 capture locations for males and non-reproductive females, only 87 (9.57 percent) did not have reproductively active females and were more than 3 miles away from captures of reproductive females. These data suggest a 100 – 9.57 = 90.43 percent overlap between the home range of individuals belonging to maternity colonies and other individuals, which we adopt for use in this BO. Because the 14 percent occupancy rate includes detections of males and non-reproductive females, we multiply the occupied forest acres of the Action Area by 0.9043, and then divide by 1,000 acres to compute the number of probable maternity colonies in the Action Area:

33,614 occupied (both sexes) acres × 0.9043 = 30,397 acres; which supports
30,397 ÷ 1000 = 31 maternity colonies (rounding up the fractional remainder).

Estimated Number of Individuals

For each 1,000 occupied acres of the Action Area, we assume the NLEB population associated with the single maternity colony that these acres support is comprised of 45 adult females, 45 adult males, and 45 juveniles following parturition (see section 3.2.1). Therefore, the active-season population associated with 31 colonies within the Action Area include 45 × 31 = 1,395 adult females, the same number of adult males, and the same number of juveniles after July 31 each year.

Relatively narrow transmission line ROWs represent about 80 percent of the Action Area (see section 2.1), and the remainder is patchy and widely dispersed throughout the TVA Region (e.g., power plants, TVA reservoir lands). As we discussed in the last paragraph of section 4.1.1 regarding Ibat colonies that we expect to occur in the Action Area, it is unlikely that the home range of 31 or more NLEB maternity colonies lie fully within the Action Area. It is more likely that the Action Area overlaps a portion of the home range of a larger number of colonies that occur in adjacent portions of the TVA Region. However, it is still useful to treat the programmatic Action Area as a unit that we expect to support the equivalent of 31 whole NLEB maternity colonies.

4.2. Action Area Conservation Needs and Threats

The conservation needs of and threats to the Ibat and NLEB in the Action Area are a regional subset of the range-wide needs and threats discussed in section 3.4. WNS is their greatest threat in the Action Area and eliminating this threat is their greatest conservation need. All seven states within the TVA Region have reported detecting the disease and fungus in hibernacula that are within the TVA region (https://www.fws.gov/midwest/endangered/mammals/nleb/pdf/WNSZone.pdf). The BA reports that TVA monitors caves on TVA-managed lands and cooperates with other agencies to monitor caves elsewhere in the TVA region. This monitoring tracks bat populations and the spread of WNS.

Sections 4.1.4 and 4.2.4 of the BA describe several ongoing TVA activities that support Ibat and NLEB conservation, including various studies, habitat management, artificial roosting structures, and installing bat-friendly cave gates.

5. EFFECTS OF THE ACTION

This section analyzes the direct and indirect effects of the Action on the Ibat and NLEB. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur. Our analyses are organized according to the description of the Action in section 2, which lists tree removal (section 2.2) and prescribed burning (section 2.3) as the components of the Action that may affect the Ibat and NLEB that require this BO for ESA compliance purposes. For the reasons we discussed in section 2.4, we are unable to assess meaningfully the beneficial effects to bats resulting from the "additional conservation measures" that TVA describes as part of the programmatic Action. However, we acknowledge that these measures to some degree offset the adverse effects of tree removal and prescribed burning.

5.1. Effects Analysis Methods

In the two following activity-specific sections (5.2 Tree Removal, and 5.3 Prescribed Burning), we identify the stressors (alteration of the environment that is relevant to the two species) that each activity will cause based on the description of the proposed Action. We then review the best available science and commercial information about how individual Ibats and NLEBs are likely to respond to each stressor. Lastly, we identify the circumstances for an individual bat's exposure to each stressor (overlap in time and space between the stressor and an Ibat or NLEB, considering the proposed conservation measures), and estimate the amount or extent of individual responses at the Action Area scale. This section explains the methods we apply to the last step under each activity-specific analysis.

Estimating the Spatial Extent of Bat Exposure

TVA projects will affect about 100,000 acres annually within a 1.015-million acre Action Area that is not delineated in the BA, and this Action Area is distributed throughout the 82-million acre TVA Region (see section 2.1). The BA provides the maximum annual acreage, and the 20-year cumulative acreage, of various activities that may occur during seasons that are relevant to the bats' life history (see sections 2.2 and 2.3). Ibat and NLEB are not ubiquitous in the Action Area, and we do not assume that all Action activity will occur in occupied habitats. Instead, our effects analyses compute the expected degree of spatial overlap between activities and occupied areas as the product of two independent event probabilities within the same space. We multiply a total area by the percentage of the area that will receive an activity and by the percentage of the area that a species occupies. The resulting acreage is the expected overlap (intersection) between the activity and the species' occupied habitat.

The area for the NLEB analyses is the forested acreage of the entire Action Area, which is 240,103 acres, and the NLEB occupancy rate within this area is 14 percent (see section 4.1.2). The area for the Ibat analyses is the forested acreage of the Action Area within the Ibat range, which is 153,498 acres (63.93 percent of the full Action Area), and the Ibat occupancy rate within this area is 3.3 percent (see section 4.1.1). For the Ibat analyses, we prorate the acreage of activities according to the percentage of the Action Area that is within the Ibat range (63.93 percent). Table 5-1 shows these calculations for tree removal activity. Such proration of the acreage of activities is not necessary for the NLEB analyses, because the range of the species encompasses the entire Action Area.

Table 5-1. Estimated acreage of seasonal tree removal activity that is within the range of the Ibat (63.93 percent of the total Action Area acreage from Table 2-1).

Years	**Inactive Season**[a]	**Active Season; All Bats Volant**[b]	**Active Season; Pups Non-Volant**[c]	**Total**
Annual 2018-2021	1,258	557	589	2,403
Annual 2022-2037	810	277	198	1,285
Cumulative 2018-2037	17,990	6,667	5,516	30,172

[a] Mid-November to mid-March

[b] Mid-March to April 30, and August 1 to mid-November

[c] June and July

Table 5-2 shows the amount of seasonal tree removal activity that will occur in the Action Area expressed as a percentage of the total amount of forested acreage (240,104 acres) in the Action Area. These percentages apply to both the Ibat and NLEB analyses, because we have prorated both the amount of tree removal activity and the amount of forested acreage within the range of the Ibat by the same fraction (63.93 percent).

Table 5-2. Seasonal tree removal activity expressed as a percentage of the total acreage of forest cover within the Action Area (240,103 acres within NLEB range, and 153,498 acres within Ibat range).

Years	Inactive Season[a]	Active Season; All Bats Volant[b]	Active Season; Pups Non-Volant[c]	Total
Annual 2018-2021	0.82%	0.36%	0.38%	1.57%
Annual 2022-2037	0.53%	0.18%	0.13%	0.84%
Cumulative 2018-2037	11.72%	4.34%	3.59%	19.66%

Estimating Numbers of Bats Exposed

Our analyses examine effects to Ibats and NLEBs while they are in their day-time roost trees, which constitute a tiny fraction of the total number of trees in the forested habitats they use for foraging and travel during the spring, summer, and fall. The broadly defined Action Area and programmatic nature of this consultation precludes any attempt to estimate effects at the scale of roost trees, or to partition the effects of Action activities between areas that contain roosts for pregnant females, solitary males, fall swarming, spring staging, etc. A substantial majority of the available data on Ibat and NLEB home range describes summer habitat and roost characteristics; therefore, we use summer home range and roost characteristics to represent the possible intersection between Action activities and the bats' active-season occupied habitats.

Although male Ibats generally remain closer to hibernacula during the active season than females (see section 3.2.1), we cannot attempt separate effects analyses for males and females without a partitioning of the Action Area relative to known Ibat hibernacula. NLEB migrate shorter distances from hibernacula than Ibats, and both sexes are frequently observed in the same summer habitats (see section 3.2.4). Therefore, we include both Ibat and NLEB adult males in an analysis based on maternity colony characteristics, recognizing that maternity colonies may occur in areas that are both close to and far from known hibernacula. Projects located closer to Ibat hibernacula would likely affect a higher percentage of Ibat males and cause fewer effects to pups, and vice versa for projects located farther from hibernacula.

We estimate numbers of bats affected in the expected area of overlap between Action activities and occupied habitats as the product of:

(a) the overlap area;
(b) the density of bats in a maternity colony home range, including sympatric males and non-reproductive females; and
(c) an expected response rate.

For adult Ibats, the density under (b) above is 60 females and 60 males in 1,700 acres, or 120 ÷ 1,700 = 0.0706 bats per acre (see section 4.1.1). Following the birth of up to 1 pup per adult female during the active season, this density increases to a maximum of 180 ÷ 1,700 = 0.1056 bats per acre. The density we use for NLEBs is 45 females and 45 males in 1,000 acres, or 90 ÷ 1,000 = 0.090 bats per acre (see section 4.1.2). Following the birth of up to 1 pup per adult female during the active season, this density increases to a maximum of 135 ÷ 1,000 = 0.135 bats per acre. The response rates we use under (c) above are stressor and life-stage specific. We explain the basis for the response rates we use in the discussion for each stressor caused by tree removal and by prescribed burning.

5.2. Tree Removal

In section 5.2 we examine the direct and indirect effects on Ibat and NLEB of the proposed tree removal associated with various routine activities over the next 20 years. Section 5.2.1 reviews best available data about stressors associated with tree removal and the responses of bats to these stressors. Section 5.2.2 provides our estimation of the amount or extent of bat exposure to these stressors caused by the Action. In this introduction to section 5.2, we first dismiss from further analysis potential stressors that are not likely to have measurable or detectable effect on bat numbers, reproduction, or distribution.

TVA determined that its BMPs and other conservation measures for protecting water quality during tree removal operations would reduce the introduction of sediments and contaminants to drinking water sources to levels that are not likely to adversely affect listed bats. The Service previously concurred with this determination relative to the gray bat, Virginia big-eared bat, and Ibat critical habitat (see section 1). We also concur with this determination relative to the Ibat and NLEB (see section 2.2.2; discussion under "Sedimentation, Spills, Pollutants, and Contaminants"). Therefore, we do not further address changes in water quality resulting from tree removal as a stressor to bats.

The removal of substantial amounts of forest cover may reduce the local availability and quality of foraging habitat for the Ibat and NLEB. However, analyzing such effects that projects implemented under this programmatic Action may cause is not feasible, because we have no data on the availability or quality of forest cover at the project scale. Further, we estimate that the Ibat and NLEB occupy only 3.3 and 14 percent, respectively, of all forest cover at both the Action Area and TVA Region scales; therefore, it is unlikely that foraging habitat is limiting for these species at these scales. In this BO, we assume that the individuals associated with Ibat and NLEB summer colonies forage and roost in an area of about 1,700 and 1,000 acres, respectively (see sections 4.1.1 and 4.1.2). Maximum annual tree removal under the Action is 3,759 acres (section 2.2.1). This tree removal will occur on multiple projects distributed throughout the 1.015-million acre Action Area. We consider the potential for a project under this Action to cause a measurable or detectable response by Ibat or NLEB individuals through reducing the availability or quality of foraging habitat as negligible. Therefore, we do not further address the effects of tree removal on bats via exposure to changes in foraging habitat availability or quality.

The conservation measures that TVA proposes to implement for tree removal activity (see section 2.2.2) include a general prohibition for tree removal near known Ibat and NLEB hibernacula. Specially, measure TR2 states:

> "Removal of suitable summer roosting habitat within 0.5 mile of Priority 1/Priority 2 Indiana bat hibernacula, or 0.25 mile of Priority 3/Priority 4 Indiana bat hibernacula or any northern long-eared bat hibernacula will be prohibited, regardless of season, with very few exceptions (*e.g.,* vegetation maintenance of TL ROW immediately adjacent to Norris Dam Cave, Campbell County, TN)."

We believe this measure limits the severity of any effects of tree removal on the microclimate of hibernacula, and on any bat individuals hibernating within, to insignificant levels. Therefore, we do not further address the direct or indirect effects of tree removal under this Action on bats in hibernacula.

Two of TVA's proposed conservation measures address the removal of trees that are documented as Ibat or NLEB roost trees (TR6) or are within 150 feet of documented roost trees (TR5) (see section 2.2.2). If documented roosts are present or within 150 feet of a tree-removal project area, these measures commit TVA to a site-specific review and assessment. If pups are present in trees planned for removal, these measures also commit TVA to coordination with the Service in determining how to "minimize impacts to pups to the extent possible" (BA pg. 117).

Although the Service supports these measures, we have no ability to assess their effectiveness at reducing impacts at the scale of this programmatic Action. The BA does not identify or tally the number of documented roost trees that are within the Action Area. Because the Action Area is not specifically delineated, we are unable to determine whether the Action may affect any particular documented roosts. Therefore, we acknowledge the potential benefits of these measures in project-level implementation of the Action, but do not attempt to estimate the extent to which they may avoid or minimize adverse effects of tree removal in the following analyses.

Six other proposed conservation measures for tree removal (TR1, 3–4, and 7–9) either relate to tracking and reporting tree removal activity or prescribe general conditions that may or may not reduce potential adverse effects (e.g., TR7, which limits tree removal within 100 feet of existing transmission ROWs to hazard trees). The tracking and reporting measures are appropriate components of this programmatic Action, but do not change the effects of the Action. For the remaining measures, we are unable to estimate the degree to which they may change the effects of the Action, and do not further consider them in the following analyses.

5.2.1. Stressors and Responses

The BA describes three primary stressors associated with the proposed tree removal activity: (1) noise and disturbance during removal operations; (2) loss of shelter (roost trees); and (3) introduction of sediments and contaminants to drinking water sources. We have dismissed #3 from further analysis (see section 5.2), but we agree that (1) and (2) are environmental changes caused by tree removal that are relevant to the Ibat and NLEB.

Noise/Disturbance

The people, chainsaws, and heavy equipment involved in tree removal generate noise and disturbance. During the active season for bats, this disturbance could cause volant bats to temporarily flee or permanently abandon roosts during the day, which is a disruption of normal behavior. Gardner *et al.* (1991b) reported that Ibats continued to roost and forage in an area with an active timber harvest. Callahan (1993) monitored the location of a primary roost by evening exit counts, which Ibats abandoned at some point during an 18-day gap between successive counts. Also at some point during that 18-day gap, a bulldozer started clearing brush adjacent to the tree, which Callahan noted as the likely, but not confirmed, cause of the roost abandonment.

Adult females that permanently abandon a roost with non-volant nursing pups would cause the death or injury of these pups. Although Ibats are known to carry pups between roosts, such movement increases the likelihood of injury. Regardless whether pups are present, the additional energy expenditure that flight away from disturbance causes is an adverse effect, and day-time flight is an alteration of normal nocturnal behavior.

Mikula *et al.* (2016) reviewed about 1,500 reports from 109 countries of attacks by 143 species of diurnal birds on 124 species of bats. The review compiled cases involving species from several bat taxonomic families. The family Vespertilionidae, to which the genus *Myotis* belongs, represented 22.8 and 58.8 percent of the cases of bats taken by raptors of the hawk and falcon families, respectively, and 77 percent of the bats taken by non-raptors (e.g., gulls, crows). Citing data from other studies, the authors surmised that the diurnal predation rate on bats is likely 100–1,000 times higher than the nocturnal predation rate when standardized relative to the duration of day versus night bat activity. The authors concluded that the reports and studies they reviewed strongly suggest that predation by birds restricts daytime activity in bats and is likely a major factor that contributed to the evolution of their generally nocturnal behavioral patterns.

About half of the forecast 20-year cumulative tree removal activity under this Action will occur within the narrow ROWs of power lines (see Table 2-1). Noise and disturbance will move with these operations along the length of the ROW, such that the duration of high sound and activity levels at any one location is brief. We believe it is unlikely that brief periods of noise and disturbance during daylight hours would cause females to permanently abandon roosts containing their non-volant pups, but noise, vibration, and machinery exhaust sufficiently close to roosts it may temporarily flush a percentage of volant bats. Despite the evidence of no such response in Gardner *et al.* (1991b) cited above, we conservatively estimate in this BO that 10 percent of volant bats exposed to daytime tree removal disturbance will fly to an alternate roost located away from the disturbance. The results of Mikula *et al.* (2016) summarized above support a finding that such disruption of diurnal sheltering behavior increases the likelihood of injury through predation by diurnal predators, which is consistent with the definition of incidental take in the form of harassment.

Roost Tree Loss – Direct Effects

Ibats and NLEBs use a network of multiple roost trees within their home range, and show fidelity to roosts used in previous years (see section 3.2.1). However, trees are an ephemeral resource, especially the trees preferred for roosting, which are typically dead or dying, with cavities, crevices, exfoliating bark, and other characteristics of senescence or poor health. Despite the observed use of the same roosts between years, both species must seek new roosts as necessary when traditional roost trees inevitably fall. Potential bat responses to roost loss, caused by natural factors or felling by humans, depends on when the loss occurs during the annual life cycle: (a) when non-volant pups (or adults in torpor) are present in the tree; (b) other times during the active season; or (c) during the inactive (hibernation) season. Removal of an occupied roost tree during the spring, summer, or fall has direct and immediate effects. Removal of an unoccupied roost tree has indirect (later in time) effects, which we discuss in the following sub-section.

Due to their small size, it is extremely unlikely to detect an Ibat or NLEB killed or injured by tree felling in a forested setting. The literature we have reviewed contains no reports of NLEB mortality resulting from roost tree removal. In the biological opinion for the NLEB 4(d) rule (USFWS 2016: pg. 38), the Service summarized three accounts of Ibat injury and mortality resulting from tree removal, which we quote here.

> "Cope *et al.* (1974) reported the first felling of an occupied Indiana bat maternity roost tree in Wayne County, Indiana. The landowner observed bats exiting the tree when it was bulldozed down. The original account stated that eight bats (2 adult females and 6 juveniles) were "captured and identified as Indiana bats," and that about 50 bats flew from the tree. Although the original account did not specify how the eight bats were captured, J. Whitaker (Indiana State University, pers. comm., 2005) recounted that those bats were killed or disabled, retrieved by the landowner, and subsequently identified by a biologist. In another case, Belwood (2002) reported on the felling of a dead maple in a residential lawn in Ohio. One dead adult female and 33 non-volant young were retrieved by the researcher. Three of the young bats were already dead when they were picked up, and two more died subsequently. The rest were apparently retrieved by adult bats that had survived. In a third case, 11 dead adult female Indiana bats were retrieved (by people) when their roost was felled in Knox County, Indiana (J. Whitaker, pers. comm., 2005)."

All three of these accounts document adult bat mortality. Two document juvenile mortality, two document adult survival, and one documents juvenile survival. Of the two documenting adult survival, apparently far more adults survived than were killed, and more juveniles survived than were killed in the Belwood case. The juvenile survival rate in the Belwood case was apparently high (5 died out of 33 retrieved, and the rest were apparently carried away by adults). This case from a residential lawn is the only available data on juvenile bat survival/mortality rates following roost tree removal. However, we believe it is not representative of tree felling in forested settings, where the ability to detect, retrieve, and place pups where adult bats may find them and carry them away is likely negligible.

For purposes of this consultation, we conservatively assume that removal of an occupied roost will harm (kill or injure) all non-volant pups present. We also assume that roost removal will either harm or harass all volant bats present. Cutting an occupied roost tree may cause some to fly away before the tree falls and crush some when the tree falls, but will cause all volant survivors to seek an alternate roost after the tree falls. Expelled from their roost, survivors are exposed to diurnal predators and other hazards until finding alternate shelter. For simplicity, and to avoid underestimating lethal effects, we treat these two responses to tree removal (immediate death/injury *vs.* displacement that creates the likelihood of injury) as a single effects pathway, to which we attribute a 100 percent harm response.

Roost Tree Loss – Indirect Effects

The effects of removing a roost tree while it is unoccupied depend on how individual Ibats and NLEBs use that tree at other times, whether as a maternity roost, an alternate summer roost, or a roost during spring staging or fall swarming. Removal of a primary maternity roost likely has the greatest impact, but the loss of any previously established roost causes bats to spend time and energy seeking a new roost that meets their requirements in that area.

Ibats and NLEBs form summer maternity colonies that exhibit "fission-fusion" behavior (Barclay and Kurta 2007; Garroway and Broders 2007). Members coalesce to form a group (fusion), but the composition of the main unit is dynamic. Individuals exit the main unit for solitary roosting or to form smaller roosting groups (fission), and later return to the main unit, which may sometimes move to another roost. Ibats and NLEBs switch roosts often, typically every 2–3 days (Kurta *et al.* 2002; Kurta 2005; Foster and Kurta 1999; Owen *et al.* 2002; Carter and Feldhamer 2005; Timpone *et al.* 2010). Several researchers interpret these behaviors as a an adaption to the ephemeral nature of tree roosts, whereby bats proactively seek and test the suitability of new roost trees in preparation for the eventual loss of the primary and secondary roosts they previously and currently use (Kurta *et al.* 2002, Carter and Feldhamer 2005, Timpone *et al.* 2010).

Because Ibats and NLEBs rely on previously established roosts, roost tree loss, regardless whether it occurs during the active or inactive (winter) seasons, may affect the fission-fusion dynamics of their maternity colonies. Kurta (2005) suggested that loss of a single alternate roost at any time of year probably has little impact on Ibats, because Ibat colonies use at least 8–25 alternate summer roosts, but that loss of a primary roost could disrupt colony social structure. Sparks *et al.* (2003) found that the natural loss of a single primary maternity roost led to the fragmentation of the colony (bats used more roosts and congregated less) following the roost loss. Because colonial behavior contributes to reproductive success (see section 3.2.1), colony fragmentation could reduce the colony recruitment rate (survival of offspring to sexual maturity).

Silvis *et al.* (2014a) studied the social dynamics of an Ibat colony located in central Ohio for two years using telemetry methods. These investigators represented the observed roosting networks in a mathematical model and then simulated the effects of roost removal. Results varied between the models of each year's networks. The probability of colony fragmentation exceeded 50 percent with the simulated removal of only 5 percent of the roosts using the 2009 network data, but with the simulated removal of 30 percent of the roosts using the 2010 network data. In both years, simulated removal of the primary roost resulted in fragmentation. The advantages of colonial behavior are reduced or lost when a colony fragments. However, colony fragmentation is probably also a necessary dispersal adaptation to the inevitable loss of ephemeral roosts. The authors of this study concluded: "As the ephemerality of roost trees likely cause Indiana bat maternity colonies to experience frequent roost loss, including that of primary roosts, fission-fusion dynamics may provide a mechanism for the formation of new maternity colonies by presenting opportunities for the colony to split."

At Fort Knox in Kentucky, Silvis *et al.* (2014b) tracked three maternity colonies of NLEB to evaluate their social and resource networks, *i.e.*, roost trees. Roost and social network structure differed between maternity colonies, and roost availability was not strongly related to network characteristics or space use. In model simulations based on the tracking data, removal of more than 20 percent of roosts initiated social network fragmentation, with greater loss causing greater fragmentation. The authors suggested that flexible social dynamics and tolerance of roost loss are adaptive strategies for coping with ephemeral conditions in dynamic forest habitats.

In the same Fort Knox study area with the same three NLEB maternity colonies, Silvis *et al.* (2015) removed (during winter) a primary maternity roost tree from one colony, 24 percent of the secondary roosts from another colony, and none from the third. Neither removal treatment altered the number of roosts used by individual bats the following active season, but secondary roost removal doubled the distances moved between sequentially used roosts. The overall location and spatial size of colonies was similar pre- and post-treatment. Patterns of roost use before and after removal treatments also were similar. Roost height, diameter at breast height, percent canopy openness, and roost species composition were similar pre- and post-treatment. The study did not investigate pre- and post-treatment reproductive success. NLEB use a wide range of tree species and sizes as roosts, and potential roosts were not limited in the treatment areas.

The studies summarized above suggest that colony fragmentation is a likely later-in-time Ibat response to the loss of a primary roost tree and to the loss of a sufficient percentage of alternate roost trees. Colony fragmentation, or delayed colony formation upon returning from hibernation to an altered colony home range, could reduce recruitment rates. Such reduction is consistent with the definition of incidental take in the form of harm, but no studies have yet investigated this indirect effect on either Ibats or NLEBs. Experimental results of roost tree removal during winter from two NLEB colonies did not document fragmentation, but loss of secondary roosts doubled the distances individuals travelled between roosts, and effects on reproductive success were not investigated. Therefore, available evidence indicates that, at minimum, the later-in-time Ibat and NELB response to roost tree loss is an increased energy expenditure to establish a new roost network, and that this increase is likely proportional to the fraction of home range roost trees removed. Although studies have focused on summer maternity habitats, it is reasonable to assume that loss of roosts in spring staging and fall swarming habitats also causes an increased energy expenditure. Whether this response to habitat modification actually reduces survival or reproductive success is uncertain.

Service policy regarding significant gaps in the best available data is to either:

- "extend the due date of the biological opinion until sufficient information is developed for a more complete analysis" (if the action agency agrees); or
- "develop the biological opinion with the available information giving the benefit of the doubt to the species" (USFWS and NMFS 1998: pg 1-6).

The need to determine whether, and to what degree, roost tree removal reduces survival or reproductive success is not unique to this consultation. Further, studies that could address this data gap are not feasible within a time frame that would serve TVA's ESA compliance obligations for the activities included under this programmatic Action. Therefore, in this BO we give the "benefit of the doubt" to the listed species by treating the removal of unoccupied roost trees as a habitat modification that may injure Ibats and NLEBs by significantly impairing their essential breeding or sheltering behaviors, *i.e.,* incidental take in the form of harm.

The increased energy expenditure caused by the removal of unoccupied roosts is likely proportional to the number of roosts an individual bat lost, the type of roost (a primary maternity roost, an alternate social roost, or a solitary roost), and other factors. Whether the time and energy spent seeking replacement roosts actually injures a bat (e.g., causes reproductive failure) likely depends on the availability of suitable roosts, the individual's condition (e.g., fat reserves depleted by hibernation and migration, suffering from WNS, etc.), and other factors. These factors are variable and will not always combine in a manner that causes injury. For this BO, we limit the injury caused by unoccupied roost removal, regardless of season, to adult females, and we use an injury rate of 10 percent to estimate numbers of bats responding to this stressor in this manner.

5.2.2. Estimation of Exposure and Numbers of Bats Affected

Section 5.2.1 identified noise/disturbance, direct physical trauma, and the loss/reduction of shelter (roost trees) as stressors caused by tree removal that are relevant to Ibat and NLEB individuals. We identified the bat responses to these stressors as: (1) fleeing noise/disturbance; (2) death or injury (removing occupied roost trees); and (3) reduced survival or reproductive success (removing unoccupied roost trees). We identified the response to disturbance as a disruption of diurnal roosting behavior that creates the likelihood of injury thorough predation (harassment), with an expected 10 percent response rate upon exposure (*i.e.*, 10 percent will flee; 90 percent will not). We identified the response to unoccupied roost tree removal as a reduction in reproductive success (harm), with expected 10 percent response rate upon exposure (*i.e.*, 10 percent will fail to raise a pup to volancy). Although some bat pups and volant bats may survive the felling of an occupied roost tree, we assume a 100 percent lethal/injurious (harm) response rate to such exposure. Ibat and NLEB exposure to the three stressors depends on the timing and location of tree removal relative to their home ranges within the Action Area.

TVA does not specify the locations for tree removal activity under this programmatic Action. Instead, the BA provides annual and 20-year cumulative acreages for tree removal that will occur in the 1.015-million acre Action Area, and specifies the seasonal timing for these acreages (see Table 2-2). Conducting 60 percent of the 20-year cumulative tree removal during the inactive season limits the direct impacts of noise and physical trauma to 40 percent of the acreage affected by this activity. Proposed conservation measures that may further limit the extent of exposure to the stressors caused by tree removal include (paraphrased):

- TR2 – With few exceptions, prohibiting the removal of suitable summer roosting habitat within 0.5 mile of P1/P2 Ibat hibernacula, and within 0.25 mile of P3/P4 Ibat hibernacula or any NLEB hibernacula.
- TR5 and TR6 – Requiring a site-specific review and assessment before removing a known Ibat or NLEB maternity roost tree, or any trees within 150 feet of a known Ibat or NLEB maternity roost tree, during the active season. If pups are present in trees planned

for removal, TVA will coordinate with the USFWS to determine how to minimize impacts to pups.

Table 5.3 provides our estimates of the numbers of Ibats and NLEBs that we expect tree removal activity to affect. For each stressor and corresponding life-stage-specific response, the table provides data for the expected spatial overlap between seasonal tree removal activity and occupied areas, bat densities in occupied areas, and the expected bat response rate, to calculate bat numbers affected, and the corresponding percentage of the Action Area total population affected. Three sets of seasonal tree removal activity are used in these calculations: (1) Annual 2018–2021; (2) Annual 2022–2037; and (3) Cumulative 2018–2037. These sets correspond to the description of the Action, which estimates a higher acreage of tree removal during the first 3 years than in the remaining 17 years, and the 20-year total acreage.

5.3. Prescribed Burning

In section 5.3, we examine the direct and indirect effects on Ibat and NLEB of the proposed prescribed burning on TVA lands over the next 20 years. Section 5.3.1 reviews best available data about stressors associated with prescribed burning and the responses of bats to these stressors. Section 5.3.2 provides our estimation of the amount or extent of bat exposure to these stressors caused by the Action. In this introduction to section 5.3, we first dismiss from further analysis potential stressors that are not likely to have measurable or detectable effect on bat numbers, reproduction, or distribution.

TVA determined that prescribed fire under this Action is not likely to adversely affect listed bats when they are within caves and mines documented as hibernacula or as active-season roosts. The TVA burning program prohibits prescribed fire within 0.25 mile of the entrances to such sites and other measures that limit the potential for smoke entering caves and mines that bats occupy (see section 2.3.2). The Service previously concurred with this determination relative to the gray bat, Virginia big-eared bat, and Ibat critical habitat (see section 1). We also concur with this determination relative to the Ibat and NLEB. Therefore, we do not further address in this BO the effects of prescribed burning on bats via exposure to smoke in hibernacula.

Prescribed fire may have both beneficial and adverse effects on the availability of suitable tree roosts and prey resources, which some of the literature we reviewed for the following section describes. However, we believe the scale of the TVA prescribed burning program, which will rarely exceed 1,500 acres annually (see section 2.3) on 26,247 acres of TVA Reservoir Lands (5.7 percent), is unlikely to have a measurable or detectable effect on the availability of roost tree or prey resources for the Ibat or NLEB colonies that may occupy these lands. Further, several of the TVA burning objectives listed in Table 2-3 are to maintain an early-successional seral stage, which is not Ibat and NLEB habitat.

Table 5-3. Estimated numbers of bats affected by tree removal.

Stressors -->	Noise/ disturbance	Physical trauma		Reduction of shelter resource
Stressor type	Direct	Direct	Direct	Indirect
Exposure period	Entire active season	Pup season	Entire active season	Year round
Life stage affected	Volant bats	Pups	Volant bats	Adult females
Individual Response	Flight to alternate roost (harassment)	Death or injury (harm)	Death or injury (harm)	Reduced reproduction (harm)
A. Response rate (section 5.2.2)	10%	100%	100%	10%
B. Percent of forest cover affected (from Table 5-2)				
Annual 2018-2021	0.75%	0.38%	0.75%	1.57%
Annual 2022-2037	0.31%	0.13%	0.31%	0.84%
Cumulative 2018-2037	7.94%	3.59%	7.94%	19.66%
C. Percent of forest cover occupied (sections 4.1.1 and 4.2.2)				
Ibat		3.30%		
NLEB		14.00%		
D. Total Action Area Forested Acres (section 2.1)				
Ibat		153,498		
NLEB		240,103		
E. Expected overlap (acres) (B*C*D)				
Ibat				
Annual 2018-2021	38	19	38	79
Annual 2022-2037	16	7	16	42
Cumulative 2018-2037	402	182	402	996
NLEB				
Annual 2018-2021	251	129	251	526
Annual 2022-2037	104	43	104	281
Cumulative 2018-2037	2,668	1,208	2,668	6,607
F. Bat density in occupied areas (section 5.1)				
# Ibat/acre	0.0706	0.0353	0.0706	0.0353
# NLEB/acre	0.0900	0.0450	0.0900	0.0450
G. Number of bats affected (A*E*F) (rounded up to nearest whole integer)				
Ibat				
Annual 2018-2021	1	1	3	1
Annual 2022-2037	1	1	2	1
Cumulative 2018-2037	3	7	29	4
NLEB				
Annual 2018-2021	3	6	23	3
Annual 2022-2037	1	2	10	2
Cumulative 2018-2037	25	55	241	30
H. Percentage of Action Area bats affected (G/H)				
Ibat (H=360 adults, or 180 pups, as applicable)				
Annual 2018-2021	0.28%	0.56%	0.83%	0.28%
Annual 2022-2037	0.28%	0.56%	0.56%	0.28%
Cumulative 2018-2037	0.83%	3.89%	8.06%	1.11%
NLEB (H=2,790 adults, or 1,395 pups, as applicable)				
Annual 2018-2021	0.11%	0.43%	0.82%	0.11%
Annual 2022-2037	0.04%	0.14%	0.36%	0.07%
Cumulative 2018-2037	0.90%	3.94%	8.64%	1.08%

In this BO, we use occupancy rates in the Action Area of 3.3 and 14 percent for Ibat and NLEB, respectively. Assuming that all 26,247 acres of Reservoir Lands that could use prescribed fire are forested, burning 5.7 percent of these lands annually yields an expected overlap between burning and bats of 49 and 210 acres for Ibat and NLEB, respectively. While we do not discount this overlap, assessing the indirect effects (later in time changes in roost and prey availability) of burning at this small scale in a programmatic context without site-specific data is not feasible. Therefore, we limit our analysis of prescribed burning to its direct effects on bats in forested habitats.

5.3.1. Stressors and Responses

Smoke and heat are stressors that are relevant to all species within or near the path of a fire, including the Ibat and NLEB, whether it is a wildfire or a prescribed burn. Three of the proposed avoidance and minimization measures listed in section 2.3.2 should limit the severity of smoke and heat as stressors in forested settings that bats occupy. TVA will use fire breaks to burn larger areas in smaller units (SHF1 and SHF3). Burns in April and May will occur when temperatures exceed 55°F to avoid affecting adult bats in torpor, who are unable to rouse quickly and fly to a roost beyond the smoke (SHF4).

Perry (2012) provided a review of fire effects on bats in the eastern oak region of the U.S., and Carter *et al.* (2002) provided a similar review for bats in the southeastern and mid-Atlantic states. Forest-dwelling bats, including the Ibat and NLEB, were presumably adapted to the fire regime that preceded European settlement and subsequent fire suppression in many parts of the eastern U.S. These reviews summarized how fire may affect individual bats directly (negatively) through exposure to heat, smoke, and carbon monoxide, and indirectly (both positively and negatively) through habitat modifications and resulting changes in their food base and tree roosts (Dickinson *et al.* 2009).

<u>Direct Effects in Tree Roosts</u>

Few studies have examined bat escape behaviors, direct mortality, or potential reductions in survival associated with fire. Dickinson *et al.* (2009) monitored two NLEB (one male and one female) in roosts during a controlled summer burn. Within 10 minutes of ignition near their roosts, both bats flew to areas that were not burning. All four bats they tracked before and after burning switched roosts during the fire, with no observed mortality. Rodrigue *et al.* (2001) reported flushing a *Myotis* bat from an ignited snag during an April controlled burn in West Virginia. Although these studies did not document injury or mortality resulting from daytime flights away from prescribed fire, this disruption of normal sheltering behavior creates the likelihood of injury by exposure to diurnal avian predators (see discussion in section 5.2.1 under "Noise/Disturbance").

Carter *et al.* (2002) suggested that the risk of direct injury and mortality to southeastern forest-dwelling bats resulting from summer prescribed fire is generally low. During warm temperatures, bats are able to arouse from short-term torpor quickly. Most adult bats are quick, flying at speeds > 30 km/hour (> 18 miles/hour) (Patterson and Hardin 1969), enabling escape to unburned areas. Ibats and NLEBs use multiple roosts, switching roost trees often (see section 3.2.1), and could likely use alternative roosts in unburned areas, should smoke make the current roost uninhabitable or fire destroy it. Non-volant pups are likely the most vulnerable to death and injury from fire. Although most eastern bat species are able to carry their young for some time after they are born (Davis 1970), the degree to which this behavior would allow females to relocate their young if fire threatens the nursery roost is unknown.

Dickinson *et al.* (2010) used a fire plume model, field measurements, and models of carbon monoxide and heat effects on mammals to explore the risk to the Ibat and other tree- roosting bats during prescribed fires in mixed-oak forests of southeastern Ohio and eastern Kentucky. Carbon monoxide levels did not reach critical thresholds that could harm bats in low- intensity burns at typical roosting heights for the Ibat (8.6 m) (28.2 ft). NLEB roost height selection is more variable, but on average lower (6.9 m) (22.8 ft) than the Ibat (Lacki *et al.* 2009). In this range of heights, direct heat could cause injury to the thin tissue of bat ears. Such injury would occur at roughly the same height as tree foliage necrosis (death), or where temperatures reach 60 °C (140 °F). Generally, forest managers plan prescribed fires to avoid significant tree scorch.

5.3.2. Estimation of Exposure and Numbers of Bats Affected

Prescribed burning is proposed for a well-defined portion of the larger Action Area for this consultation. This portion is comprised of 26,247 acres of TVA Reservoir lands on which TVA believes fire is an appropriate habitat management tool during the next 20 years (see section 2.3.1). These lands are entirely within the range of both the Ibat and NLEB; therefore, no partitioning of the proposed prescribed burning activity by species is necessary for this analysis.

Due to funding and staff limitations, TVA indicates that its burn activity is unlikely to exceed 1,500 acres annually, and that burn frequency on parcels presently treated with fire ranges from 1–5 years. Burning 1,500 different acres only once every year for the next 20 years would cover 30,000 acres, slightly more than the 26,247 acres that could benefit from prescribed fire. Maintaining a fire frequency of 1–5 years on some parcels and burning less than 1,500 acres annually will necessarily fall short of covering all the lands TVA would like to burn.

TVA proposes to conduct 10 percent of its prescribed burning during the active season outside of the pup season, none during the pup season (June and July), and the remainder (90 percent) during the inactive (winter) season (see section 2.3.1). Burning under the proposed Action will have no direct effects on non-volant pups. As we discussed in the introduction to section 5.3, we have dismissed from further analysis the direct effects of smoke on bats in hibernacula, due to the proposed conservation measures that limit such effects to insignificant levels. We have also dismissed from further analysis the indirect effects of burning on bats through changes in their forested habitat resources, such as roost tree availability and prey abundance. Winter burning has no direct effects on bats in forested habitats (bats are not present); therefore, our analysis in this section is limited to the direct effects of active season burning, which is limited to the months in which all bats are volant.

The 20-year cumulative acreage proposed for burning during the bat active season outside the pup season is 10 percent of 26,247 acres, or 2,624 acres. Lacking more specific data, we assume that the seasonal breakdown for the 20-year cumulative acreage applies to annual burning activity, which TVA indicates will rarely exceed 1,500 acres. Therefore, 150 acres is the expected annual amount of burning that may directly affect Ibats and NLEBs in their forested habitats, which is 0.571 percent of the TVA Reservoir Lands that may receive prescribed fire.

In this BO, we use occupancy rates in forested portions of the Action Area of 3.3 and 14 percent for Ibat and NLEB, respectively (see sections 4.1.1 and 4.1.2). Assuming that all 26,247 acres of Reservoir Lands that could use prescribed fire are forested, burning 0.571 percent of these lands annually yields an expected overlap between burning and occupied areas of 4.9 and 21.0 acres for Ibat and NLEB, respectively ($0.00571 \times 0.033 \times 26{,}247 = 4.9$, and $0.00571 \times 0.14 \times 26{,}247 = 21.0$).

In this BO, we use a density of 120 adult bats per 1,700 acres for Ibat (0.0706 bats/acre), and 90 adults per 1,000 acres for NLEB (0.09 bats/acre). On 4.9 and 21.0 occupied acres burned annually, the expected number of Ibats and NLEBs affected is 0.35 and 1.89, respectively, which we round up to 1 and 2. Without rounding up, burning 0.571 percent of the eligible Reservoir Lands annually for 20 years with constant bat occupancy rates and densities, we would expect fire to affect about 7 Ibats and and 38 NLEBs over the full duration of the Action (20×0.35 and 20×1.89).

Based on our literature review of the effects of fire on bats in section 5.3.1, we expect that all adult Ibats and NLEBs exposed to smoke or heat from prescribed fire would fly to alternate roosts, and that most would do so without injury. However, daytime flight away from such annoyance exposes bats to diurnal avian predators (see discussion in section 5.2.1 under "Noise/Disturbance"), which is consistent with the definition of incidental take in the form of harassment.

5.4. Summary of Effects

In section 5.2, we identified four unique pathways by which we expect stressors caused by tree removal under this Action to affect bats: noise and disturbance, physical trauma to non-volant pups, physical trauma to volant bats, and loss of shelter indirectly causing reduced reproduction. Bat responses upon exposure to the latter three pathways are consistent with the definition of incidental take in the form of harm, and responses to disturbance are consistent with the definition of take in the form of harassment.

However, the scale of this harm and harassment is small relative to the size of the Action Area and the numbers of bats we estimate it supports. We expect that noise from tree removal will each year cause a few individuals (1 Ibat and 3 NLEB) to flee their roosts, exposing them to diurnal predators. These numbers are low because we believe that Ibats and NLEBs are more likely (90 percent) to remain in a roost during tree removal operations that do not actually remove the roost tree.

For the Ibat, we expect the three pathways leading to harm to affect up to 5 individuals annually (1 pup, 3 volant bats, and 1 adult female). The 20-year cumulative estimates of harm are 7 pups and 29 volant bats killed or injured by felling an occupied tree, and 4 adult females injured (reproductive failure that year) by removal of unoccupied roost trees from the individual's roost network. Harming up to 4 volant bats annually represents 1.11 percent of the Ibat adult population that we believe the Action Area is likely to support (3 maternity colonies; 360 adults).

For the NLEB, the scale of harm caused by tree removal is greater than for the Ibat, but also small relative to the Action Area population. Two factors explain the different results for NLEB and Ibat: (a) the range of the NLEB encompasses the entire Action Area, whereas the range of the Ibat covers only 64 percent; and (b) we use an occupancy rate of 14 percent for the NLEB, and only 3.3 percent for the Ibat. The same three pathways leading to Ibat harm lead to NLEB harm. We expect tree removal to annually harm up to 6 NLEB pups, 23 volant bats, and 3 adult females. The 20-year cumulative estimates of harm are 55 pups, 241 volant bats, and 30 adult females. Harming up to 26 volant bats annually represents 0.93 percent of the NLEB adult population that we believe the Action Area is likely to support (31 maternity colonies; 2,790 adults).

In section 5.3, we determined that only the direct effects of prescribed burning during the bat-volant season (portion of the active season outside the pup season) are relevant to our analysis. Only 10 percent of the proposed burning will occur in this seasonal period. We expect that up to one (1) Ibat and two (2) NLEB annually will experience heat and smoke in their roosts and fly to an alternate roost, which will expose them to diurnal avian predators. This disruption of normal sheltering behavior, which creates the likelihood of injury, is consistent with the definition of incidental take in the form of harassment.

6. CUMULATIVE EFFECTS

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA.

The BA suggests that many types of non-federal actions may occur within the 1.015-million-acre Action Area during the next 20 years that may affect environmental resources. As examples, TVA lists state highway maintenance and improvement projects, airport operations and expansions, rail development projects, and others. However, the BA does not provide an assessment of how these actions may affect the Ibat or NLEB.

Most of the lands (about 89 percent) included in the Action Area are under a large or substantial degree of TVA control:

- 331,000 acres of TVA-retained lands (33 percent); and
- 569,001 acres of transmission line easements (56 percent) (source: BA Table 2-1).

Although non-federal actions may occur within transmission line easements, we believe it reasonable to assume that all actions on TVA-retained lands and many on TVA easements will involve managing and maintaining conditions for TVA purposes. Such actions are federal actions that we do not consider under cumulative effects in a consultation. The BA does not assess the effects of other non-federal actions that are reasonably certain to occur on these lands.

The remaining 11 percent of the Action Area lands are other non-TVA public lands associated with an anticipated level of TVA economic development support (7 percent), and an anticipated acreage of private lands identified for distributed solar energy generation (4 percent). These areas not under TVA ownership or easement, but are not specifically identified in the BA, because many of the sites that may support such activity in the next 20 years are not yet determined.

TVA expects that activities under the Action will affect only about 462,000 acres (45 percent) of the 1.015-million-acre Action Area. Therefore, it is not necessary to consider cumulative effects on about 55 percent of the Action Area. We lack a spatial delineation of the area that the Action may affect and any data about non-federal actions that are reasonably certain to occur in that area; therefore, the Service is unable to assess meaningfully the cumulative effects that may be relevant to this consultation.

7. CONCLUSION

In this section, we summarize and interpret the findings of the previous sections for the Ibat and NLEB (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat.

"Jeopardize the continued existence" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

Status – Biennial Ibat population estimates were increasing from 2001 to 2007, suggesting a reversal in a long-term decline. The decline thereafter is largely attributable to WNS, especially in the Northeast Recovery Unit. The NLEB was common in many areas of its broad range until the onset of WNS in 2006, but has declined rapidly since. We expect further declines in both species as WNS continues to spread. The most recent Ibat census (2017) estimated a total of 530,705 Ibats in 229 hibernacula in 17 states. The Service calculated a rough range-wide population estimate of about 6.5 million NLEB in the intra-Service BO for the species' final 4(d) rule. Although WNS continues to kill and weaken individuals in most of the species' range, NLEB populations may still number in the millions, but its status is highly uncertain.

Baseline – Based on the Ibat hibernacula census data, we estimate that the 82-million-acre TVA Region supports about 23,000 adult Ibats. Of this regional population, we estimate that the 1.015-million-acre Action Area supports three (3) Ibat maternity colonies, each comprised of 60 adult females and associated with the same number of sympatric adult males. Estimates of NLEB numbers cannot rely on hibernacula census data. Instead, we make inferences based on an observed occupancy rate of 14 percent in the TVA Region and colony characteristics from the literature. We estimate that the Action Area supports about 31 NLEB maternity colonies, each comprised of 45 adult females and associated with the same number of sympatric adult males. Ibat and NLEB conservation needs and threats in the Action Area are largely the same as the range-wide needs and threats. WNS is detected in all 7 states of the TVA Region, and is the primary threat to their survival and recovery.

Effects – We expect that noise and disturbance caused by tree removal activity under the proposed Action will harass small numbers (up to 1 Ibat and 3 NLEB) each year by flushing individuals from tree roosts. We expect tree removal to harm relatively small numbers of Ibats and NLEBs each year.

For the Ibat, our estimates of harm are up to 1 pup and 3 volant bats killed or injured by felling occupied roost trees, and up to one 1 adult female injured (reproductive failure that year) by removing roost trees from the individual's roost network. Harming up to 5 bats in a year represents about 1 percent of the Ibat population that we believe the Action Area is likely to support before pups are born (3 maternity colonies; 360 adults).

For the NLEB, our estimates are higher than for the Ibat, but not large. Our estimates of harm are up to 6 pups and 23 volant bats killed or injured by felling occupied roost trees, and up to 3 adult females injured (reproductive failure that year) by removing roost trees from their roost networks. Harming up to 32 bats in a year represents about 1 percent of the NLEB population that we believe the Action Area is likely to support before pups are born (31 maternity colonies; 2,790 adults).

The extent of prescribed burning on TVA lands that may affect bats is about 150 acres per year. This burning will not affect bat pups. We expect that up to 1 Ibat and 2 NLEB annually will experience heat and smoke in their roosts and fly to an alternate roost, which will expose them to diurnal predators.

Harming up to 5 Ibats per year of the current range-wide population of about 530,000 Ibats will not appreciably reduce the likelihood of the species' survival and recovery in the wild. Ibat numbers have declined due to WNS by about 10,000–60,000 adults between successive biennial winter census counts in recent years. The effects of this Action will not alter that trend by an amount that is biologically meaningful at either the recovery unit or range-wide scales.

Harming up to 32 NLEBs per year from a wide-wide population that may still number in the millions will not appreciably reduce the likelihood of the species' survival and recovery in the wild. The Service determined previously that an average annual timber harvest rate of about 3.7 million acres per year throughout the range of the NLEB was not likely to appreciably reduce the likelihood of the species' survival and recovery in the wild (USWFW 2016). Tree removal under this Action, up to 3,759 acres per year, is a tiny subset of this range-wide average annual activity. Although NLEB numbers continue to decline due to WNS, the effects of this Action will not alter this trend by an amount that is biologically meaningful at the scale of either regional populations overlapping the Action Area or the species' range.

Cumulative Effects – TVA expects that various activities under the Action will affect about 462,000 acres (45 percent) of the 1.015-million-acre Action Area. Therefore, it is not necessary to consider cumulative effects on about 55 percent of the Action Area. We lack a spatial delineation of the 462,000 acres that the Action may affect and any data about non-federal actions that are reasonably certain to occur in that area; therefore, the Service is unable to assess meaningfully the cumulative effects that may be relevant to this consultation.

Conclusion – After reviewing the species' current status, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the Ibat or the NLEB.

8. INCIDENTAL TAKE STATEMENT

ESA §9(a)(1) and regulations issued under §4(d) prohibit the take of endangered and threatened fish and wildlife species without special exemption. The term "take" in the ESA means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (ESA §3). In regulations at 50 CFR §17.3, the Service further defines:

- "harass" as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering;"
- "harm" as "an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering;" and
- "incidental take" as "any taking otherwise prohibited, if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity."

Under the terms of ESA §7(b)(4) and §7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered prohibited, provided that such taking is in compliance with the terms and conditions of an incidental take statement (ITS).

Regulations issued under ESA §4(d) prohibit the taking of the northern long-eared bat (NLEB) under specific conditions and circumstances, which are more limited than under the definitions quoted above. These prohibitions include incidental take resulting from tree-removal activity that "cuts or destroys known occupied maternity roost trees, or any other trees within a 150-foot (45-meter) radius from the maternity roost tree, during the pup season (June 1 through July 31)" (50 CFR §17.40). In this BO, we anticipate that projects under the programmatic Action will cause the taking of NLEB incidental to the removal of undocumented roost trees. Such taking is not prohibited under the NLEB 4(d) rule, and, therefore, does not require special exemption through compliance with the terms and conditions of an ITS. None are included for the NLEB in this ITS.

The programmatic Action evaluated in this BO does not authorize, fund, or carry out any of the future project-level activities that it describes, and these future Federal activities are subject to the requirements in ESA §7(a)(2). The TVA must determine on a project-level basis whether a proposed activity is consistent with the description of activities included in the programmatic Action and addressed in this BO, and if so, may rely upon the findings of this BO to document its compliance with §7(a)(2) with respect to the Indiana bat (Ibat) and NLEB. Such compliance does not relieve TVA of the requirements in §7(a)(2) for activities that may affect designated critical habitat or endangered and threatened species other than the Ibat and NLEB.

For the exemption in ESA §7(o)(2) to apply to the incidental taking of Ibats caused by project-level activities that are consistent with the programmatic Action addressed in this BO, TVA must undertake the non-discretionary measures described in this ITS, and these measures must become binding conditions of any permit, contract, or grant issued for implementing the Action. TVA has a continuing duty to regulate the activity covered by this ITS. The protective coverage of §7(o)(2) may lapse if the TVA fails to:

- assume and implement the terms and conditions; or
- require a permittee, contractor, or grantee to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit, contract, or grant document.

In order to monitor the impact of prohibited incidental take, TVA must report the progress of the Action and its impact on the species to the Service as specified in this ITS.

8.1. Amount or Extent of Take

This section specifies the amount or extent of take of Ibats that the Action is reasonably certain to cause, which we estimated in the "Effects of the Action" section of this BO. We reference, but do not repeat, these analyses here. We do not specify the anticipated amount or extent of take of NLEBs, because we do not expect the proposed Action to cause take of NLEB that is prohibited under the applicable regulations at 50 CFR §17.40.

The Service anticipates that the Action is reasonably certain to cause incidental take of individual Ibats consistent with the definition of harm resulting from tree removal activities (see section 5.2). We expect that the amount of take will not exceed five (5) individuals per calendar year and will not exceed 40 individuals over the 20-year duration (2018–2037) of the programmatic Action (see Table 5-3).

The Service anticipates that the Action is reasonably certain to cause incidental take of individual Ibats consistent with the definition of harass resulting from tree removal activities (see section 5.2) and from prescribed burning (see section 5.3). We expect that the amount of harassment caused by tree removal will not exceed one (1) individual per calendar year and will not exceed three (3) individuals over the 20-year duration (2018–2037) of the programmatic Action (see Table 5-3). We expect that the amount of harassment caused by prescribed burning will not exceed one (1) individual per calendar year and will not exceed seven (7) individuals over the 20-year duration (2018–2037) of the programmatic Action (see section 5.3.2).

The Service expects that incidental take of Ibats caused by the Action will be difficult to detect for the following reasons:

- individuals are small, mostly nocturnal, and when not hibernating, occupy forested habitats where they are difficult to observe;
- the species forms maternity colonies of about 60 adult females under loose bark or in the cavities of trees, and males and non-reproductive females may roost individually, which makes finding roost trees difficult;
- finding dead or injured individuals during or following tree removal in forested habitats is unlikely;
- observing individuals flying away from trees that are not known to contain a bat roost during tree removal operations or prescribed burning is unlikely; and

- some of the anticipated incidental take is in the form of reproductive failure that is not directly observable.

Due to the difficulty of detecting take of Ibats, TVA will monitor the extent of taking using the annual and 20-year cumulative acreages of tree removal and prescribed burning under the programmatic Action as a surrogate measure, because these activities will cause the taking. The amount of anticipated taking depends upon the seasonal timing of these activities. Therefore, TVA will monitor the annual and cumulative acreages according to the three seasonal periods defined for these activities in the description of the proposed Action. Taking of Ibats is expected in the Counties of the Action Area that are within the range of the Ibat (as shown in Figure 4-1), which represent about 64 percent of the total Action Area. Taking of Ibats will not exceed the levels we estimate in this BO resulting from tree removal and prescribed burning on an acreage within the range of the Ibat that is less than or equal to the following amounts:

	Tree Removal Acreage			
Years	Inactive Season; Bats Hibernating; November 15 – March 15	Active Season; All Bats Volant; March 16 – April 30, and August 1 – November 14	Active Season; Pups Non-Volant; June 1 – July 30	Total
Annual 2018-2021	1,258	557	589	2,403
Annual 2022-2037	810	277	198	1,285
Cumulative 2018-2037	17,990	6,667	5,516	30,172
	Prescribed Burning Acreage			
Annual	1,350	150	0	1,500
Cumulative 2018-2037	23,622	2,625	0	26,247

8.2. Reasonable and Prudent Measures

The proposed programmatic Action includes conservation measures to avoid and minimize impacts to the Ibat (see sections 2.2.2, 2.3.2) and to promote its recovery (see section 2.4). The analysis of effects of the Action in this BO considers that TVA will authorize, fund, or carry out all activities under the Action in a manner that is consistent with the description of activities in the BA, including all applicable conservation measures.

TVA also proposes procedures to document and report the alignment of TVA activities with the proposed programmatic Action (see section 2.5). These procedures include advance notification of the appropriate Service Field Office regarding project-specific effects determinations, alignment with the programmatic Action, bat survey results (if conducted), and coordination with Service Field Offices in the event that tree removal activity may directly affect Ibat or NLEB non-volant pups.

Based on our review of the proposed Action, its conservation measures, and its project-level review and notification procedures, the Service believes that no reasonable and prudent measures are necessary or appropriate to minimize the impacts of incidental take on the Ibat caused by the Action. Minor changes that do not alter the basic design, location, scope, duration, or timing of the Action will not reduce incidental take below the amount or extent anticipated for the Action as proposed. Therefore, this ITS does not provide reasonable and prudent measures.

8.3. Terms and Conditions

No reasonable and prudent measures to minimize the impacts of incidental take caused by the Action are provided in this ITS; therefore, no terms and conditions for carrying out such measures are necessary.

8.4. Monitoring and Reporting Requirements

In order to monitor the impacts of incidental take, the TVA "must report the progress of the Action and its impact on the species to the Service as specified in the incidental take statement" (50 CFR §402.14(i)(3)). This section provides the specific instructions for such monitoring and reporting (M&R). As necessary and appropriate to fulfill this responsibility, the TVA must require any permittee, contractor, or grantee to accomplish the monitoring and reporting through enforceable terms that are added to the permit, contract, or grant document. Such enforceable terms must include a requirement to immediately notify the TVA and the Service if the amount or extent of incidental take specified in this ITS is exceeded during Action implementation.

M&R1. Annual Reporting. Each year from 2019–2037, TVA will file a report not later than March 31 covering the preceding calendar year ending December 31. The report will:

(a) identify all tree-removal and prescribed burning projects, and report the seasonal timing and total acreage for each project;
(b) provide the results of any bat surveys associated with such projects;
(c) provide the effects determination for each project according to the procedures specified under Chapter 6 of the BA;
(d) summarize the outcome of any coordination with Service Field Offices as specified under tree removal conservation measures TR5 and TR6 in Chapter 5.2.4 of the BA.
(e) provide the results of any TVA-sponsored bat monitoring and research in the TVA Region.

TVA will provide these annual reports to the U.S. Fish and Wildlife Service, Tennessee Field Office, at 446 Neal Street, Cookeville, Tennessee 38501.

M&R2. Annual Coordination. TVA will convene a meeting with the Tennessee Field Office at least once each calendar year on a mutually agreeable date between May 1 and December 31 to:

(a) discuss the annual report under M&R1;
(b) review the progress of the Action; and
(c) review any new information relevant to the Action and its effects on the bat species considered in this consultation.

M&R3. Handling and Reporting Dead or Injured Listed Species. All personnel involved in activities under this TVA programmatic Action must take care when handling dead or injured Ibats, NLEBs, and any other endangered or threatened species that are found in a project area to preserve biological material in the best possible state, and to protect the handler from exposure to diseases, such as rabies. Project personnel are responsible for ensuring that evidence for determining the cause of death or injury is not disturbed unnecessarily. Reporting the discovery of dead or injured listed species is required in all cases to enable the Service to determine whether the level of incidental take exempted by this ITS is exceeded. Personnel finding a dead, injured, or sick specimen of any endangered or threatened species, must promptly notify the Service's Division of Law Enforcement at 1875 Century Blvd., Suite 380, Atlanta, Georgia 30345 (Telephone: 404/679-7057), and then the Service's Ecological Services Field Office of applicable jurisdiction.

9. CONSERVATION RECOMMENDATIONS

§7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to avoid or minimize the adverse effects of a proposed action, implement recovery plans, or develop information that is useful for the conservation of listed species. The Service offers the following recommendations that are relevant to the listed species addressed in this BO and that we believe are consistent with the authorities of the TVA. In general, our recommendations are to continue and expand the various programs that TVA already undertakes to contribute to bat conservation.

1. Continue the TVA collaboration with partners to survey bridges that may support maternity colonies.
2. Continue the TVA collaboration with partners to learn more about how bats are using habitats within the TVA region (*e.g.*, spring migration radio tagging and tracking, location and assessment of roost trees).
3. Conduct bat monitoring following bat habitat enhancement and artificial roost projects on TVA-managed lands to assess project benefits.
4. Monitor and maintain gates and signage at caves that listed bats use, and determine the need for new gates, fences, or signage at other caves on TVA lands that listed bats use.
5. Continue to serve as a member of state WNS planning committees.
6. Continue to update and maintain a database of listed bat occurrence records (*i.e.*, mist net captures, cave, bridge, and tree roosts, *etc.*), and use this database to inform project-specific environmental reviews and BAs.
7. Continue to offer workshops to TVA staff interested in assisting with conducting bat habitat assessments.

10. REINITIATION NOTICE

Formal consultation for the Action considered in this BO is concluded. Reinitiating consultation is required if the TVA retains discretionary involvement or control over the Action (or is authorized by law) when:

a. the amount or extent of incidental take is exceeded;
b. new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;
c. the Action is modified in a manner that causes effects to listed species or designated

critical habitat not considered in this BO; or

d. a new species is listed or critical habitat designated that the Action may affect.

In instances where the amount or extent of incidental take is exceeded, the TVA is required to immediately request a reinitiation of formal consultation.

LITERATURE CITED

Adams, R.A., and M.A. Hayes. 2008. Water availability and successful lactation by bats as related to climate change in arid regions of western North America. J. Animal Ecology 77:1115-1121.

Amelon, S., and D. Burhans. 2006. Conservation assessment: *Myotis septentrionalis* (northern long-eared bat) in the eastern United States. Pages 69-82 *in* Conservation assessments for five forest bat species in the eastern United States, Thompson, F. R., III, editor. U.S. Department of Agriculture, Forest Service, North Central Research Station, General Technical Report NC-260. St. Paul, Minnesota. 82pp.

Barbour, R.W. and W.H. Davis. 1969. Bats of America. University Press of Kentucky, Lexington. 286 pp.

Barclay, R.M.R., and A. Kurta. 2007. Ecology and Behavior of Bats Roosting in Tree Cavities and Under Bark. Chapter 2: pp. 17-60 in Bats in Forests: Conservation and Management, M.J. Lacki, J.P. Hayes, and A. Kurta, editors. The Johns Hopkins University Press, Baltimore, Maryland, 352pp.

Brack, V. Jr. 2006. Autumn activities of *Myotis sodalis* (Indiana bat) in Bland County, Virginia. Northeastern Naturalist 13(3):421-434.

Brack, V., Jr., and J.O. Whitaker, Jr. 2001. Foods of the northern myotis, *Myotis septentrionalis*, from Missouri and Indiana with notes on foraging. Acta Chiropterologica 3(2):203-210.

Broders, H.G., G.J. Forbes, S. Woodley, and I.D. Thompson. 2006. Range extent and stand selection for roosting and foraging in forest-dwelling northern long-eared bats and little brown bats in the Greater Fundy ecosystem, New Brunswick. J. Wildlife Management 70(5):1174-1184.

Caceres, M. C., and M. J. Pybus. 1997. Status of the northern long-eared bat (*Myotis septentrionalis*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 3, Edmonton, AB.

Callahan, E.V., III. 1993. Indiana bat summer habitat requirements. M.S. Thesis, University of Missouri, Columbia, Missouri.

Callahan, E.V., R.D. Drobney, and R.L. Clawson. 1997. Selection of summer roosting sites by Indiana bats (*Myotis sodalis*) in Missouri. J. Mamnmalogy. 78:818-825.

Carter, T. C., W.M. Ford, and M.A. Menzel. 2002. Fire and bats in the Southeast and Mid-Atlantic: more questions than answers? *In*: W.M. Ford, K.R. Russell, C.E. Moorman, eds., Proceedings: the role of fire for nongame wildlife management and community restoration: traditional uses and new directions. General Technical Report GTR-NE-288.

Newtown Square, PA: USDA Forest Service, Northeastern Research Station. pp. 139-143.

Carter, T.C., and G. Feldhamer. 2005. Roost tree use by maternity colonies of Indiana bats and northern long-eared bats in southern Illinois. Forest Ecology and Management 219:259-268.

Clawson, R.L. 2002. Trends in population size and current status. Pp. 2-8 in A. Kurta and J. Kennedy (eds.), The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, TX.

Davis, R. 1970. Carrying young by flying female North American bats. American Midland Naturalist, 83: 186- 196.

Dickinson, M.B., M.J. Lacki, and D.R. Cox. 2009. Fire and the endangered Indiana bat. Proceedings of the 3rd Fire in Eastern Oak Forests Conference GTR-NRS-P-46. Pp. 51-75.

Dickinson, M.B., J.C. Norris, A.S. Bova, R.L. Kremens, V. Young, and M.J. Lacki. 2010. Effects of wildland fire smoke on a tree-roosting bat: integrating a plume model, field measurements, and mammalian dose-response relationships. Canadian J. Forest Research 40:2187-2203.

Foster, R.W., and A. Kurta. 1999. Roosting ecology of the northern bat (*Myotis septentrionalis*) and comparisons with the endangered Indiana bat (*Myotis sodalis*). J. Mammalogy 80(2):659-672.

Gardner, J.E. and E.A. Cook. 2002. Seasonal and geographic distribution and quantification of potential summer habitat. Pp. 9-20 *in* A. Kurta and J. Kennedy (eds.), The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, TX.

Gardner, J.E., J.D. Garner, and J.E. Hofmann. 1991a. Summary of *Myotis sodalis* summer habitat studies in Illinois: with recommendations for impact assessment. Report prepared for Indiana/Gray bat Recovery Team Meeting, Columbia, MO 28 pp.

Gardner, J.E., J.D. Garner, and J.E. Hofmann. 1991b. Summer roost selection and roosting behavior of *Myotis sodalis* (Indiana bat) in Illinois. Unpublished report to Region-3 U.S.

Garroway, C.J., and H.G. Broders. 2007. Nonrandom association patterns at northern long-eared bat maternity roosts. Canadian J. Zoology 85:956-964.

Hall, J.S. 1962. A life history and taxonomic study of the Indiana bat, *Myotis sodalis*. Reading Publ. Mus. Art., Gallery Publ. 12:1-68.

Hall, J.S., R.J. Cloutier, and D.R. Griffin. 1957. Longevity Records and Notes on Tooth Wear of Bats. J. Mammalogy 38(3):407-409.

Henderson, L.E., and H.G. Broders. 2008. Movements and resource selection of the northern long-eared myotis (*Myotis septentrionalis*) in a forest-agriculture landscape. J. Mammalogy 89(4):952-963.

Humphrey, S.R., A.S. Richter and J.B. Cope. 1977. Summer habitat and ecology of the endangered Indiana bat, *Myotis sodalis*. J. Mammalogy 58(3):334-346.

Humphrey, S.R., and J.B. Cope. 1977. Survival rates of the endangered Indiana bat, *Myotis sodalis*. J. Mammalogy 58:32-36.

Jachowski, D.S., J.B. Johnson, C.A. Dobony, J.W. Edwards, W.M. Ford. 2014. Space use and resource selection by foraging Indiana bats at the northern edge of their distribution. Endangered Species Research 24(2):149.

Jackson, J.L. 2004. Effects of wildlife stand improvements and prescribed burning on bat and insect on bat and insect communities: Buffalo Ranger District, Ozark-St. Francis National Forest, Arkansas. MSc Thesis, Arkansas State University, Jonesboro, Arkansas, 152pp.

Johnson, J.B, J.W. Edwards, W.M. Ford, and J.E. Gates. 2009. Roost tree selection by northern myotis *(Myotis septentrionalis)* maternity colonies following prescribed fire in a Central Appalachian Mountains hardwood forest. Forest Ecology and Management 258:233- 242.

Kiser, J.D. and C.L. Elliott. 1996. Foraging habitat, food habits, and roost tree characteristics of the Indiana bat (*Myotis sodalis*) during autumn in Jackson County, Kentucky. Report prepared for Kentucky Department of Fish and Wildlife Resources, Nongame Program, Frankfort, KY. 65 pp.

Kniowski, A.B., and S.D. Gehrt. 2014. Home range and habitat selection of the Indiana bat in an agricultural landscape. J. Wildlife Management 78(3):503-512.

Kurta, A. 2005. Roosting ecology and behavior of Indiana bats (*Myotis sodalis*) in summer. Pp. 29-42 *in* K.C. Vories and A. Harrington (eds.), Proceedings of the Indiana bat and coal mining: a technical interactive forum. Office of Surface Mining, U.S. Department of the Interior, Alton, IL. Available at: http://www.mcrcc.osmre.gov/PDF/Forums/Bat%20Indiana/TOC.pdf.

Kurta, A., S.W. Murray, and D.H. Miller. 2002. Roost selection and movements across the summer landscape. Pp. 118-129 *in* A. Kurta and J. Kennedy (eds.), The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, TX.

Lacki, M.J., D.R. Cox, and M.B. Dickinson. 2009. Meta-analysis of summer roosting characteristics of two species of *Myotis* bats. American Midland Naturalist. 162: 318-26.

LaVal, R.K., R.L. Clawson, M.L. LaVal and W. Caire. 1977. Foraging Behavior and Nocturnal Activity Patterns of Missouri Bats, with Emphasis on the endangered species *Myotis grisescens* and *Myotis sodalis*. J. Mammalogy 58(4):592-599

LaVal, R.K. and M.L. LaVal. 1980. Ecological studies and management of Missouri bats, with emphasis on cave-dwelling species. Missouri Department of Conservation, Terrestrial Series 8:1-52.

Menzel, J.M., W.M. Ford, M.A. Menzel, T.C. Carter, J.E. Gardner, J.D. Garner, and J.E. Hofmann. 2005. Summer habitat use and home-range analysis of the endangered Indiana bat. J. Wildlife Management 69(1):430-436.

Mikula, P., F. Morelli, R.K. Lucan, D.N. Jones, and P. Tryjanowski. 2016. Bats as prey of diurnal birds: a global perspective. Mammal Review. 46. 10.1111/mam.12060.

Myers, R.F. 1964. Ecology of three species of myotine bats in the Ozark Plateau. Ph.D. Dissertation. University of Missouri, Columbia, MO. 210 pp.

NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://explorer.natureserve.org. (Accessed: May 10, 2017).

Owen, S.F., M.A. Menzel, W.M. Ford, B.R. Chapman, K.V. Miller, J.W. Edwards, and P.B. Wood. 2003. Home-range size and habitat used by the Northern Myotis (*Myotis septentrionalis*). American Midland Naturalist 150(2):352-359.

Owen, S.F., M.A. Menzel, W.M. Ford, J.W. Edwards, B.R. Chapman, K.V. Miller, and P.B. Wood. 2002. Roost tree selection by maternal colonies of northern long-eared myotis in an intensively managed forest. USDA Forest Service. Newtown Square, Pennsylvania.

Patriquin, K.J. and R.M. Barclay. 2003. Foraging by bats in cleared, thinned, and unharvested boreal forest. J. Applied Ecology, 40:646-657.

Patterson, A.P. and J.W. Hardin. 1969. Flight Speeds of Five Species of Vespertilionid Bats. J. Mammalogy 50(1):152–153. Available at: https://doi.org/10.2307/1378653.

Perry, R.W. 2011. Fidelity of Bats to Forest Sites Revealed From Mist-Netting Recaptures. J. Fish and Wildlife Management 2(1):112-116.

Perry, R.W. 2012. A Review of Fire Effects on Bats and Bat Habitat in the Eastern Oak Region. Proceedings of the 4th Fire in Eastern Oak Forests Conference. GTR-NRS-P-102.

Rodrigue, J.L., T.M. Schuler, and M.A. Menzel. 2001. Observations of bat activity during prescribed burning in West Virginia. Bat Research News 42:48-49.

Rommé, R.C., A.B. Henry, R.A. King, T. Glueck, and K. Tyrell. 2002. Home range near hibernacula in spring and autumn. Pp. 153-158 in A. Kurta and J. Kennedy (eds.), The Indiana bat: biology and management of an endangered species Bat Conservation International, Austin, TX.

Sasse, D.B., and P.J. Pekins. 1996. Summer roosting ecology of northern long-eared bats (*Myotis septentrionalis*) in the White Mountain National Forest. Bats and Forests Symposium October 1995, Victoria, British Columbia, Canada, pp. 91-101.

Sherwin, H.A., W.I. Montgomery, and M.G. Lundy. 2013. The impact and implications of climate change for bats. Mammal Review 43(3):171-182.

Silvis, A., A.B. Kniowski, S.D. Gehrt, and W.M. Ford. 2014a. Roosting and Foraging Social Structure of the Endangered Indiana Bat *(Myotis sodalis)*. PloS one 9:e96937.

Silvis, A., W.M. Ford, and E.R. Britzke, and J.B. Johnson. 2014b. Association, roost use and simulated disruption of *Myotis septentrionalis* maternity colonies. Behavioral processes, 103:283-290.

Silvis, A., W.M. Ford, and E.R. Britzke. 2015. Effects of Hierarchical Roost Removal on Northern Long-Eared Bat (*Myotis septentrionalis*) Maternity Colonies. PLoS ONE, 10(1):1-17.

Sparks D.W., M.T. Simmons, C.L. Gummer, and J.E. Duchamp. 2003. Disturbance of roosting bats by woodpeckers and raccoons. Northeastern Naturalist 10:105-8.

Sparks, D.W., C.M. Ritzi, J.E. Duchamp, and J.O. Whitaker, Jr. 2005. Foraging habitat of the Indiana bat *(Myotis sodalis)* at an urban-rural interface. J. Mammalogy 86:713-718.

Timpone, J.C., J.G. Boyles, K.L. Murray, D.P. Aubrey, and L.W. Robbins. 2010. Overlap in roosting habits of Indiana Bats (*Myotis sodalis*) and northern bats (*Myotis septentrionalis*). American Midland Naturalist 163:115-123.

U.S. Department of Agriculture, Forest Service (USFS). 2014. U.S. Forest Resource Facts and Historical Trends. Forest Service, FS-1035, 64pp.

U.S. Fish and Wildlife Service (USFWS). 1983. Recovery Plan for the Indiana Bat. Twin Cities, MN.

U.S. Fish and Wildlife Service (USFWS). 2007. Indiana bat (*Myotis sodalis*) Draft Recovery Plan: First Revision. Fort Snelling, MN.

U.S. Fish and Wildlife Service (USFWS). 2009. Indiana Bat (*Myotis sodalis*) 5-Year Review: Summary and Evaluation. Bloomington Ecological Services Field Office, Bloomington, Indiana. 45 pp.

U.S. Fish and Wildlife Service (USFWS). 2014. Northern Long-eared Bat Interim Conference and Planning Guidance. USFWS Regions 2, 3, 4, 5, & 6. 67 pages, including appendices.

U.S. Fish and Wildlife Service (USFWS). 2015a. Biological Opinion, Kentucky Field Office's Participation in Conservation Memoranda of Understanding for the Indiana Bat and/or Northern Long-eared Bat. USFWS, Southeast Regional Office, Atlanta, Georgia.

U.S. Fish and Wildlife Service (USFWS). 2015b. Biological Opinion, Tennessee Field Office's Participation in Conservation Memoranda of Understanding for the Indiana Bat and/or Northern Long-eared Bat. USFWS, Southeast Regional Office, Atlanta, Georgia.

U.S. Fish and Wildlife Service (USFWS). 2016. Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-Eared Bat and Activities from Take Prohibitions. Midwest Region. 103 pp.

U.S. Fish and Wildlife Service (USFWS). 2017. 2017 Indiana bat (*Myotis sodalis*) population status update. Indiana Ecological Services Field Office. 9 pp.

U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). 1998. Endangered Species Consultation Handbook. Available at: https://www.fws.gov/endangered/esa-library/pdf/esa_section7_handbook.pdf.

Watrous, K.S., T.M. Donovan, R.M. Mickey, S.R. Darling, A.C. Hicks, and S.L. Von Oettingen. 2006. Predicting minimum habitat characteristics for the Indiana bat in the Champlain Valley. J. Wildlife Management 70:1128-1237.

Whitaker, J.O., Jr. and V. Brack, Jr. 2002. Distribution and summer ecology in Indiana. Pp. 48-54 *in* A. Kurta and J. Kennedy (eds.), The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, TX.

Whitaker, J.O., and W.J. Hamilton. 1998. Order Chiroptera: Bats. Chapter 3: pp.89-102 in Mammals of the eastern United States, Third Edition, Comstock Publishing Associates, a Division of Cornell University Press, Ithaca, New York, 608pp.

Yates, M.D., and R.M. Muzika. 2006. Effect of forest structure and fragmentation on site occupancy of bat species in Missouri Ozark Forests. J. Wildlife Management 70(5):1238-1248.

Personal Communications:

Garland, Jennifer. 2015. U.S. Fish and Wildlife Service, Kentucky Ecological Services Field Office. Memo dated July 22, 2015, to Jerry Ziewitz, U.S. Fish and Wildlife Service, Southeast Regional Office.

LeGrand, Holly. 2017. Tennessee Valley Authority. Email dated December 17, 2017, to Todd Shaw, U.S. Fish and Wildlife Service, Tennessee Ecological Services Office.

LeGrand, Holly. 2018a. Tennessee Valley Authority. Email dated January 9, 2018, to Todd Shaw, U.S. Fish and Wildlife Service, Tennessee Ecological Services Office.

LeGrand, Holly. 2018b. Tennessee Valley Authority. Email dated March 28, 2018, to Jerry Ziewitz, U.S. Fish and Wildlife Service, Southeast Regional Office.

Appendix D – Agency Correspondence and Consultation on Federally Listed Threatened and Endangered Species (Except Bats) on the Impacts of Routine Vegetation Management Activities

This page intentionally left blank

United States Department of the Interior

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

December 18, 2018

Mr. John T. Baxter
Manager, Biological Compliance
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902

Re: FWS #2018-F-0958; Programmatic Consultation for Right-of-Way Vegetation Management that May Affect Endangered or Threatened Plants in the Tennessee Valley Authority Service Area

Dear Mr. Baxter:

This letter acknowledges the U.S. Fish and Wildlife Service's (Service) November 21, 2018, receipt of your November 19, 2015, letter requesting initiation of formal section 7 consultation under the Endangered Species Act (Act). The consultation concerns the possible effects of your proposed Programmatic Strategy for Right-of-Way Vegetation Management that May Affect Endangered or Threatened Plants in the Tennessee Valley Authority Service Area (TVA) (the Proposed Action) on 18 federally listed plants, including:

- Price's potato-bean (*Apios priceana*)
- Braun's rock-cress (*Arabis perstellata*)
- Pyne's ground plum (*Astragalus bibullatus*)
- Morefield's leather-flower (*Clematis morefieldii*)
- Alabama leather flower (*Clematis socialis*)
- leafy prairie-clover (*Dalea foliosa*)
- whorled sunflower (*Helianthus verticillatus*)
- small whorled pogonia (*Isotria medeoloides*)
- fleshy-fruit gladecress (*Leavenworthia crassa*)
- lyre-leaf bladderpod (*Lesquerella lyrata*)
- Spring Creek bladderpod (*Lesquerella perforata*)
- Mohr's Barbara's buttons (*Marshallia mohrii*)
- Cumberland sandwort (*Minuartia cumberlandensis*)
- Short's bladderpod (*Physaria globosa*)
- white fringeless orchid (*Platanthera integrilabia*)
- green pitcher plant (*Sarracenia oreophila*)
- large-flowered skullcap (*Scutellaria montana*)
- Tennessee yellow-eyed grass (*Xyris tennesseensis*)

All information required of you to initiate consultation was either included with your letter or is otherwise accessible for our consideration and reference. We have assigned log number FWS 2018-F-0958 to this consultation. Please refer to that number in future correspondence on this consultation.

Based on the information provided, the Service agrees that the Proposed Action may affect and is likely to adversely affect the 18 plant species listed above and that initiation of formal consultation is appropriate for the Proposed Action. Section 7 allows the Service up to 90 calendar days to conclude formal consultation with your agency and an additional 45 calendar days to prepare a biological opinion (unless we mutually agree to an extension). Therefore, we expect to provide you with a final biological opinion no later than April 5, 2019. As has been previously discussed, we also agree to provide TVA a draft biological opinion for review by March 5, 2019.

As a reminder, the Act requires that after initiation of formal consultation, the federal action agency may not make any irreversible or irretrievable commitment of resources that limits future options. This practice insures agency actions do not preclude the formulation or implementation of reasonable and prudent alternatives that avoid jeopardizing the continued existence of endangered or threatened species or destroying or modifying their critical habitats.

In your letter, TVA also determined that the proposed Action is not likely to adversely affect the listed species and designated critical habitats on the attached list. The Service has reviewed the data and rationale for these determinations that was provided in the BA. We agree that the proposed best management practices, standard operating procedures, and appropriate avoidance measures associated with the activities that may affect these species and critical habitats will limit any adverse effects to an insignificant scale or discountable probability. Therefore, we concur with TVA's determinations for the listed species and designated critical habitats in the attached list, and this letter concludes consultation for the Action relative to those listed species and designated critical habitats. However, reinitiating consultation relative to the species and critical habitats in the attached list is required if TVA retains discretionary involvement or control over the Action (or is authorized by law) when:

- new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BA;
- the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BA; or
- a new species is listed or critical habitat designated that the Action may affect.

If you have any questions or concerns about this consultation or the consultation process in general, please feel free to contact myself or Todd Shaw of this office at 931/525-4985, or at *ross_shaw@fws.gov*.

Sincerely,

Virgil Lee Andrews, Jr.
Acting Field Supervisor

xc: Christine Willis, USFWS, Region 4
attachment – NLAA Species and Critical Habitats List

Listed species (LE=listed as endangered; LT=listed as threatened) and designated critical habitats (DCH) that TVA has determined the proposed Action is not likely to adversely affect (NLAA).

Scientific Name	Common Name	Federal Status	DCH (Y=Yes)	TVA Species Determination	TVA DCH Determination
Mammals					
Glaucomys sabrinus coloratus	Carolina Northern Flying Squirrel	LE	-	NLAA	-
Birds					
Charadrius melodus	Piping Plover	LT	-	NLAA	-
Grus americana	Whooping Crane	LE	-	NLAA	-
Mycteria americana	Wood Stork	LT	-	NLAA	-
Picoides borealis	Red-cockaded Woodpecker	LE	-	NLAA	-
Sterna antillarum athalassos	Interior Least Tern	LE	-	NLAA	-
Reptiles					
Graptemys oculifera	Ringed Map Turtle	LT	-	NLAA	-
Sternotherus depressus	Flattened Musk Turtle	LT	-	NLAA	-
Amphibians					
Gyrinophilus gulolineatus	Berry Cave Salamander	C	-	NLAA	-
Necturus alabamensis	Black Warrior Waterdog	LE	Y	NLAA	NLAA
Fishes					
Acipenser oxyrinchus desotoi	Gulf Sturgeon	LT	-	NLAA	-
Chrosomus saylori	Laurel Dace	LE	Y	NLAA	NLAA
Cottus paulus (pygmaeus)	Pygmy Sculpin	LT	Proposed	NLAA	NE*
Crystallaria cincotta	Diamond Darter	LE	Y	NLAA	NLAA
Cyprinella caerulea	Blue Shiner	LT	-	NLAA	-
Elassoma alabamae	Spring Pygmy Sunfish	LT	Proposed	NLAA	NLAA
Erimonax monachus	Spotfin Chub	LT	Y	NLAA	NLAA
Erimystax cahni	Slender Chub	LT	Y	NLAA	NLAA
Etheostoma akatulo	Bluemask Darter	LE	-	NLAA	-
Etheostoma boschungi	Slackwater Darter	LT	Y	NLAA	NLAA
Etheostoma chermocki	Vermilion Darter	LE	Y	NLAA	NE*
Etheostoma chienense	Relict Darter	LE	-	NLAA	-
Etheostoma nuchale	Watercress darter	LE	-	NLAA	-
Etheostoma percnurum	Duskytail Darter	LE	-	NLAA	-
Etheostoma phytophilum	Rush Darter	LE	Y	NLAA	NE*
Etheostoma rubrum	Bayou Darter	LT	-	NLAA	-
Etheostoma spilotum	Kentucky Arrow Darter	LT	-	NLAA	-
Etheostoma susanae	Cumberland Darter	LE	Y	NLAA	NLAA
Etheostoma trisella	Trispot Darter	PT	-	NLAA	-
Etheostoma wapiti	Boulder Darter	LE	-	NLAA	-
Moxostoma sp. 2	Sicklefin Redhorse	Under Review	-	NLAA	-
Notropis albizonatus	Palezone Shiner	LE	-	NLAA	-
Notropis cahabae	Cahaba Shiner	LE	Proposed	NLAA	NE*

Scientific Name	Common Name	Federal Status	DCH (Y=Yes)	TVA Species Determination	TVA DCH Determination
Noturus baileyi	Smoky Madtom	LE	Y	NLAA	NE*
Noturus crypticus	Chucky Madtom	LE	Y	NLAA	NE*
Noturus flavipinnis	Yellowfin Madtom	LT	Y	NLAA	NE*
Noturus stanauli	Pygmy Madtom	LE	-	NLAA	-
Percina antesella	Amber Darter	LE	Y	NLAA	NLAA
Percina aurolineata	Goldline Darter	LT	Proposed	NLAA	NE*
Percina aurora	Pearl Darter	LT	-	NLAA	-
Percina jenkinsi	Conasauga Logperch	LE	Y	NLAA	NLAA
Percina tanasi	Snail Darter	LT	-	NLAA	-
Phoxinus cumberlandensis	Blackside Dace	LT	-	NLAA	-
Scaphirhynchus albus	Pallid Sturgeon	LE	-	NLAA	NLAA
Scaphirhynchus suttkusi	Alabama Sturgeon	LE	-	NLAA	-
Speoplatyrhinus poulsoni	Alabama Cavefish	LE	Y	NLAA	NE*
Freshwater mussels					
Alasmidonta atropurpurea	Cumberland Elktoe	LE	Y	NLAA	NLAA
Alasmidonta raveneliana	Appalachian Elktoe	LE	Y	NLAA	NE*
Cumberlandia monodonta	Spectaclecase	LE	-	NLAA	-
Cyprogenia stegaria	Fanshell	LE	-	NLAA	-
Dromus dromas	Dromedary Pearlymussel	LE	-	NLAA	-
Epioblasma brevidens	Cumberlandian Combshell	LE	Y	NLAA	NLAA
Epioblasma capsaeformis	Oyster Mussel	LE	Y	NLAA	NLAA
Epioblasma florentina florentina	Yellow-blossom Pearlymussel	LE	-	NLAA	-
Epioblasma florentina walkeri	Tan Riffleshell	LE	-	NLAA	-
Epioblasma metastriata	Upland Combshell	LE	Y	NLAA	NLAA
Epioblasma obliquata obliquata	Purple Catspaw	LE	-	NLAA	-
Epioblasma othcaloogensis	Southern Acornshell	LE	Y	NLAA	NLAA
Epioblasma penita	Southern Combshell	LE	-	NLAA	-
Epioblasma torulosa gubernaculum	Green Blossom Pearlymussel	LE	-	NLAA	-
Epioblasma torulosa rangiana	Northern Riffleshell	LE	-	NLAA	-
Epioblasma torulosa torulosa	Tuberculed Blossom Pearlymussel	LE	-	NLAA	-
Epioblasma triquetra	Snuffbox	LE	-	NLAA	-
Epioblasma turgidula	Turgid Blossom Pearlymussel	LE	-	NLAA	-
Fusconaia cor	Shiny Pigtoe Pearlymussel	LE	-	NLAA	-

Scientific Name	Common Name	Federal Status	DCH (Y=Yes)	TVA Species Determination	TVA DCH Determination
Fusconaia cuneolus	Fine-rayed Pigtoe	LE	-	NLAA	-
Hemistena lata	Cracking Pearlymussel	LE	-	NLAA	-
Lampsilis abrupta	Pink Mucket	LE	-	NLAA	-
Lampsilis altilis	Fine-lined Pocketbook	LT	Y	NLAA	NLAA
Lampsilis perovalis	Orange-nacre Mucket	LT	Y	NLAA	NLAA
Lampsilis virescens	Alabama Lampmussel	LE	-	NLAA	-
Lemiox rimosus	Birdwing Pearlymussel	LE	-	NLAA	-
Leptodea leptodon	Scaleshell	LE	-	NLAA	-
Medionidus acutissimus	Alabama Moccasinshell	LT	Y	NLAA	NLAA
Medionidus parvulus	Coosa Moccasinshell	LE	Y	NLAA	NLAA
Obovaria retusa	Ring Pink	LE	-	NLAA	-
Pegias fabula	Little-wing Pearlymussel	LE	-	NLAA	-
Plethobasus cicatricosus	White Wartyback	LE	-	NLAA	-
Plethobasus cooperianus	Orange-foot Pimpleback	LE	-	NLAA	-
Plethobasus cyphyus	Sheepnose	LE	-	NLAA	-
Pleurobema clava	Clubshell	LE	-	NLAA	-
Pleurobema curtum	Black Clubshell	LE	-	NLAA	-
Pleurobema decisum	Southern Clubshell	LE	Y	NLAA	NLAA
Pleurobema furvum	Dark Pigtoe	LE	Y	NLAA	NLAA
Pleurobema georgianum	Southern Pigtoe	LE	-	NLAA	-
Pleurobema gibberum	Cumberland Pigtoe	LE	-	NLAA	-
Pleurobema hanleyianum	Georgia Pigtoe	LE	-	NLAA	-
Pleurobema marshalli	Flat Pigtoe	LE	-	NLAA	-
Pleurobema perovatum	Ovate Clubshell	LE	Y	NLAA	NLAA
Pleurobema plenum	Rough Pigtoe	LE	-	NLAA	-
Pleurobema taitianum	Heavy Pigtoe	LE	-	NLAA	-
Pleuronaia dolabelloides	Slabside Pearlymussel	LE	Y	NLAA	NLAA
Potamilus capax	Fat Pocketbook	LE	-	NLAA	-
Potamilus inflatus	Alamabama (inflated) Heelsplitter	LT	-	NLAA	-
Ptychobranchus greenii	Triangular Kidneyshell	LE	Y	NLAA	NLAA
Ptychobranchus subtentum	Fluted Kidneyshell	LE	Y	NLAA	NLAA
Quadrula cylindrica	Rabbitsfoot	LT	Y	NLAA	NLAA
Quadrula cylindrica strigillata	Rough Rabbitsfoot	LE	Y	NLAA	NLAA
Quadrula fragosa	Winged Mapleleaf	LE	-	NLAA	-
Quadrula intermedia	Cumberland Monkeyface	LE	-	NLAA	-
Quadrula sparsa	Appalachian Monkeyface	LE	-	NLAA	-
Quadrula stapes	Stirrupshell	LE	-	NLAA	-
Toxolasma cylindrellus	Pale Lilliput	LE	-	NLAA	-
Villosa fabalis	Rayed Bean	LE	-	NLAA	-
Villosa perpurpurea	Purple Bean	LE	Y	NLAA	NLAA
Villosa trabalis	Cumberland Bean	LE	-	NLAA	-
Snails					

Scientific Name	Common Name	Federal Status	DCH (Y=Yes)	TVA Species Determination	TVA DCH Determination
Anguispira picta	Painted Snake Coiled Forest Snail	LT	-	NLAA	-
Athearnia anthonyi	Anthony's River Snail	LE	-	NLAA	-
Campeloma decampi	Slender Campeloma	LE	-	NLAA	-
Leptoxis ampla	Round Rocksnail	LT	-	NLAA	-
Leptoxis foremani	Interrupted Rocksnail	LE	Y	NLAA	NLAA
Leptoxis plicata	Plicate Rocksnail	LE	-	NLAA	-
Leptoxis taeniata	Painted Rocksnail	LT	-	NLAA	-
Lioplax cyclostomaformis	Cylindrical Lioplax	LE	-	NLAA	-
Pleurocera foremani	Rough Hornsnail	LE	-	NLAA	-
Pyrgulopsis ogmorhaphe	Royal Marstonia	LE	-	NLAA	-
Pyrgulopsis pachyta	Armored Marstonia	LE	-	NLAA	-
Insects					
Neonympha mitchellii	Mitchell's Satyr	LE	-	NLAA	-
Crustaceans					
Orconectes shoupi	Nashville Crayfish	LE	-	NLAA	-
Flowering Plants					
Arabis georgiana	Georgia Rock-cress	LT	Y	NLAA	NE*
Conradina verticillata	Cumberland Rosemary	LT	-	NLAA	-
Liatris helleri	Heller's Blazing Star	LT	-	NLAA	-
Lindera melissifolia	Pondberry	LE	-	NLAA	-
Ptilimnium nodosum	Harperella	LE	-	NLAA	-
Sagittaria secundifolia	Kral's Water-plantain	LT	-	NLAA	-
Spigelia gentianoides	Gentian Pinkroot	LE	-	NLAA	-
Spiraea virginiana	Virginia Spiraea	LT	-	NLAA	-

*NE = No Effect

Biological Opinion

Programmatic Strategy for Right-of-Way Vegetation Management that May Affect Endangered or Threatened Plants in the Tennessee Valley Authority Service Area

FWS Log #: 04ET1000-2018-F-0958

Prepared by:

U.S. Fish and Wildlife Service
Tennessee Ecological Services Field Office
446 Neal Street
Cookeville, Tennessee 38501

Virgil Lee Andrews, Jr. Date
Acting Field Office Supervisor

TABLE OF CONTENTS

Abbreviations/Acronyms

ac	acre(s)
ADCNR	Alabama Department of Conservation and Natural Resources
ANHP	Alabama Natural Heritage Program
AMM	avoidance and minimization measure
ATV	all-terrain vehicle
BA	biological assessment
BISO	Big South Fork National Scenic River and Recreation Area
BMP	best management practices
BO	biological opinion
CFR	Code of Federal Regulations
CH	federally designated critical habitat
cm	centimeter(s)
COE	United States Army Corps of Engineers
CR/CAP	Condition Report/Corrective Action Plan
dc	decimeter(s)
DOD	United States Department of Defense
EO	element occurrence
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act of 1973
FY	fiscal year
FO	field office (refers to a state U.S. Fish and Wildlife Ecological Services Office)
FR	Federal Register
Ft	Foot or Feet
GDNR	Georgia Department of Natural Resources
GIS	Geographic Information System
IDNR	Indiana Department of Natural Resources
in	inch(es)
KNHP	Kentucky Natural Heritage Program
KSNPC	Kentucky State Nature Preserves Commission (recently renamed as the Office of Kentucky Nature Preserves)
km	kilometer(s)
km^2	square kilometer(s)
LAA	may affect, and is likely to adversely affect
LBL	Land Between the Lakes National Recreation Area
LRCNP	Little River Canyon National Preserve
LTNA	Land Trust of North Alabama
m	meter(s)
m^2	square meter(s)
mi	mile(s)
mi^2	square mile(s)
mm	millimeter(s)
mph	miles per hour
NEPA	National Environmental Policy Act
NB	National Battlefield

NF	National Forest
NLAA	may affect, but not likely to adversely affect
NMLT	North Mississippi Land Trust
NRCS	Natural Resources Conservation Service
NP	Nature Preserve
NPS	National Park Service
O&M	operations and maintenance
ORV	off-road vehicle
O-SAR	Office Level Sensitive Area Review
PSA	Power Service Area
PSF	Pickett State Forest
PSP	Pickett State Park
QA/QC	quality assurance/quality control
RM	river mile(s)
RO	United States Fish and Wildlife Service, Southeast Regional Office
ROW	rights-of-way
SMZ	streamside management zone
SNA	State Natural Area
SNHP	State Natural Heritage Program
SOP	standard operating procedure
TDEC	Tennessee Department of Environment and Conservation
TL	transmission line
TDNA	Tennessee Division of Natural Areas
TNC	The Nature Conservancy
TNFO	Tennessee Ecological Services Field Office
TNHP	Tennessee Natural Heritage Program
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WMA	Wildlife Management Area
WWC	Wet Weather Conveyance

CONSULTATION HISTORY

This section lists key meetings and correspondence (events) during the course of this consultation. A complete administrative record of this consultation is on file in the U.S. Fish and Wildlife Service's (USFWS) Tennessee Ecological Services Field Office (TNFO).

Date	Event	Participants	Discussion Topic
Nov. 27, 2017	Telephone call	Tennessee Valley Authority (TVA) staff; USFWS TNFO staff	Scope of consultation and TVA interest in having a meeting with Field Offices (FOs) from all seven states intersected by the TVA power service area (PSA). TNFO is lead office.
Dec. 18, 2017	Video Conference hosted by TVA, Knoxville, TN	TVA Staff; USFWS TN, KY, GA, MS, and VA FO staff	Discussion of consultation scope, TVA right-of-way (ROW) vegetation management practices, and proposed project schedule.
Jan. 3, 2018	Postal correspondence	TVA to USWFS TNFO	Letter requesting early coordination, including draft species list and proposed schedule.
Feb. 28, 2018	Video Conference hosted by TVA, Knoxville, TN	TVA Staff; USFWS TN, AL, and GA FO staff	Presentation of TVA debris management techniques and rationale behind TVA preliminary species determinations.
Mar. 6, 2018	Conference call	Staff from TVA and USFWS Southeast Regional Office (RO)	Recent retirement of TNFO Field Supervisor and discussion of moving the consultation forward.
Mar. 14, 2018	Conference call	Staff from TVA and USFWS Southeast RO	USFWS Southeast RO clarified that it would function as a facilitator and provide a support role during the consultation, and the TNFO would retain responsibility for development and completion of the biological opinion (BO).
Mar. 14, 2018	E-mail correspondence	GIS staff from USFWS TNFO and TVA staff	Initiated coordination with TVA to acquire maps, illustrating locations of TVA transmission lines (TLs) to overlay listed species occurrences.
Mar. 20, 2018	Telephone call	Staff from TVA and USFWS Southeast RO	USFWS Southeast RO provided updates on recent USFWS

Date	Event	Participants	Discussion Topic
			activities and upcoming meetings.
Mar. 22, 2018	Postal correspondence	TVA to USFWS Southeast RO	TVA sent a non-disclosure agreement to USFWS for release of map data with TVA TL locations.
Apr. 4, 2018	E-mail correspondence	Staff from TVA, USFWS Southeast RO, and USFWS AL, GA, NC, MS, KY, TN, and VA FOs	TVA responded to USFWS questions from recent internal meeting.
Apr. 16, 2018	Telephone call	Staff from TVA, USFWS Southeast RO, and USFWS AL, GA, NC, MS, KY, TN, and VA FOs	Discussed what actions and species should be covered in the consultation and reviewed TVA's ROW Vegetation Management methods and tools and project scope.
June 13, 2018	Video Conference hosted by TVA, Knoxville, TN	Staff from TVA, Southeast RO and USFWS AL, GA, NC, MS, KY, TN, and VA FOs	Discussed species determinations for all listed species in the Action Area.
July 10, 2018	E-mail correspondence	Staff from USFWS ALFO and TVA	Discussed effect determinations for Black Warrior waterdog, flattened musk turtle, and whooping crane.
July 13, 2018	E-mail correspondence	Staff from USFWS GA and TNFOs, USFWS Southeast RO and TVA	Discussed effect determinations for species found in the Conasauga River in TN and GA.
July 18, 2018	Telephone call	Staff from MSFO and TVA	Discussed effect determinations for Mitchell's satyr and red-cockaded woodpecker.
July 24, 2018	Telephone call	Staff from VAFO and TVA	Discussed effect determinations for aquatic species, particularly those in the Clinch and Powell rivers.
July 24, 2018	E-mail correspondence	Staff from TVA, USFWS Southeast RO, and USFWS AL, GA, NC, MS, KY, TN, and VA FOs	TVA sent message with complete species list and all species determinations discussed by USFWS and TVA.

Date	Event	Participants	Discussion Topic
Aug. 13, 2018	Conference call	Staff from TVA, USFWS Southeast RO, and USFWS AL, GA, NC, MS, KY, TN, and VA FOs	TVA discussed rationale underlying determinations for designated critical habitats (CH). TVA provided the schedule for remainder of consultation.
Sept. 14, 2018	E-mail correspondence	Staff from TVA, USFWS Southeast and Northeast ROs, and USFWS AL, GA, NC, MS, KY, TN, and VA FOs	TVA submitted draft biological assessment (BA).
Oct. 2018	E-mail correspondence	Staff from TVA and USFWS GAFO	Discussion of the potential effects of mechanical tree clearing on aquatic species in the Conasauga River basin.
Nov. 19, 2018	E-mail and postal correspondence	TVA provided to USFWS Southeast RO and USFWS AL, GA, NC, MS, KY, TN, and VA FOs	TVA submitted the Final BA.
Dec. 18, 2018	E-mail correspondence, letter attached	USFWS TNFO provided to TVA	The TNFO initiated formal consultation and indicated that the subject draft BO would be provided to TVA no later than Mar. 5, 2019 and the final BO provided to TVA no later than Apr. 5, 2019.
Feb. 20, 2019	E-mail correspondence	USFWS TNFO provided to TVA	Based on a Feb. 8, 2019 conference call between the USFWS Southeast RO, USFWS TNFO and TVA, the TNFO provided revised due dates for the draft and final BO (due to a several week government shutdown, deliverable dates had to be extended). The revised draft BO due date was indicated as Apr. 9, 2019, and the revised final BO due date was indicated as May 10, 2019.
Apr. 9, 2019	E-mail correspondence	USFWS TNFO provided to TVA	The TNFO notified TVA that the draft BO would be forthcoming on April 10, 2019.

Date	Event	Participants	Discussion Topic
Apr. 10, 2019	E-mail correspondence	USFWS TNFO provided to TVA	The TNFO forwarded the draft BO to TVA for review and comment.
Apr. 11 – May 3, 2019	Telephone calls and E-mail correspondence	Staff from USFWS TNFO and TVA	The TNFO and TVA coordinated regarding reviews and necessary revisions to the draft BO.
Apr. 29, 2019	E-mail correspondence	TVA provided to USFWS TNFO	The TVA provided comments on the draft BO to the TNFO for consideration and incorporation into the document.
Apr. 30, 2019	E-mail correspondence	USFWS TNFO provided to TVA	The TNFO provided the final draft BO to TVA for review and comment.
May 3, 2019	E-mail correspondence	TVA provided to USFWS TNFO	The TVA provided comments on the final draft BO to the TNFO for consideration and incorporation into the document.
May 8, 2019	E-mail correspondence	USFWS TNFO provided to TVA	The TNFO provided the signed, final BO to TVA.

BIOLOGICAL OPINION

1. INTRODUCTION

A biological opinion (BO) is the document that states the opinion of the USFWS under section 7 of the Endangered Species Act of 1973, as amended (ESA), as to whether a Federal action is likely to:

- jeopardize the continued existence of species listed as endangered or threatened; or
- result in the destruction or adverse modification of designated critical habitat (CH).

The Federal action addressed in this BO is the TVA proposed programmatic strategy for ROW vegetation management that may affect 18 endangered or threatened plants in the TVA Power Service Area (PSA) (the Action). The TVA's request for formal consultation was received on November 21, 2018, and formal consultation was initiated on that date. With that correspondence, TVA enclosed a Biological Assessment (BA) for the Action, dated November 2018, which describes how three overarching categories and 13 methods of vegetation management, that TVA authorizes, funds, or carries out, would be carried out over the next 20 years. Four bat species, and all potential effects to bats from TVA ROW vegetation management activities were previously addressed in the recently finalized BO, *Programmatic Strategy for Routine Actions that May Affect Endangered or Threatened Bats* (signed April 12, 2018).

The BA addresses potential effects to all 163 plant and animal species, federally-listed as endangered or threatened at the date of the BA, that could occur in the 209 county area that intersects the TVA PSA and associated TLs. TVA also addresses how the proposed vegetation management methods and tools may affect CHs for a number of species. The TVA transmission system intersects CH for 35 species. Bat species are not analyzed here because the recent Biological Opinion *Programmatic Strategy for Routine Actions that May Affect Endangered or Threatened Bats* (signed April 12, 2018) accounts for all effects of TVA ROW vegetation management on those species.

The TVA determined that all 13 of methods of vegetation management have no effect on one arachnid, one snail, three crustaceans, and 13 plants or designated CH for 12 species (Appendix I). The TVA also determined that all 13 of methods of vegetation management are "may affect, but not likely to adversely affect" (NLAA) 127 species, including one mammal, five birds, two reptiles, two amphibians, 36 fish, 60 freshwater mussels, eleven snails, one insect, one crustacean, and eight flowering plants; TVA also made a NLAA determination for CH designated for one amphibian, 14 fish, 19 mussels, and one snail (Appendix I). By letter dated December 18, 2018, the USFWS concurred with TVA's NLAA determinations, which concluded the consultation relative to these species, CHs, and activities. Until new information warrants a reinitiation of the consultation that supported these activity-specific findings, projects that are fully consistent with the activity description in the BA do not require further consultation with the USFWS regarding the species and CHs for which the USFWS provided programmatic concurrence. TVA will annually report all project-level activities that complied with ESA §7(a)(2) by relying on the programmatic consultation (see Section 21 below).

Finally, the TVA determined in the BA that the Action "may affect, and is likely to adversely affect" (LAA) the eighteen plant species, listed below:

- Price's potato-bean (*Apios priceana*)
- Braun's rock-cress (*Arabis perstellata*)
- Pyne's ground plum (*Astragalus bibullatus*)
- Morefield's leather-flower (*Clematis morefieldii*)
- Alabama leather-flower (*Clematis socialis*)
- leafy prairie-clover (*Dalea foliosa*)
- whorled sunflower (*Helianthus verticillatus*)
- small whorled pogonia (*Isotria medeoloides*)
- fleshy-fruit gladecress (*Leavenworthia crassa*)
- lyrate (*a.k.a.*, lyreleaf) bladderpod (*Lesquerella lyrata*)
- Spring Creek bladderpod (*Lesquerella perforata*)
- Mohr's Barbara's buttons (*Marshallia mohrii*)
- Cumberland sandwort (*Minuartia cumberlandensis*)
- Short's bladderpod (*Physaria globosa*)
- white fringeless orchid (*Platanthera integrilabia*)
- green pitcher plant (*Sarracenia oreophila*)
- large-flowered skullcap (*Scutellaria montana*)
- Tennessee yellow-eyed grass (*Xyris tennesseensis*)

This BO is limited in scope to evaluating the effects of 12 of the 13 methods of ROW vegetation management that TVA determined would LAA the 18 plant species listed above. One method of vegetation management (Reseeding, Restoration) is considered further in the BO as explained later in Section 2.

ESA §9(a)(2) prohibits certain acts with respect to endangered plant species, including acts that:

(a) remove and reduce to possession from areas under Federal jurisdiction;
(b) maliciously damage or destroy on areas under Federal jurisdiction; and
(c) remove, cut, dig up, or damage or destroy on any other area in knowing violation of any law or regulation of any state or in the course of any violation of a state criminal trespass law.

Regulations issued under ESA §4(d) extend the prohibition under (a) above to threatened plant species (50 CFR §17.71). The damage or destruction of endangered and threatened plants that is incidental to (not the purpose of) an otherwise lawful activity is not prohibited. A Federal action that is likely to jeopardize the continued existence of listed plant species is not lawful; therefore, our BO evaluates the effects of the Action to the 18 listed plant species included under this consultation.

A Federal action that is likely to destroy or adversely modify designated CH is not lawful. Based on the information provided in the BA, the USFWS concurred with TVA's NLAA determinations for CH potentially affected by the Action. Since no CH for listed plant species will be destroyed or adversely modified, this BO does not further mention or address CH.

A BO evaluates the effects of a Federal action along with those resulting from interrelated and interdependent actions, and from non-federal actions unrelated to the proposed Action (cumulative effects), relative to the status of listed species and the status of CH. A USFWS opinion that concludes a proposed Federal action is *not* likely to jeopardize species and is *not* likely to destroy or adversely modify CH fulfills the Federal agency's responsibilities under §7(a)(2) of the ESA. "*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

2. PROPOSED ACTION

TVA proposes a Vegetation Management Programmatic Strategy (the Action) to streamline the manner in which the agency fulfills its responsibilities under ESA §7 relative to ESA-listed plant species. TVA's BA for the Action describes various methods that may affect listed plant species and conservation measures, including best management practices (BMPs), standard operating procedures (SOPs), and avoidance and minimization measures (AMMs), that TVA will apply to ameliorate adverse effects. Addressing these activities programmatically is intended to promote consistency, predictability, and efficiency of project-level consultations, and to more effectively address the conservation needs of listed plants at local and landscape scales.

The Action is comprised of 13 methods of vegetation management under the following three general action categories that TVA authorizes, funds, or carries out:

1) vegetation control;
2) debris management; and
3) ROW restoration.

The Action does *not* include activities associated with:

- Maintenance work on existing TL infrastructure (*e.g.*, pole/structure replacement, addition of grillage/surcharge, installation of lightning arrestors, overhead ground wire replacement, reconductoring, or any other work on TL assets).
- Intentional ground disturbance (excavation/fill, access road construction, *etc*.), work within a stream channel, and placing fill in wetland.
- Future ROW acquisitions and new TL construction.[1]

TVA determined that 12 of the 13 methods of vegetation management under two of the three general action categories, listed above, are LAA the 18 endangered and threatened plants discussed in Section 1:

[1] To address potential impacts of vegetation management along new TL ROW, TVA would tier from this programmatic ROW vegetation management consultation unless the environmental conditions projected to be present in the new ROW are not addressed in this document.

1) Manual Clearing – cutting or pulling using hand tools or chainsaws;
2) Mechanical Clearing – clearing of trees and shrubs where previous vegetation maintenance has been infrequent and woody plants have encroached into the ROW or removal of vegetation in areas where trees were never cleared. Mechanical clearing can also be used to safely remove off-ROW danger trees;
3) Mechanical Mowing – mowing of herbaceous plants and seedlings to maintain vegetation within the floor area of the ROW;
4) Mechanical, Side-Wall Trimming – tree trimming, from ground or air, on the ROW edge;
5) Herbicide, Spot Treatment – highly targeted herbicide application, such as stump treatment or hack and squirt;
6) Herbicide, Localized – low volume foliar application is most common, but basal treatment, localized granular application, and bareground treatments are also included;
7) Herbicide, Broadcast (ground) – non-selective herbicide application made from the ground;
8) Herbicide, Broadcast (aerial) – non-selective herbicide application made from the air using a fixed-wing airplane or helicopter equipped with a boom-type spray assembly;
9) Manual, Debris Management – cut and leave trees, but material may be cut into smaller pieces to facilitate decomposition;
10) Mechanical, Debris Management – chipping, mulching, and off-site hauling of debris;
11) Burning, Debris Management – burning in piles or containers; and
12) Landowner Use, Debris Management – debris can be provided to the landowner in the form of firewood or mulch.

In this BO, we do not further address the one method of vegetation management (Reseeding, Restoration) described for the Action that TVA determined is NLAA listed plants. The USFWS concurs with that determination based on the discountable nature of affects associated with that method. As a result, the scope of the BO is limited to the 12 methods of vegetation management included above that are LAA the 18 listed plants, and to the proposed conservation measures that are relevant to these species.

In the context of consultation under ESA §7(a)(2), the Action is consistent with the regulatory definition at 50 CFR §402.02 of a "framework programmatic action," which is a Federal action that approves a framework for the development of future actions that are authorized, funded, or carried out at a later time, and are subject to further consultation.

2.1. Action Area

For purposes of consultation under ESA §7, the action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.02). The 13 vegetation management methods of the programmatic Action will occur on lands associated with the three general action categories listed in the previous section.

TVA's transmission system consists of a network of more than 16,000 miles (mi) of electric TLs and about 500 power substations, which are all contained within 238,196 acres (ac) of utility ROW. The ROW width for a single line varies from approximately 75 feet (ft) to 200 ft, increasing with the voltage of the line. ROWs containing multiple lines can be larger depending on the number of lines and voltage. As summarized in Table 2-1, TVA's transmission ROW can be classified into three broad categories based on the need for routine vegetation maintenance. TVA has management responsibility for the entirety of the 238,196 ac of transmission ROW; however, TVA actively maintains only approximately 47 percent or 110,752 ac. This is because approximately 52 percent of the transmission ROW is used as cropland, golf courses, orchards or similar uses that integrate compatible vegetation, which is primarily maintained by the respective landowners.

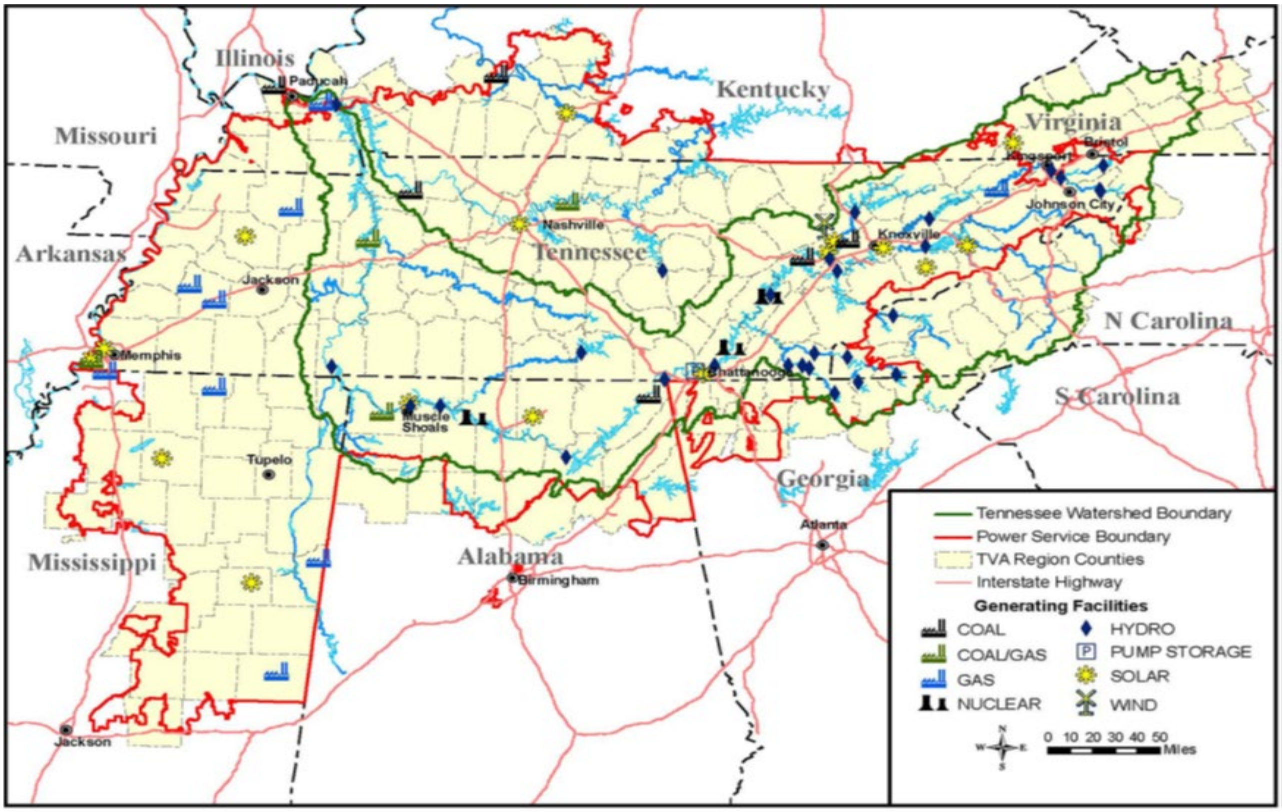
A relatively small amount of the TVA transmission system ROW (4,720 ac) does not require routine vegetation management by TVA or the landowner. These areas include transmission ROW that spans open water or deep valleys where vegetation growing at lower elevations does not threaten the TL.

Table 2-1. Summary of routine vegetation maintenance responsibility and extent within TVA transmission rights-of-way (source: BA Table 1-1).

Broad Land Management Category	ROW (ac)	Percent of ROW
Lands Primarily Maintained by Others	122,724	51.5%
Lands Not Subject to Management	4,720	2.0%
Lands Actively Managed by TVA	110,752	46.5%
Total	**238,196**	**100%**

The 238,196 ac reported in Table 2-1 are distributed throughout TVA's more than 82,000-square-mile (mi^2) (approximately 52.5-million ac) PSA (Figure 2-1) in Tennessee, northern Alabama, northern Georgia, southern Kentucky, eastern Mississippi, western North Carolina, and southwestern Virginia. TVA has described the total 238,196 ac of transmission ROW lands that may receive effects of project activity at any time during the next 20 years as the "Action Area" for this consultation. The BA does not provide maps delineating Action lands within the TVA PSA, because many are difficult to display effectively at a regional scale (*e.g.,* where various vegetation methods would be applied within the existing transmission ROW network). However, the BA does provide a map of six regions consisting of 12 sectors that TVA has designated for vegetation management purposes (Figure 2-2). The Action Area represents 0.5 percent of the entire 52.5-million acre PSA, within the 82.8 million acre TVA Region.

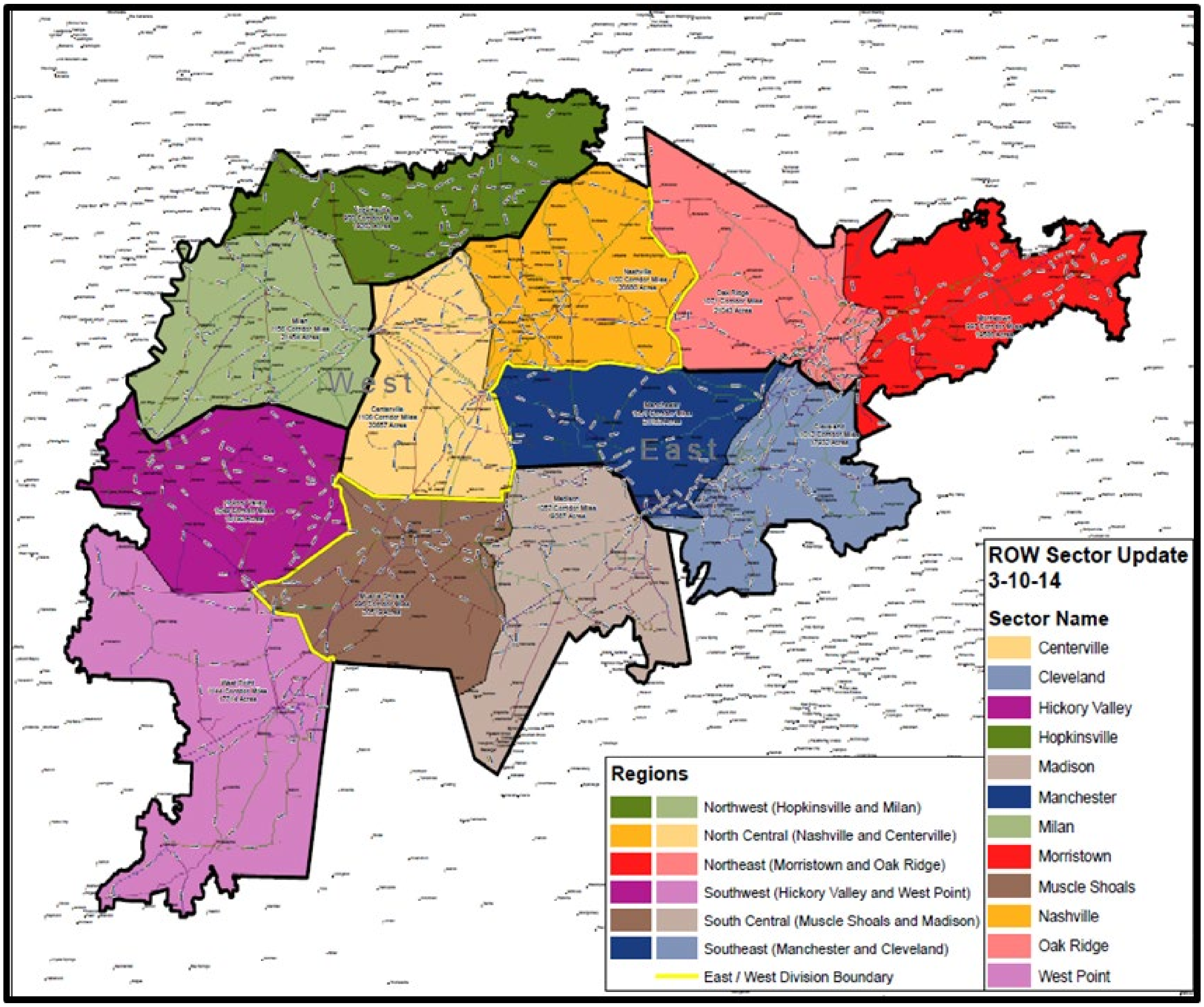
Figure 2-1. TVA Power Service Area (source: BA Figure 1-1).



TVA must continuously manage vegetation occurring on TL ROW in order to ensure reliability of the system. The BA does not provide a project-specific schedule or map of activities over the 20-year Action duration, but TVA does develop annual plans to maintain TL ROWs within each of the 12 vegetation management sectors (Figure 2-2). Routinely, TVA estimates that approximately 47 percent or about 110,752 ac of the 238,196 ac of the Action lands for which the programmatic Action is formulated will receive direct and indirect effects from project activity; therefore, the majority (approximately 52 percent) of the Action lands will receive no effects. Vegetation management activities will likely occur at irregular timeframes due to environmental and site-specific factors. This will mean that some areas may receive vegetation management activities infrequently or that some may be treated on multiple occasions over the 20-year term of the consultation. We have adopted TVA's definition of the Action Area for this programmatic consultation, but we recognize that application and distribution of the vegetation management activities likely will not be uniform; TVA will rely on its annual plan to determine where, when, and which activities are undertaken to meet its overall vegetation management objectives.

Chapter 2 of the BA, "Description of Action Area," provides data about terrestrial vegetation, terrestrial wildlife, and aquatic ecology of the 238,196 ac PSA (i.e., the Action Area), distributed in linear corridors (e.g., transmission ROWs) throughout the region.

Figure 2-2. TVA's vegetation management regions and sectors (source: BA Figure 1-2).



2.2. Vegetation Control

TVA is considering eight methods of vegetation control that can be used alone or in combination to manage vegetation within the TL ROW including:

- Manual clearing;
- Mechanical clearing;
- Mechanical mowing;
- Mechanical side-wall trimming;
- Herbicide, spot treatment;
- Herbicide, localized;
- Herbicide, broadcast (ground); and
- Herbicide, broadcast (aerial).

These vegetation control methods, and the advantages and disadvantages of each method (as perceived by TVA, are described in Table 2-2.

Table 2-2. Transmission Line Right-of-Way Vegetation Control Methods (Source: BA Table 3-1).

Description	Advantages	Disadvantages
Manual Clearing (Hand Work - Pulling or Cutting)		
Chainsaw, machete, brush hooks, axes, bush blades		
Hand clearing work is effective for selective vegetation removal and may be necessary in select areas where mechanical or chemical methods cannot be used. Hand clearing is likely most effective for minor projects or sensitive areas such as wetlands, steep slopes, or where restrictions are imposed on other viable methods.	Selective – Only targeted vegetation is removed. Lighter footprint – Causes less ground disturbance, which mitigates potential impacts to sensitive cultural or biological areas. Can be employed under most field conditions.	Prohibitively expensive for large areas. Labor intensive, less safe to workers, and more intrusive than some herbicide treatments. Typically, most effective for areas of low density vegetation. Can create an environment where resprouting occurs, which increases the woody stem count. Resprouting leads to increased safety concerns and higher costs due to the need for increased long-term vegetation management. Not effective for noxious weeds and can facilitate the expansion of invasive plant communities. Chainsaw use may be restricted at certain times in areas with protected animal species.
Mechanical Clearing (Cutting and Trimming)		
Bulldozer, track-hoe, skid steer, shears (*e.g.*, feller-buncher), mulcher/chipper, Hydro-ax including various other attachments, tracked equipment such as Compact Track Loader		
Clearing of trees and shrubs where previous vegetation maintenance has been infrequent and woody plants have encroached into ROW or removal of vegetation in areas where trees were never cleared. Can also be used to safely remove off-ROW danger trees.	Efficient and lowest cost methods of re-clearing, especially for areas of dense vegetation. The use of mechanized equipment can also be used to mitigate certain hazard exposures due to working near energized TLs. Can fell, lift, and stack trees; or mulch trees; or selectively cut trees depending on the machine and attachments. Mechanical equipment that can mulch or chip eliminates removal of large debris, hastens decomposition, adds organic matter to the soil (keeps nutrients in place), and reduces erosion potential.	Used on large, accessible areas. May not be appropriate for sensitive areas (*e.g.*, archeological sites). Cannot be used on steep slopes (>30%). Negative environmental impacts include non-selective removal of vegetation, ground agitation, noise, and possible oil leaks and spills. Not effective against noxious weeds, as the machines scatter seeds and leave roots. Shatters stumps and supporting near-surface root crowns. Resprouting from shattered stumps and root crowns can produce multi-stem dense stands, which can result in a monoculture (single species vegetation cover).

Description	Advantages	Disadvantages
		Potential seasonal restrictions for sensitive species (*e.g.*, federally listed bat species and ground-nesting birds).
Mechanical Mowing (Mower or brush hog)		
Involves mowing of herbaceous plants and seedlings to maintain vegetation within the floor area of the ROW. Typically performed on a short-term basis (cycle is 3 years or less). Removes and grinds brush and fells small trees.	Effective at grinding brush and felling small trees. Grinding and scattering improves aesthetics, facilitates debris decomposition, and reduces fire hazards. Mowing reduces debris size (creates mulch), hastens decomposition, and adds organic matter to the soil (keeps nutrients in place). Appropriate timing can affect plant community development by selecting for low-growing plants.	Disadvantages are typically the same as those for clearing.
Mechanical (Side-Wall Trimming)		
From air – Helicopter tree saw		
Trimming trees immediately adjacent to the ROW to prevent encroachment within the ROW.	Can prune trees quickly and efficiently.	Requires repeated treatments that may not keep up with fast growing species and leads to ongoing vegetation management cost.
From ground – Hydro-ax, Jarraff & Kershaw line trimmers, aerial lifts		
Trimming trees immediately adjacent to the ROW to prevent encroachment.	Efficient and safer than other trimming methods.	Same as side-wall trimming from air.
Herbicide, Spot Treatment		
Stump spray following cutting to control re-growth. Hack and squirt involves making small cuts in the trunk of target trees and squirting herbicide into the cut. Growth regulators are designed to reduce growth rates of some fast-growing species.	Stump spraying kills unwanted woody plants by preventing re-growth or sucker growth. Growth regulators are helpful to slow growth and avoid removal where tree removals or vegetation conversions are prohibited or impractical (*e.g.*, urban forests). Result in better erosion protection, more wildlife food and cover plants, and often yield an increase in flowering plants and shrubs which enhances available pollinator habitat. Select herbicides retain ground cover, which helps reduce erosion issues in the transmission ROW, and the ground cover provides habitat, which helps retain the biological communities associated with those habitats.	Effectiveness varies by season (works best when plants are taking up nutrients for the winter). Growth regulators are not economical on a large scale. Applicators must be trained, follow applicable state guidelines for licensure and charter requirements. Applicators must also follow manufacturer instructions and U.S. Environmental Protection Agency (EPA) guidelines. Application can require written permissions or permits. Multiple, specific restrictions on applications around waterbodies, agricultural areas, urban areas, federal and state parks and forests, and other sensitive areas. Herbicides must be prevented from reaching streams whether by direct

Description	Advantages	Disadvantages
		application or through runoff (unless labeled for aquatic use). Timing of application is seasonally dependent.
Herbicide, Localized		
Individually treats selected species or groups of species within a limited area using a variety of techniques including: Basal treatments – herbicides are applied by hand via squirt bottle or backpack to the base of the plant from the ground up to knee height. Low-volume foliar treatments – herbicides primarily are applied by workers using backpack sprayers and applicator. An all-terrain vehicle (ATV) or tractor with a spray-gun attachment also can be used. Herbicide is applied to the foliage of individual or clumps of plants according to the label directions during the growing season. Localized granular application – granular or pellet forms of herbicide are hand-applied to the soil surface beneath the drip lines of an individual plant or as close to a tree trunk or stem base as possible. Herbicide is applied when there is enough moisture to dissolve and carry the herbicide to the root zone. Bare-ground treatments – applications made via backpack sprayer, ATV, tractor with a spray-gun, or hand disbursed. This approach treats the ground to keep any vegetation from growing rather than treating the vegetation itself. The herbicide used can be in liquid or granular formulations. This technique commonly would be used in an electric yard (substation) and around wood transmission poles within the transmission ROW.	Species-specific, low-volume applications of herbicides using a variety of techniques and timing show definite improvement of ROW plant diversity. Work well in treating deciduous tree stumps to prevent resprout and regrowth in the transmission ROW. Selective treatment of vegetation at a distance allows for less ground disturbance, which minimizes inadvertent damage to sensitive areas or compatible (non-targeted) vegetation. Result in better erosion protection, more wildlife food and cover plants, and often yield an increase in flowering plants and shrubs which enhances available pollinator habitat. Select herbicides retain ground cover, which helps reduce erosion issues in the transmission ROW, and this ground cover provides habitat, which helps retain the biological communities associated with those habitats.	Applicators must be trained, follow applicable state guidelines for licensure and charter requirements. Applicators must also follow manufacturer instructions and U.S. EPA guidelines. Application can require written permissions or permits. Multiple, specific restrictions on applications around waterbodies, agricultural areas, urban areas, federal and state parks and forests, and other sensitive areas. Herbicides must be prevented from reaching streams whether by direct application or through runoff (unless labeled for aquatic use). Timing of application is seasonally dependent.
Herbicide, Broadcast (Ground)		
Non-selective, broadcast applications made from the ground (manual and mechanical) to treat an entire area, rather than individual	Herbicides can be liquid, granular, or powder and can be broadcast, giving this method some application flexibility. Involves less ground disturbance when applied at a distance, which minimizes	Applicators must be trained, follow applicable state guidelines for licensure and charter requirements. Applicators must also follow

Description	Advantages	Disadvantages
plants or small groupings of plants. Used to treat transmission ROWs that are heavily vegetated, and also are used to treat noxious weeds. Application techniques include: High-volume foliar treatments – herbicide is applied by truck, ATV, or tractor with a spray-gun, broadcast nozzle, or boom to spray foliage and stems of target vegetation. The herbicide mixture is pumped through hoses to either a hand-held nozzle or a boom. Cut-stubble treatment – herbicide is applied from a mobile boom over large swaths of freshly mechanically-cut areas to prevent resprout or regrowth of vegetation. This is the broadcast style of stump treatment. Broadcast granular treatment – granular forms of herbicide are dispersed by hand, belly grinder (a front-held container that disperses seeds by turning a hand crank), truck, or tractor. The herbicide is dispersed over a relatively large area, such as in an electric yard (substation) or around the tower legs of a transmission structure. Broadcast bare-ground treatments – herbicide is dispersed by ATV or tractor with a spray-gun by trucks with mounted booms, or can be hand disbursed. This application treats the ground to keep vegetation from growing, but covers a wider area than other broadcast application methods. Generally, this application technique is used in electric yards (substations) and other areas that need to be kept completely clear of vegetation for safety purposes (*i.e.*, prevention of worker electrocution due to vegetation creating a difference in the electrical potential).	damage to soils, archaeological resources, and nesting and tunneling wildlife.	manufacturer instructions and U.S. EPA guidelines. Application can require written permissions or permits. Multiple, specific restrictions on applications around waterbodies, agricultural areas, urban areas, federal and state parks and forests, and other sensitive areas. Herbicides must be prevented from reaching streams whether by direct application or through runoff (unless labeled for aquatic use). Timing of application is seasonally dependent.

Description	Advantages	Disadvantages
Herbicide, Broadcast (Aerial) - Aerial Sprayers		
Non-selective herbicide application made from a fixed wing or rotary aircraft.	Cost-effective because it can be used without disturbing the ROW. Can be cost effective and efficient for large, remote, or difficult-to-access sites. Herbicides can be liquid, granular, or powder and can be broadcast, giving this method some application flexibility. Involves less ground disturbance when applied at a distance, which minimizes damage to soils, archaeological resources, and nesting and tunneling wildlife.	Requires preflight walking or flying inspection 72 hours (hrs) prior to application (or as specific state statutes require). Aerial application of herbicides requires specific weather conditions (*e.g.*, wind speed, fog, temperatures) and involves risks associated with flying. Long-term decreases in diversity of native plants and degraded habitat for sensitive species. Aerial applications require buffers around sensitive resources. Threat to off-target vegetation from drift of herbicides. Applicators must be trained, follow applicable state guidelines for licensure and charter requirements. Applicators must also follow manufacturer instructions and U.S. EPA guidelines. Application can require written permissions or permits. Multiple, specific restrictions on applications around waterbodies, agricultural areas, urban areas, federal and state parks and forests, and other sensitive areas. Herbicides must be prevented from reaching streams whether by direct application or through runoff (unless labeled for aquatic use). Timing of application is seasonally dependent.

2.3. Debris Management

A second general TVA action category identified in section 2 routinely involves a need to manage debris. TVA is considering four methods of general debris management that can be used alone or in combination to manage debris within the TL ROW including:

- Manual, Debris Management;
- Mechanical, Debris Management;
- Burning, Debris Management;
- Landowner Use, Debris Management

These debris management methods, and the advantages and disadvantages of each method, are described in Table 2-3.

Table 2-3. Transmission Line Right-of-Way Debris Management Methods (source: BA Table 3-5).

Descriptions	Advantages	Disadvantages
Manual, Debris Management		
Cut and Leave (left in place) – chainsaws or other manual tools		
Trees may be cut and left in place in specified areas with approval from the appropriate regulatory agency. These areas may include sensitive areas where tree removal would cause excessive ground disturbance or very rugged terrain where windrowed trees are used as sediment barriers along the edge of the ROW. TVA prefers to leave vegetation in place in areas where removal is a significant risk to worker safety.	Eliminates off-site hauling costs. Can provide wildlife habitat under coarse-woody debris (depending on the species of interest). Can provide nutrient recycling (*i.e.*, organic soil matter). Can provide erosion control. Good for sensitive areas or very rugged terrain.	Requires prior approval from appropriate regulatory agency. Potential public backlash because of the initial aesthetics of felled logs and brush debris. Reduced access for subsequent vegetation maintenance activities. Cut vegetation might visually intrude on public or private landowner uses. Can create fuel for wildfires. Can harbor tree pests (e.g., emerald ash borer) and disease.
Cut & Leave (lopping and scattering) - ground crews, chainsaws, brush rakes, skidders		
Branches of trees are cut (lopped) and trunks are cut into 4 to 8 ft. lengths. Limbs and trunks are then scattered throughout the ROW, laid flat, and left to decompose. Debris can then be "crushed" by driving over with machinery (which can speed decomposition).	Eliminates off-site hauling costs. Some mechanical equipment also can mulch or lop and scatter vegetation debris as the equipment moves through an area. Can provide wildlife habitat (depending on the species of interest). Can provide erosion control and nutrient recycling.	Can be difficult, time consuming, and less safe. Cut vegetation might visually intrude in lands traditionally used by others. Can create more fuel for wildfires. Can harbor tree pests (*e.g.*, emerald ash borer), disease, and spread invasive species (*e.g.*, scatter seed). Limited use for certain tree species. For example, pine needles can reduce grass re-growth and there is a risk of poisoning to grazing livestock from pine needles and the wilted leaves of wild cherry. Not appropriate for sensitive areas.
Mechanical, Debris Management		
Chipping in Place – chippers, skidders, grapples, rakes		
Mechanical brush disposal cuts brush into chips (less than 4-inch diameter). Chips are then spread over the ROW. Trunks too large to chip are de-limbed then placed as windrows at the edge or scattered along the ROW, as the situation requires.	Eliminates off-site hauling costs. Can provide erosion control and nutrient recycling (*i.e.*, organic soil matter). Spread-out wood chips and mulch can create a visually appealing park-like look. Windrows can capture snow/precipitation and hold more moisture and provide some shade protection for seedling establishment. Potential benefits to wildlife and nutrient cycling.	Non-target plants can be damaged when debris is dispersed. Chipper machinery can have limited access. More labor intensive than mulching. Windrows allow tree saplings to sprout in places where mechanical equipment cannot reach during future vegetation control.
Mulching in Place – roller-choppers, mulchers, mowers		
Mulching falls between chip and lop-and-scatter methods.	Same as Chipping in Place	Not effective against noxious weeds (spread seed and leave roots).

Descriptions	Advantages	Disadvantages
Debris is cut into 4 inches to 2 ft lengths and scattered in the ROW to decompose and is best used when terrain or conditions do not allow use of mechanical chipping equipment.		Not appropriate for sensitive areas. Non-target plants can be damaged when mulching. Results in more coarse debris than chipping.
Offsite Debris Disposal (hauling) – loaders; truck and trailers		
Cut trees and brush are collected into piles and loaded onto trailers or debris trucks, regardless of debris size. Debris is then hauled by trucks to offsite locations.	Removing all debris can create a more visually appealing look. Creates safer conditions in the ROW for workers and the public. Reduces the fuel available for wildfires.	Trucks can have limited access. Rutting can damage non-target plants and compact soils from repeated truck-trips. May inadvertently spread invasive species by distributing seeds off the ROW. More labor intensive and expensive than Cut and Leave methods. Potential disposal costs at offsite locations.
Offsite Debris Disposal (chip and haul) – chippers; truck and trailers		
Brush is chipped and blown directly into a trailer. Trunks too large to chip are de-limbed then placed onto trailers. All debris is then hauled by trucks to offsite locations.	Removing all debris can create a more visually appealing look. Creates safer conditions in the ROW for workers and the public. Reduces the fuel available for wildfires. Chipping increases the amount of debris that can be loaded onto a single trailer, reducing number of truck-trips needed.	Same as above.
Burning, Debris Management		
Burning (pile) – ground crews, chainsaws, skidders, brush rakes, drip torches		
Debris is moved off the ROW and burned in small piles.	Reduces or eliminates hauling and debris processing costs. Reduces wildfire potential of remaining slash. Reduces transmission of insects and disease.	Reduces air quality, visibility, and public health due to the smoke created by burning woody biomass. Conditions can alter the effectiveness of this method and fire can spread if not managed properly. Workers conducting the burning can experience minor to severe burns, smoke irritation, and inhalation of toxic agents or particulates that can have acute effects. Burning is a hazard in the ROW and near substations where smoke can induce flashovers from electrified facilities. Will typically sterilize an area of the soil, making it susceptible to weeds. The soil in and around the burn should be stirred to re-inoculate the soil with beneficial micro-flora and fauna.

Descriptions	Advantages	Disadvantages
Burning (container) – air current incineration systems (*e.g.*, air current destructor, air curtain burner, trench burner)		
The main operating principle of air curtain incineration systems is high velocity air (curtain) that is blown across and into the upper portion of the combustion chamber. The high volume of air causes over-oxygenation of the fire, and secondly the high velocity airflow over the combustion chamber traps particulates (smoke). These types of burners can efficiently dispose of large quantities of forest waste products at very high temperatures with very little air emissions.	Produces lower smoke emissions compared to pile or broadcast burning. Burns a greater variety of materials (new and old) and turns 95 to 98% of debris into ash. Reduces fire risk and outbreak of insect problems. Operates with fewer restrictions on weather and burn conditions. Residents in urban interface areas are more willing to accept use and remove wood waste and slash fuel hazards around their homes if offered free disposal. The fire is contained and easily and quickly extinguished, if necessary.	Still produces smoke emissions and heat, which may make this option untenable in the ROW. May not be as cost competitive in areas where broadcast and pile burning are acceptable. Requires use of motors to add forced-air into the system which has risks (*e.g.*, fuel spills, emissions, noise). Requires purchase of the system which is an expensive upfront capital cost.
Landowner Use, Debris Management		
Landowner Use - feller-buncher, forwarders, skidders, chainsaws		
Wood that is large enough for firewood or sale by the owner can be cut to lengths upon request and left for the owner's use.	Benefits local landowners and can improve relations overall. Reduces need to remove large timber from the ROW.	Generally, only an option during initial ROW clearing and has limited application for existing ROW vegetation management. Requires prior communication and coordination with local landowners.

2.4. Avoidance and Minimization Measures (AMMs) to Protect Listed Plants

Information in this section was derived from Chapter 4 of the BA.

2.4.1. Office Level Sensitive Area Review (O-SAR)

The types of sensitive resources occurring in or near the transmission ROW vary widely and include threatened and endangered plant and animal species, caves, heron/osprey rookeries, natural areas, and wetlands. To protect sensitive resources on TL ROWs, TVA developed the Office Level Sensitive Area Review (O-SAR) process as an integral component of all of its vegetation management practices.

The O-SAR process is used to address routine vegetation maintenance activities. As part of the O-SAR process, qualified biologists perform reviews of the entire transmission system every three years. These desktop reviews use computer-based mapping programs and a wide array of digital data in lieu of field surveys to ascertain where sensitive resources may occur on TVA transmission ROWs. Field-verified data is added to the O-SAR data, if and when it becomes available. The common and widely available data sets used in office-level reviews include aerial photography, U.S. Geological Survey topographic maps, National Wetlands Inventory data, EPA Level 4 ecoregion maps, and Natural Resource Conservation Service (NRCS) soils maps.

Sensitive resources identified as part of the review process are grouped into five general categories: Plants, Aquatic Animals, Terrestrial Animals, Natural Areas, and Wetlands. Regarding plants, the data descriptions include documented or potential locations of federally or state-listed species or unique communities. Based on proposed vegetation management activities, and the requirements of sensitive resources present within areas to be managed, specific criteria are developed to guide project planning and work. These include limitations on the use of certain vegetation management practices (*e.g.*, broadcast herbicide application would be restricted around federally listed plant populations).

Each AMM is grouped into SAR "classes" for the respective categories. These classes define appropriate or inappropriate vegetation management practices, or impose additional review or coordination requirements prior to initiation of work.

TVA's approach is unique in that it uses specific data as part of the O-SAR review that includes both TL/structure locations coupled with TVA's extensive Regional Natural Heritage database. This is a "living" database that contains approximately 40,000 occurrence records for protected plants, animals, caves, heronries, eagle nests, and natural areas for the entire TVA operations area. TVA shares data with the USFWS, and most of the seven states within the TVA region to ensure the quality of data contained in the TVA Regional Natural Heritage database.

In the first phase of the O-SAR review process, data are added to the O-SAR database, primarily when TVA biologists conduct desktop reviews of portions of the transmission system. O-SAR reviews are conducted annually on approximately 1/3 of the transmission system in conjunction with planned vegetation maintenance activities. If during the review, data indicates a sensitive resource may be present, a polygon that defines the area of interest is created within the O-SAR database and overlaid on the segment of TL ROW under review. Each polygon is assigned an O-SAR class which identifies needed AMMs for the resource.

Sensitive areas may be defined based on information available on the various computer-based mapping sources described above. These also may be added to the O-SAR database because landscape features *(i.e.*, slope, soils, exposed bedrock) and proximity to previously documented resources could indicate that other sensitive resources may be present within or near the ROW easement.

In the second phase of the O-SAR review process, specific guidance governing transmission ROW vegetation management is appended to every identified sensitive resource polygon. This guidance results in the assignment of a "Class" level for each polygon, which is accompanied by specific guidance provided to TVA transmission ROW personnel to support further vegetation management planning efforts. The guidance may be informational or prescriptive and result in limitations of particular control measures, requirements for notification to TVA biologists, or the need for site-specific field surveys to be performed by TVA biologists prior to work activities. This guidance constitutes an important aspect of the implementation of BMPs to minimize environmental impact.

The guidance is particularly important to clearly define what vegetation maintenance activities are permissible within sensitive areas, taking into account the specific sensitive resources that occur or might occur on a given section of transmission ROW. The guidance also seeks to give certainty and flexibility to TVA transmission ROW personnel, who develop vegetation control activities over large areas under schedule and budget constraints.

Resources are assigned to various classes from those that need less special treatment to those that include more sensitive species, which require greater precautions. Resource categories include plants, aquatic and terrestrial animals, natural areas, and wetlands. Because this consultation only addresses listed plants, we only discuss the classes into which plants are categorized and O-SAR guidance, specific to plants, including how the guidance types are assigned, below.

Plants, Class 1

This Class allows for selective herbicide application to woody plants and mechanical/hand-clearing of all vegetation without site-specific coordination with the TVA botanist, regardless of season. Broadcast herbicides are not permitted. This level of guidance is applied to protect rare species and habitats and is applied when federally or state-listed plants, or uniquely diverse plant communities, are somewhat likely to occur within a given section of transmission ROW based on the professional judgment of the TVA botanist when performing desktop O-SAR reviews.

Broadcast herbicide use is prohibited under this guidance because it is considered to be the most detrimental vegetation maintenance tool to rare plants and diverse, herbaceous plant habitats dominated by native plant species. Also, selective application of herbicide to woody plant species often promotes herbaceous habitat and is considered an appropriate tool for the large portions of the TVA transmission system that have not been field surveyed and could contain federally or state-listed plant species.

Currently, broadcast and aerial herbicide is restricted from use on approximately 17 percent (about 41,000 ac) of TVA TL ROWs likely to contain important habitat.

Plants, Class 2

Management of sensitive plant areas assigned as Class 2 requires active coordination between TVA operations' personnel and the TVA botanist. The guidance provided does not prescribe or prohibit any specific tool because each Class 2 area is handled on a case by case basis depending on the site, plant species in question, and the timing/type of vegetation clearing proposed.

This guidance is applied to sensitive areas where federally or state-listed (rank of S1 or S2) species are known to (or are highly likely to) occur. Often, areas covered under this classification are areas of regional conservation significance and contain unique species and habitat that are better represented within the early successional habitats perpetuated within the transmission ROW. Before scheduled vegetation maintenance, particularly herbicide application, TVA botanists regularly perform field surveys to assess the site.

Slightly less than one percent (about 2,000 ac) of TVA transmission ROW is known to contain populations of rare plant species; these areas are designated as Class 2 sites in the O-SAR database. When work is scheduled to occur at these locations, TVA botanists and transmission

ROW operations staff coordinate to ensure habitats are protected. Sometimes the proposed work would not affect listed plants found in the transmission ROW, but sometimes operations staff augment the timing or method of proposed work to protect sensitive resources. The following are representative examples of how O-SAR is used to avoid negative impacts to rare plants.

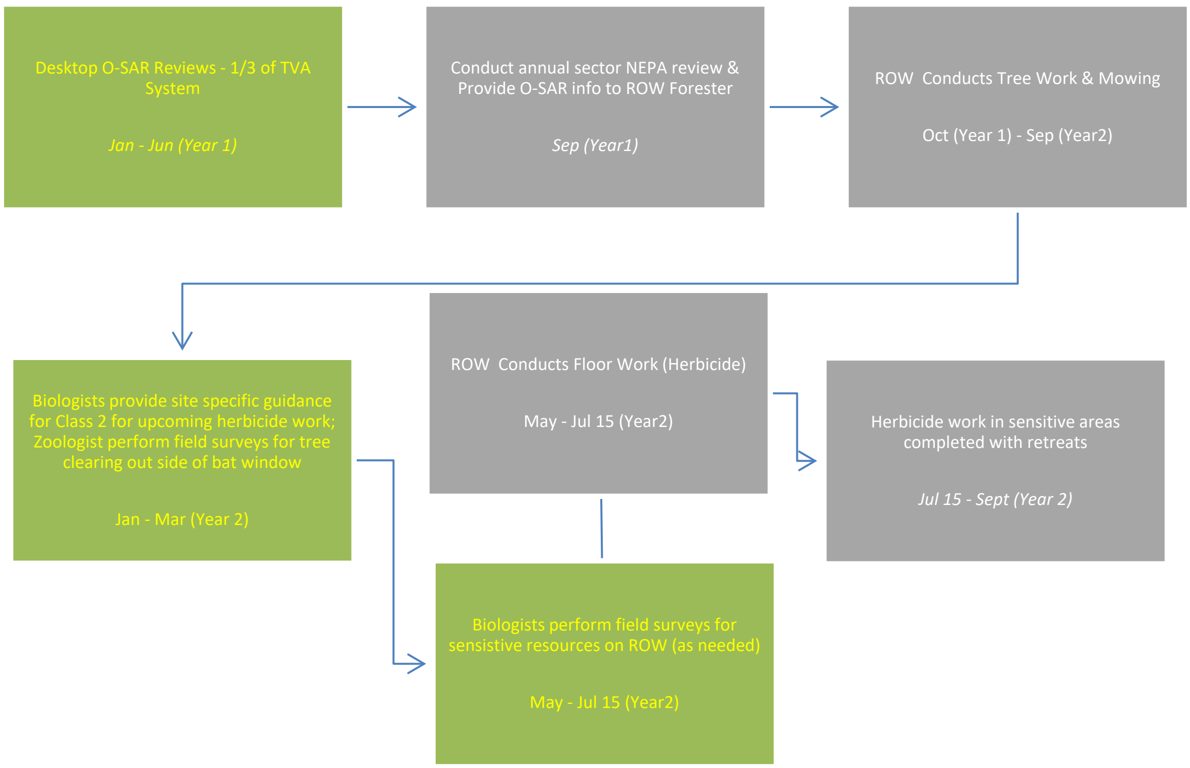
- *Timing* – TVA would avoid spraying herbicide in areas where federally listed plants may occur until after a species has completed its life cycle for the year (*i.e.*, after plants have bloomed and set seed).
- *Flagging* – Before localized herbicide application, typically low volume foliar application to woody plants, TVA botanists would perform field surveys to delineate specific areas where listed plants occur. Sites would be marked in the field with flagging tape and maps provided to the herbicide contractor, along with instructions on how work would be conducted in these areas. Typically, foliar herbicide would not be applied within flagged areas and any woody vegetation within those relatively small areas would be removed with machetes or spot application of herbicide.
- *Conservation Spray* – TVA documents sites where targeted, low-volume foliar application of herbicide to woody plants along the transmission ROW does not appear to negatively impact listed plant populations (*e.g.*, white fringeless orchid). This "conservation spray" differs from standard foliar application of herbicide because of extensive communication between TVA staff and herbicide applicators on the sensitive nature of the site. In addition, there is direct TVA oversight during the application, which leads to extra caution and large reductions in damage to non-target vegetation, such as the white fringeless orchid.
- *Natural Area Cooperation* – Where populations of listed plants occur on TVA TL ROW, TVA has worked with resource managers, who have coordinated with a third party to use herbicides to control woody plants in sensitive areas on ROW. Agreements with land management agencies are made on a case-by-case basis.

2.4.2. Implementation of O-SAR

The O-SAR process is fully integrated into the TVA vegetation management program. Figure 2-3 illustrates how the current iteration of this process fits in with other vegetation management activities and the National Environmental Policy Act (NEPA) reviews, which are conducted annually for each of the twelve ROW sectors that comprise the TVA transmission system. Specific attributes of O-SAR process may change over time, but integration of biology and ROW operations will continue into the future. In addition to ensuring NEPA compliance, these annual environmental reviews incorporate new O-SAR polygons and guidance, generated by TVA biologists, into the vegetation management planning process for the subsequent fiscal year (FY).

When all desktop O-SAR reviews have been completed for plants and all other disciplines (aquatic animals, terrestrial animals, natural areas, and wetlands), this data is then used for each sector specific NEPA review. The information is then passed on to the ROW Forester, who oversees vegetation management for each sector and uses it to inform on-the-ground vegetation management beginning the subsequent FY (i.e., beginning October 1 of each year).

Figure 2-3. Integration of O-SAR into the TVA Vegetation Management Program – Current Process (biologist actions are shown in green and ROW actions in gray) (source: BA Figure 4-3).



After providing updated O-SAR data via desktop review, there are several instances when biologists interact ROW operations staff. These include providing site specific guidance on Class 2 polygons (plants and aquatic animals) ahead of planned herbicide work (*i.e.*, low volume foliar treatment) and performing bat habitat surveys to support proposed tree work that must occur outside of the established clearing window. Botanists typically perform field surveys of Class 2 botany polygons during the growing season. These ROW are skipped during initial herbicide application. This allows botanists to perform field surveys at a seasonally appropriate time before application and prevents the surveys from holding up herbicide crews. The skipped Class 2 botany areas are then treated with other parts ROW in the TVA system that were inadvertently missed during the initial herbicide application (retreats). In these areas, AMMs, such as timing, flagging and conservation spray (See Plants, Class 1 and Class 2 under 2.4.1), are employed on a case-by-case basis according to the findings of the field survey.

2.5. Best Management Practices and Standard Operating Procedures

Information in this section was derived from Chapter 4 of the BA.

Several mechanisms govern how TVA performs ROW vegetation management activities on the ground. These range from formalized procedures and BMPs to indirect controls that serve to limit adverse effects of vegetation work. The formalized processes and procedures outlined in three TVA documents are as follows.

- Guideline for Vegetation Maintenance, Site Specific Environmental Reviews & Permitting (TVA 2015a) – Appendix A of BA.
- A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Construction and Maintenance Activities, Revision 3 (TVA 2017a) – Appendix B of BA.[2]
- Transmission Environmental Protection Procedures, Right-Of-Way Vegetation Management Guidelines, Revision 8 (TVA 2017b) – Appendix C of BA.

Together, these practices, when paired with the planning and execution that takes place with O-SAR, allow TVA to avoid and minimize effects to listed plant species.

2.5.1. Streamside Management Zone Definition

Given the potential for herbicide application to negatively affect water quality and aquatic organisms, and the potential for soil disturbance to contribute to instream impacts, special restrictions are required when operating adjacent to intermittent or perennial waterbodies, including springs, streams, reservoirs, ponds, rivers, and other waterbodies. Measures are also taken to protect ephemeral streams (sometimes referred to as wet weather conveyances [WWCs]) even when they are not identified on project or topographic maps.

Streamside management zones (SMZs) are defined by TVA as, "an area or zone, covered with vegetation on both sides of perennial and intermittent streams and along the margins of bodies of open water, where extra precaution is used in carrying out activities (including vegetation management) to protect streambanks, instream aquatic habitat, and water quality". The width of SMZs may vary depending on the type of watercourse, primary use of the water resource, topography, existing features, land use, or the known or likely presence of listed animal species. A minimum 50-ft SMZ is established at ROW crossings. The width of the SMZ is increased as determined by conditions identified in Table 2-4.

Table 2-4. Recommended Minimum Width of Streamside Management Zones (source: BA Table 4-2).

Streamside Management Zone Category	**Percent Slope of Adjacent Lands**				
	1-10	11-20	21-30	31-40	41+
	Streamside Management Zone Width Each Side (Ft)				
A - Standard	50	70	90	110	130
B - Important	70	90	110	130	150
C - Unique	90	110	130	150	170

[2] Note - many techniques found in the BMP manual are designed for construction projects and do not apply to stand-alone vegetation clearing projects, however there are a number of practices that apply to both types of work.

A - Standard SMZ Protection
This is the standard (basic) level of protection for streams, springs, sinkholes, and the habitats around them.

B - Protection of Important Permanent Streams, Springs, and Sinkholes
This category will be used when there is one or more specific reason(s) why a permanent (always-flowing) stream, spring, or sinkhole requires protection beyond that provided by standard BMPs. Reasons for requiring this additional protection include high potential for occupancy by federally listed or significant state listed species, the presence of suitable habitat for federally listed or significant state listed species, CH, or areas designated as a special use classification (*e.g.*, trout waters). The purpose of these guidelines is to minimize the disturbance of the banks and water in the flowing stream(s) where this level of protection is required.

C - Protection of Unique Habitats
This category would be used when, for one or more specific reasons, a temporary or permanent aquatic habitat requires special protection. This relatively uncommon level of protection would be appropriate and required when a unique habitat requiring special protection is present (*e.g.*, the spawning area of a rare species), the stream is known to be occupied by a federally listed or significant state listed species, or when required as a special condition resulting from consultation with the USFWS to avoid project effects on a listed species or CH.

2.5.2. Site Specific Environmental Reviews

TVA uses prescriptive guidance within the O-SAR process to minimize and avoid effects to listed species. Most of this information is generated from desktop reviews. However, there are situations that would trigger a site-specific review by TVA environmental scientists should they arise during the course of vegetation management activities (TVA 2015a). Most of these situations rarely occur during vegetation management, but they include:

- O-SAR conditions and guidance cannot be met;
- Activities with the vicinity of large bird nests >2 ft in diameter;
- Activities in WWCs and SMZs including:
    - Culvert installations
    - Construction of stream crossing
    - Dredging/placing fill or riprap within a SMZ;
- Activities in wetlands including:
    - Equipment use cannot meet requirements laid out in TVA (2017a) for clearing in wetlands
    - Placing fill
    - Leaving brush, timber, tree limbs, debris, *etc*. in wetland area;
- Ground disturbing activities including:
    - Creating new access or clearing/regrading existing access
    - Leveling ground for equipment access
    - Other excavation/fill
    - Landowner requests (*e.g.*, repairing existing access, culvert repairs or installations, grading)

    - Use of bulldozer;
- Herbicide application cannot be applied in accordance with label use restrictions.

If these types of actions are needed during the course of ROW vegetation management, TVA would assess the potential impact of the work and enter into section 7 consultation if the proposed action may affect listed species.

2.5.3. Standard BMPs – Herbicide Use

Herbicides are an important tool in the integrated vegetation management approach utilized by TVA. While appropriate herbicide use benefits the ROW vegetation management program, there are some potential risks associated with their use. Some of these risks include contamination of waterways, over application that results in soil erosion, and unintended damage that could harm off-target plant and animal species. For these reasons, TVA employs a host of BMPs focused on avoiding and minimizing negative impacts of herbicide use. BMPs are reported comprehensively in TVA (2017a, 2017b) and summarized here.

- The sites to be treated are selected and application directed by the appropriate TVA official;
- Herbicide is only applied according to the label, by licensed applicators;
- Temperature, wind speed, and precipitation dictate application;
- Herbicides are not applied to surface water or wetlands unless specifically labeled for aquatic use. Generally, contractors are directed not to apply to waterbodies;
- Use of aerial or broadcast application of herbicides is not allowed within or adjacent to perennial streams, ponds, and other water sources;
- A pre-flight walking or flying inspection must be made within 72 hrs prior to applying herbicides aerially. This inspection should ensure that no land use changes have occurred, sensitive areas are clearly pointed out to the pilot, and proper buffer zones are maintained;
- Aerial application of liquid herbicides normally will not occur when surface wind speeds exceed five miles per hour (mph), in areas of fog, or during periods of temperature inversion or when other conditions exist that the label restricts;
- Pellet application normally will not occur when surface wind speeds exceed 10 mph or on frozen or water-saturated soils;
- Liquid application will cease when the temperature reaches 95 degrees (Fahrenheit) or above. Application during unstable, unpredictable, or changing weather patterns will be avoided. Equipment and techniques will be used that are designed to ensure maximum control of the spray swath with minimum drift; and
- Hand application of herbicides labeled for use within SMZs is used only selectively.

2.5.4. Standard BMPs – Tree Work

TVA employs many practices that encourage environmental stewardship during tree clearing activities. TVA (2017a) discusses how TVA clears vegetation in SMZ and wetlands. Specific BMPs used to minimize soil disturbance and erosion during tree clearing in SMZs and wetlands include:

- Stumps/roots are left in place;
- Hand cutting methods are used in SMZs; feller buncher use is permissible, but rarely used in SMZ for non-construction vegetation clearing; and
- Cut debris will be kept out of intermittent and perennial stream channels, wetlands, or groundwater infiltration zones. Should debris reach these areas, it would be promptly removed.

While not explicitly stated in TVA (2017a), the following practices are standard clearing procedures implemented throughout the ROW, not just in sensitive areas. These techniques limit the potential for erosion and include:

- Avoiding intentional soil disturbance during clearing – trees are hand cut with a chainsaw or cut above ground with machinery;
- Mechanical clearing equipment is not used on steep slopes exceeding 30 percent;
- Stumps and roots are left in place, allowing vegetation to quickly recover;
- Approximately 80 percent of chipping/mulching is completed <2 weeks from when trees are cut. Approximately 20 percent of chipping/mulching is completed >2 weeks from when trees are cut, usually because of weather constraints. In these situations, trees are cut and left in place until chipped or mulched; and
- TVA encourages contractors to adopt new technology as it becomes available. For example, TVA was an early adopter of the tracked chipper, which is a low ground pressure piece of equipment that results in very little soil disturbance.

Tree clearing practices designed to limit soil disturbance and erosion, resulting from clearing or rutting, is rarely problematic. If an aberrant erosion event occurred, the TVA ROW Forester would direct the contractor to immediately repair the damage resulting from TVA work. In this scenario, all work would be done according to the BMP manual (TVA 2017a). While not typically necessary, select practices used in these unusual situations could include:

- Mulch berms
- Silt fence
- Erosion control blankets
- Seeding temporary vegetation
- Seeding permanent vegetation.

2.5.5. Standard BMPs – Equipment Maintenance

All machinery requires petrochemicals in order to operate. TVA BMPs require all machinery to be in good working order (TVA 2017a). Examples of TVA BMPs designed to minimize discharge of pollutants to the environment include:

- All on-site vehicles must be monitored for leaks and receive regular preventative maintenance to reduce the chance of leakage;

- Heavy equipment may be serviced on the ROW except in designated sensitive areas. In that situation, proper ground cloths, matting, or plastic sheeting must be used to prevent releases of oil, fuel, or grease into the environment;
- Mobile and/or portable oil or fuel storage tanks should be positioned or located to prevent spilled oil from reaching watercourses; and
- Spill response equipment and sufficient absorbent material to contain and clean up fuel or chemical spills or leaks must be maintained on-site or be readily available.

2.5.6. Standard Operating Procedures

Indirect controls do not specifically direct how work is conducted, but do serve to incentivize behaviors that result in positive environmental outcomes, including reducing the potential for effects to listed species. Examples of indirect controls include direct ROW forester oversight, quality assurance/quality control (QA/QC) assessments, easement contract language, and property owner relationships. TVA also has a Condition Report/Corrective Action Plan (CR/CAP) process to identify and correct procedural and implementation issues related to its programs.

2.5.6.1. Direct Right-of-way (ROW) Forester Oversight

TVA ROW Foresters have direct day-to-day oversight over clearing contractors, who work on TVA ROW. A ROW Forester is assigned to each one of the twelve TVA ROW sectors (Figure 2-2) and has direct oversight of that particular sector. Before any work occurs in their sector, the TVA ROW Forester has a pre-job briefing with the tree clearing and herbicide contractors. During this meeting, TVA ensures that the scope of the project is clear, but also provides the clearing contractor with the TVA BMP manual and all environmental restrictions for the project area. This includes O-SAR guidance designed to protect caves, natural areas, SMZ, wetlands, and state and federally listed species. The contractor is encouraged to report issues, such as erosion events, as soon as they occur. While work is being conducted, ROW Foresters regularly visit the job site to ensure tasks are being properly conducted, including adherence to environmental standards. If issues are identified, the contractor must repair the damage immediately.

2.5.6.2. Quality Assurance/Quality Control Assessments

QA/QC assessments are a second tier of quality control that occurs at a broader scale than the direct ROW Forester oversight. The overall goal of the program is to ensure all contractors meet contract requirements in safety, vegetation management, and efficient use of resources. The inspection process provides an impartial and transparent feedback by using a third party who is not involved in the day to day activities of contractors. Specific inspection forms have been developed for each major type of inspection to be performed. Individual inspection forms are broken down into sub-categories defining specific requirements in the contract. A percentage compliant scale is used to score each type of inspection conducted. Each subcategory inspected receives a percent compliant score, which is compiled to achieve a percent compliant score for the overall completed inspection. Property damage, which includes soil disturbance and erosion, is specifically assessed. If issues are identified, the contractor must repair the damage immediately. For tree clearing projects in previously unmaintained portions of the ROW:

- A random selection of 33 percent of all spans (a span is the area between consecutive structures on a TL) is assessed in the field; and
- If problems are found, additional spans are inspected to ensure the full extent of issues is identified.

2.5.6.3. Easement/Contract Language

ROW easement and contract language are indirect, but important, mechanisms for preventing erosion when TVA clears trees. As the holder of an easement and not the landowner, TVA is responsible for repairing any damage done to a property during the course of TVA operations on ROW. Similarly, contracts for a given tree clearing project typically contain language stating that contractors are responsible for repairing damage done during work. Example language is:

> "Contractor will be responsible for erosion damage and especially for creating soil conditions that would threaten the stability or compaction of the ROW soil, the structures, or access to either."

TVA also places language in contracts to incentivize positive behavior from the herbicide and clearing contractors employed to manage vegetation on TVA ROW. Examples of contract language that facilitate support of environmental protection measures include:

- "Contractor will be subject up to a $2,500 assessment per violation or occurrence for non-compliance with environmental guidance";
- "Contractor will be financially responsible for all environmental mitigation, including direct and indirect costs incurred by TVA, that is needed to repair damage from herbicide applications resulting from Contractor error or non-adherence to TVA guidelines"; and
- "In the event a violation occurs due to Contractor's negligence or the negligence of its subcontractors, Contractor will be required to perform a root cause analysis".

2.6. Project-Level Process

In Section 1, we discussed the scope of the Action, including the methods of TVA ROW vegetation management funded, authorized, or carried to rely on this programmatic consultation for ESA compliance with respect to the listed plants that such activities may affect. In Section 2, we indicated specific activities not covered by the programmatic Action.

In Section 1.8 of the BA, TVA describes situations where it would not tier from this programmatic ROW vegetation management consultation including:

1. TVA and USFWS determine that species are LAA in a manner not identified in this programmatic consultation.
2. TVA is unable to adhere to SOPs, BMPs, or the TVA O-SAR process during vegetation management.

If TVA cannot use the programmatic consultation to address affects to listed species expected to occur during vegetation management of a new TL, TVA would address vegetation management, along with construction and operation of the new TL, during a stand-alone section 7 consultation with the USFWS.

2.7. Interrelated and Interdependent Actions

A BO evaluates the effects of a proposed Federal action. For purposes of consultation under ESA §7, the effects of a Federal action on listed species or critical habitat include the direct and indirect effects of the action, plus the effects of interrelated or interdependent actions.

> "Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR §402.02).

The 12 methods addressed in this programmatic Action are routine components of projects that serve one or more of the three general action categories listed in section 2 of this BO. Projects authorized, funded, or carried out under these three action categories may or may not involve interrelated or interdependent actions. Section 1.8 of the BA indicates that "future ROW acquisitions and new TL construction would receive an independent review" and that, "TVA would enter into section 7 consultation with the USFWS for these projects if TVA determines that construction or operation of the new TL has the potential to affect listed species". Therefore, we believe that through TVA's independent O-SAR review process, potential interrelated or interdependent activities associated with one or more of the activities covered under this programmatic Action would be adequately addressed. Any assessment of interrelated and interdependent activities at the program level of this Action would be speculative, given its activity-level focus. Therefore, we do not further address the topic of interrelated or interdependent actions in this BO.

2.8. Cumulative Effects

For purposes of consultation under ESA §7(a)(2), cumulative effects are those caused by future state, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed action are not considered, because they require separate consultation.

The BA suggests that many types of non-federal actions may potentially occur within the 238,196-ac Action Area in the foreseeable future and have varying levels of impact on environmental resources. This is because TVA maintains only 47 percent (approximately 110,752 ac) of lands within the Action Area; approximately 52 percent of the transmission ROW is primarily maintained by landowners (Table 2-1). As examples, TVA lists state highway maintenance and improvement projects, airport operations and expansions, rail development projects, industrial/residential development, and mining operations. TVA further suggests that other actions may include routine management and/or improvement of public lands by state and local agencies or an influx of new companies that leads to new infrastructure. Future routine operations and maintenance (O&M) activities undertaken by TVA also have the potential to trigger state, private and non-federal actions. Other actions may include routine management and/or improvement of public lands by state and local agencies or an influx of new companies that leads to new infrastructure.

Many of the threats identified for the 18 plant species covered under this consultation and identified in their recovery plans and 5-year reviews partially occur as a result of future state, local, or private actions that are reasonably certain to occur in the Action Area. These include indiscriminate application of herbicides, incompatible mowing regimes, and tree clearing activities for industrial forestry and ROW maintenance; introduction and encroachment of invasive exotic species and competitive herbaceous and woody vegetation; loss, alteration, and/or degradation of suitable habitat from residential, commercial, and/or industrial development (urbanization), cropland agriculture, livestock grazing, and trampling; illegal ORV use; relic hunting (at a single location known to support Cumberland sandwort) resulting in disturbance to plants via trampling and/or digging in a rock house; and poaching of plants for commercial resale purposes.

While we expect the non-federal actions discussed above to occur, we lack specific data about such actions and where the effects of such actions would occur in the Action Area. The USFWS is, therefore, unable to meaningfully assess the cumulative effects that may be relevant to this consultation, except as discussed in the Opinion sections for some of the affected species in the sections below.

3. PRICE'S POTATO-BEAN

3.1. Status of Price's Potato-Bean

This section summarizes best available data about the biology and current condition of Price's potato-bean (*Apios priceana*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the species as threatened on January 5, 1990 (55 FR 429-433).

3.1.1. Description of Price's Potato-Bean

The Price's potato-bean is a twining, herbaceous perennial vine in the pea family (Fabaceae). The species' climbing, yellow-green vines may grow up to 15 ft long and arise from stout, potato-like tubers that are about 7 inches (in) in diameter. The leaves are alternate and pinnately compound. The greenish-white to brownish-pink flowers are about 0.4-in long and tinged with magenta at the apex. The fruit is a legume about 5–6 inches long and 0.4-in wide that tapers at both ends. There are typically 4–10 seeds per legume. Fruits and seeds are olive-green when fresh, and mature fruits are brownish-red with tan lines, while the seeds are brown and glaucous when dry.

3.1.2. Life History of Price's Potato-Bean

Price's potato-bean typically flowers from mid-July through mid-August and produces fruit in August and September. Flowers are pollinated by various native arthropod species, such as the long-tailed skipper (*Urbanus proteus*) and bumble bees (*Bombus spp.*), and by non-native honeybees (*Apis mellifera*), although bees are reported to have some difficulty accessing the nectar (Robinson 1898). Flowers in the genus *Apios* have a tripping mechanism that causes the keel to coil when triggered by an insect. When the keel coils, it exposes the anthers and pistil, allowing pollination to occur (Bruneau and Anderson 1988). Price's potato-bean is the only species of *Apios* in which the keel bends backwards after tripping rather than coiling (Woods 1988). This tripping mechanism prevents self-pollination of the flowers. A single plant of Price's potato-bean growing in a private garden has been observed to set seed, indicating that the species is self-compatible (E. Croom, University of Mississippi, pers. comm., 1992).

Price's potato-bean plants have been observed to produce few seeds (Robinson 1898; Chester and Holt 1990; P. Olwell, Center for Plant Conservation, pers. comm., 1992). Shading of the plants by trees and shrubs (Medley 1980; Woods 1988; USFWS 1993), drought, and insect damage to flowers and fruits of Price's potato-bean (E. Chester, Austin Peay University, pers. comm., 1991) may all contribute to low seed set. Observations of a Mississippi population suggest that water availability may limit seed set; greater seed set has been observed in years with higher rainfall (E. Croom, pers. comm., 1992). Vegetative reproduction, if prevalent, would result in low genetic diversity that could reduce the success of sexual reproduction. Low fruit production also is seen in the American groundnut (*Apios americana*). Several populations of the species have been found to have a triploid chromosome number which precludes sexual reproduction (Bruneau and Anderson 1988). Bruneau and Anderson (1988) also found low fruit production (6 percent) in diploid populations of American groundnut and attributed low levels of fruit and seed production in these populations to limited resources and pollinators. A population of Price's potato-bean in Kentucky was found to be diploid with a somatic chromosome number of 22 (Seabrook and Dionne 1976). It is possible, however, that other populations are composed of sterile, triploid plants. More studies are needed to determine the reasons for low seed production in Price's potato-bean. When seeds are produced, they germinate readily with scarification (L. McCook, pers. comm., 1992; C. Baskin, University of Kentucky, pers. comm., 1991; Walter *et al*. 1986). In a small germination test, 18 of 20 seeds germinated after scarification (C. Baskin, pers. comm., 1991). Temperature fluctuations probably act to break the impermeable seed coat in the wild (C. Baskin, pers. comm., 1991). No information is available on when the seeds germinate in the wild.

This perennial species grows from a single large tuber, whereas American groundnut grows from several small tubers. Perhaps having a single tuber limits dispersal and vegetative reproduction of Price's potato-bean. Tubers of Price's potato-bean are dispersed when floods carry them to a new location (Seabrook and Dionne 1976). Tubers and seeds of American groundnut, frequently found near streams, may also be dispersed by water. No studies have investigated the dispersal mechanisms of the species. Plants do not flower during their first year of growth, but they can grow as much as 5–6 ft in their first season (C. Baskin, pers. comm., 1991). Observations also indicate that the tuber can remain dormant during a growing season and have vigorous growth the following year (L. McCook, pers. comm., 1992).

3.1.3. Numbers, Reproduction, and Distribution of Price's Potato-Bean

Price's potato-bean occurs in the southeastern United States in rocky, open woods and forest borders, often associated with mixed oak (*Quercus spp*.) woods, limestone, and drainage areas. When the Recovery Plan for Price's Potato-bean was published in 1993, there were 25 known extant populations distributed among 15 counties and four states: Autauga (2), Madison (1), and Marshall (1) counties, Alabama; Livingston (1), Lyon (1), and Trigg (2) counties, Kentucky; Clay (1), Lee (1), and Oktibbeha (2) counties, Mississippi; and DeKalb (1), Hickman (6), Marion (1), Maury (1), Montgomery (1), and Williamson (3) counties, Tennessee (USFWS 1993). There were 11 other populations considered extirpated in 1993 (2 in Illinois, 6 in Kentucky, and 3 in Tennessee), bringing the total number of known populations of the species at that time to 36. The species is considered extirpated from the State of Illinois (Ebinger *et al*. 2010), as no populations have been discovered in the state since the recovery plan was published.

Based on data in unpublished reports and from the Natural Heritage Programs in Alabama, Kentucky, Mississippi, and Tennessee, there are now 59 known extant populations, distributed among 26 counties in four states. Twenty-four of these populations are located entirely, or in part, on public lands or privately owned conservation lands; however, not all of these populations on protected lands receive adequate management to ensure they persist.

<u>Alabama</u>

There currently are 16 known extant populations of Price's potato-bean in Alabama, distributed among nine counties: Autauga (2), Butler (1), Dallas (2), Jackson (2), Lawrence (1), Madison (5), Marshall (1), Monroe (1), and Wilcox (1) (Alabama Natural Heritage Program [ANHP] 2014; Barger *et al*. 2014). Ten of these populations are located on publicly owned lands or private conservation lands (Table 3-1). Landowners of these sites include Alabama Department of Conservation and Natural Resources (ADCNR), Department of Defense (DOD), Land Trust of North Alabama (LTNA), U.S. Army Corps of Engineers (COE), and USFWS. The remaining populations are located on privately owned lands, including two on timberlands. These 15 extant populations totaled at least 2,266 Price's potato-bean plants, as reported by ANHP (2014). During a 2011 population census, a total of 2,158 plants were counted at Redstone Arsenal alone, half of which had stems 2 millimeters (mm) or less in diameter and were considered to be juveniles, providing evidence of recent successful recruitment (Boyd 2014).

Two extant Alabama populations that were included in the recovery plan have remained stable (Table3- 2). Based on available data, we are unable to determine the status of the other two Alabama populations that were included in the recovery plan.

<u>Kentucky</u>

There currently are seven known extant populations of Price's potato-bean in Kentucky, distributed among three counties: Livingston (2), Lyon (3), and Trigg (2) (Kentucky State Nature Preserves Commission [KSNPC] 2015). Of these seven populations, three were included in the species' recovery plan – one in Lyon County and the two in Trigg County (USFWS 1993). A fourth population, at the Carrsville Bluff site in Livingston County that was included in the recovery plan, has since been extirpated. Price's potato-bean has not been observed at this

Table 3-1. Price's potato-bean sites on protected lands (ANHP 2014; Boyd 2014; KSNPC 2015; USFS 2015; H. Sullivan pers. comm. 2016; TDEC 2018).

State	County	Site	Land Ownership	Last Observation
AL	Autauga	Jones Bluff	COE	21 vines – 2010
	Jackson	Little Coon Creek	ADCNR	5 vines – 2012
		Sauta Cave	USFWS	152 vines – 2011
	Madison	Blevins Gap	ADCNR, LTNA	32 vines – 2011
		Monte Sano State Park	ADCNR	27 vines – 2011
		Redstone Arsenal	DOD	2158 vines – 2011
		Rainbow Mountain	LTNA	42 vines – 2011
		Hale Mountain	ADCNR	6 vines – 2011
KY	Livingston	Corley Farm	Private	4 vines – 2014
		Livingston Co. WMA	Livingston County	41 vines – 2013
	Lyon	Mammoth Furnace	USFS	13 vines – 2018
		Pisgah Bay	USFS	1 vine – 2018
	Trigg	Hematite Lake	USFS	136 vines – 2018
		Laura Furnace	USFS	405 vines – 2018
MS	Chickasaw	Tombigbee NF	USFS	2 vines – 2015
	Lee	Coonewah & Chickasaw	NMLT	>500 vines – 2012 >50 vines – 2014
		Natchez Trace	NPS	53 vines – 2014
TN	DeKalb	Center Hill Bluffs	COE	>60 vines – 2015
	Franklin	Bear Hollow Mtn. WMA	TWRA	346 of vines – 2015
		Bear Hollow Mtn. WMA	TWRA	1 vine – 2011
	Hardin	Ross Forest SNA	Private	54 vines – 2015
	Montgomery	Barnett's Woods SNA	TDEC	18 vines – 2017
	Stewart	Neville Creek	USFS	44 vines – 2018
		Ft. Donelson NB	NPS	7 vines – 2017

location since 1992, despite several searches (most recently in 2008). However, American groundnut was found at this site in 1996, raising a question about the accuracy of the original record's identification as Price's potato-bean. The three extant populations that were included in the recovery plan have remained stable (Table 3-2).

Table 3-2. Status of extant Price's potato-bean populations in Alabama, Kentucky, Mississippi, and Tennessee (ANHP 2014; KSNPC 2015; TDEC 2018) that were included in the recovery plan (USFWS 1993).

State	County	Number of Vines – Date	
		Recovery Plan	Last Observation
AL	Autauga	6 – 1988	21 – 2010
	Marshall	5 or less – 1991	7 – 2010
KY	Lyon	7 – 1990	10 – 2013
	Trigg	<25 – 1989	23 – 2014
		30-50 – 1989	42 – 2014
MS	Lee	1,000 – 1983	>500 – 2012
	Oktibbeha	10-16 – 1988	11 – 2012
TN	DeKalb	25-50 – 1990	>60 – 2015
	Hickman	25 – 1990	>75 – 2015
		4 – 1991	1 – 2015
		7-10 – 1991	8 – 2015
		12 – 1991	2 – 2015
		6 – 1991	100 – 2015
		1-2 – 1991	1 – 2010 (No plants found in 2015)
	Marion	100-200 – 1990	231 – 2015
	Maury	24 – 1990	4 – 2015
	Montgomery	30-40 – 1990	61 – 2017
	Williamson	18 – 1990	47 – 2015
		45 – 1990	51 – 2015
		7 – 1990	22 – 2006 (No plants found in 2015)

The Lyon County population included in the species' recovery plan is on privately owned land. While the current landowner of this population cooperates with KSNPC (now, the Office of Kentucky Nature Preserves) conservation efforts for Price's potato-bean, there is no protection agreement in place and the landowner has expressed interest in selling this property. Two of the three populations in Lyon County are on U.S. Forest Service (USFS) property at Land Between the Lakes National Recreation Area (LBL), as are the two Trigg County populations included in the recovery plan (Table 3-1).

Both extant populations in Livingston County are protected. One population is located on the privately owned Corley Farm State Natural Area (SNA), which receives voluntary protection from the landowner under a natural area registry established in 2006. The second population is located on a site owned by Livingston County government. The Nature Conservancy (TNC) transferred ownership of this site to the local government and the KSNPC has entered into an agreement with Livingston County to assist in managing Price's potato-bean at the site (USFWS 2016a).

Mississippi

There are currently five known extant populations of Price's potato-bean in Mississippi, distributed among the following counties: Chickasaw (1), Kemper (1), Lee (2), and Oktibbeha (1) (H. Sullivan, Mississippi Department of Wildlife, Fisheries, and Parks, pers. comm. 2010, 2016; ANHP 2014; J. Burton, National Park Service [NPS], pers. comm. 2014).

Chickasaw County's population is located on the Tombigbee National Forest (NF) and consisted of two vines in 2015 (H. Sullivan pers. comm. 2016). One Lee County population is located in the North Mississippi Land Trust's (NMLT) Coonewah Nature Preserve (NP) and extends onto the neighboring Chickasaw Preserve (owned by The Archaeological Conservancy), while another population was discovered in 2014 on NPS lands along the Natchez Trace National Parkway. There were more than 500 plants estimated in the population at Coonewah NP in 2012 (ANHP 2014), over 50 plants at the Chickasaw Preserve in 2014 (Brady Davis, The Chickasaw Nation, pers. comm. 2016), and 53 plants at the Natchez Trace Parkway site (J. Burton pers. comm. 2014). The Kemper County population, consisting of only 6 plants as of 2012, and the Oktibbeha County population, with 11 plants in 2012, are both on privately owned lands (ANHP 2014). The Lee and Oktibbeha county populations were both included in the recovery plan, and based on numbers reported in the recovery plan and in ANHP (2014), appear to have remained stable (Table 3-2).

Two of the four populations that were known to exist in Mississippi at the time the recovery plan was completed have since been extirpated: the Rock Hill population in Oktibbeha County and the Clay County population. The Rock Hill population was extirpated due to incompatible land uses, including timber harvest and gravel mining. The Clay County population was apparently destroyed by a habitat improvement project funded by the NRCS (H. Sullivan pers. comm. 2010).

Tennessee

There currently are 31 known extant Price's potato-bean populations in Tennessee, distributed among 11 counties: DeKalb (1), Franklin (2), Giles (2), Hardin (3), Hickman (10), Marion (1), Maury (2), Montgomery (1), Stewart (2), Wayne (3), and Williamson (4) (Tennessee Department of Environment and Conservation [TDEC] 2018). Of these occurrences, 13 were included in the species' recovery plan – 1 each in DeKalb, Marion, Maury, and Montgomery counties, 6 in Hickman County, and 3 in Williamson County. Many of these occurrences included in the recovery plan have remained stable (Table 3-2).

There are seven populations on protected lands in Tennessee (Table 3-1). One Stewart County population is located at LBL and the other at Fort Donelson National Battlefield (NB), a NPS unit. The Montgomery County population is located at Barnett's Woods Designated SNA, owned by the TDEC, and one of the Hardin County populations discovered in 2009 is located on a privately owned, Registered SNA. The two Franklin County populations are located on Tennessee Wildlife Resources Agency's (TWRA) Bear Hollow Mountain Wildlife Management Area (WMA). In addition to these sites, there are reports of two sites on NPS lands along the Natchez Trace National Parkway, in Tennessee, supporting plants suspected to be Price's potato-bean, but positive identification of these plants has not been confirmed (Phillips 2006; Hatch and Kruse 2008).

3.1.4. Conservation Needs of and Threats to Price's Potato-Bean

Threats to Price's potato-bean include development, incompatible logging *(i.e.*, clearcutting or heavy logging), excessive shading by canopy trees, ROW maintenance for roads and utilities, and competition with non-native, invasive plants. Selective removal (hand thinning) of the canopy, if done carefully, may be beneficial to this species by increasing available light levels. It remains unknown whether excessive timber harvesting causes permanent destruction of the species; however, Kral (1983) asserts that occurrences exist in second growth forests and may recover after heavy logging.

Other threats affecting Price's potato-bean include small population size, low reproductive vigor, and potential for diminished genetic variation within the species. Despite the fact that 23 Price's potato-bean populations are on protected lands, recent observations indicate that low numbers of plants are present in most of these populations (ANHP 2014; KSNPC 2015; TDEC 2018; USFS 2015). Evidence of sufficient recruitment of seedlings into larger size classes capable of reproduction is generally lacking, with the exception of Redstone Arsenal's large population (Boyd 2014).

Davenport (2007) included Price's potato-bean in an analysis of potential effects of climate change on Alabama's plant life. The analysis was based on best professional judgment of how various habitat types and associated species may respond to climate changes that models predict Alabama will experience. Davenport (2007) concluded that "species demanding shady ravines and stream banks will constrict in distribution", including the hardwood forests inhabited by Price's potato-bean.

A previously unrecognized threat to Price's potato-bean occurred in the form of a 100-year flood event in middle Tennessee during May 2010, which severely disturbed habitat at nine populations in Hickman, Maury, and Williamson counties (TDEC 2012). Many of the affected populations occurred on steep slopes along the sides of roads that were severely damaged by the flooding due to their locations near streams in narrow valleys. As a result, further disturbance to the slopes where Price's potato-bean is located occurred at some of these sites during the process of clearing and grading the roadbeds for emergency repairs to restore traffic flow.

Conservation measures that have been implemented for Price's potato-bean include federal and state regulatory protection; research pertaining to the species' biology, ecology, and life history; establishment of seed banks; site protection and management; and surveys and monitoring. Similar conservation efforts should continue in the future.

3.2. Environmental Baseline for Price's Potato-Bean

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Price's potato-bean, its habitat, and ecosystem within the Action Area.

3.2.1. Action Area Numbers, Reproduction, and Distribution of Price's Potato-Bean

In the action area, the single known location of Price's potato-bean occurring on a TVA ROW is located in Stewart County, Tennessee, on the USFS's LBL. In cooperation with KSNPC, TDEC, and the USFWS's Kentucky FO, the USFS drafted a management plan in 2008 for sites where Price's potato-bean occurs at LBL (USFS 2009). This plan summarized management measures that TVA had taken at LBL during the mid-1990s, before transferring management authority to the USFS in 2004, and provides direction for future management and protection by USFS.

The population occurs on the lower-slopes of an east facing bluff on the left descending bank of the Cumberland River at approximately river mile (RM) 78.5. At this site, the Price's potato-bean population is found over approximately 5.5 ac and supported 54 individual plants as of 2015 (TVA 2018). Only a small part of the occupied habitat intersects the ROW, with less than five percent of the local population found within the ROW.

The most recent visit to the site by a TVA botanist was July 2013. The handful of plants observed in the ROW were located within 50 ft of the river downslope of a small limestone shelf that crosses the ROW along the contour of the slope, which runs parallel to the shoreline. Plants at this location occurred in deep shade, despite being in the ROW, because the population is located at the base of the steep slope and the TL conductor is high enough above the forest floor that trees in lower parts of the ROW do not need to be regularly maintained. Upslope of the limestone shelf in the ROW, the vegetation is thick young forest, dominated by black locust, and does not support Price's potato-bean. All plants occur in a portion of the ROW that is not currently maintained and is unlikely to be regularly maintained in the future.

Price's potato-bean's affinity for edge habitats suggests that it could be found along other transmission ROW sections in the PSA. TVA botanists have field surveyed about 4,900 ac (33 percent) of the estimated 15,000 ac of ROW in the counties where Price's potato-bean is known to occur and have not found new populations. TVA botanists have used the O-SAR process to designate about 10,250 and 400 ac of suitable habitat for Price's potato-bean in the Action Area as Class 1 and Class 2 plants, respectively. Given the limited area surveyed for the species and presence of suitable habitat in the Action Area, TVA is reasonably certain that additional Price's potato bean populations occur within the O-SAR polygons.

3.2.2. Action Area Conservation Needs of and Threats to Price's Potato-Bean

Populations of Price's potato bean on ROW and power line corridors are threatened by maintenance of the areas through indiscriminate application of herbicides, mowing, and tree clearing activities.

Conservation measures could include site protection (buffers), managing or eradicating competing vegetation, augmenting occurrences, and surveying for the species in undocumented areas.

3.3. Effects of Vegetation Management on Price's Potato-Bean

Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur. Our analyses are organized according to the description of the Action in section 2 of this BO[3].

This section analyzes the direct and indirect effects of the Action on Price's potato-bean. An effects analysis summary of the effects of various methods of vegetation management on Price's potato-bean and the other 17 listed LAA plant species from the BA has been included in Appendix II.

3.3.1. Effects of Manual Vegetation Clearing on Price's Potato-Bean

Manual vegetation clearing has the potential to adversely affect Price's potato-bean if trees need to be cleared on the lower slopes of the ROW where Price's potato-bean occurs. Direct injury or death of vines can occur during manual tree clearing activities. Indirectly, limited tree clearing activities resulting in increased light on sites where Price's potato-bean occurs will likely benefit the species by promoting growth and reproduction.

Adverse effects from mechanical clearing activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, and avoiding the use of heavy equipment (to and from the site) that may result in soil disturbance.

3.3.2. Effects of Mechanical Clearing on Price's Potato-Bean

All mechanical vegetation control methods used by TVA have the potential to adversely affect Price's potato-bean. There is some chance vegetation removal could benefit the species and promote reproduction, by increasing light availability and reducing competing vegetation. However, all of the vegetation removal activities could result in loss of individuals by trampling, cutting, and soil disturbance from machinery.

As with manual tree clearing, adverse effects from mechanical clearing activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, and avoiding the use heavy equipment that may result in soil disturbance.

3.3.3. Effects of Herbicide Use on Price's Potato-Bean

Broadcast herbicide, either from the air or ground, will adversely affect Price's potato-bean plants growing on and near the ROW edge if used in occupied habitat. Of all the methods and tools available to TVA, broadcast herbicide has the greatest potential to result in impacts that extirpate plants from the ROW. The use of broadcast herbicide in a TVA ROW that contained Price's potato-bean could result in the death of individual plants and may even lead to the extirpation of entire populations.

---

[3] This text identifies the definitions of possible effects evaluated in a biological opinion and is applicable to all other plant species included in Section 3 of this biological opinion. This text is incorporated by reference for each subsequent Effects of Vegetation Management section in the biological opinion but has not been repeated in those sections to reduce redundancy in the document.

Spot treatment of herbicide is highly targeted and not likely to adversely affect Price's potato-bean at the population level, but could result in the death of individual plants if a broad spectrum herbicide is used in close proximity (direct contact) to individuals. Cut stump and hack and squirt applications could be used when cutting trees to prevent resprouting. If trees do not need to be cut immediately, but may threaten future TL reliability, spot treatments can be used to kill the trees without directly affecting Price's potato-bean, given appropriate buffers are established to protect from overspray. Even though localized herbicide application targets woody species within the ROW floor, the use of that tool would adversely affect the species. If individual Price's potato-bean plants occur within a few feet of a localized herbicide application, chances are high that the plant would experience some level of herbicide related damage which may rise to the level of individual plant death. These targeted applications may be less likely to damage Price's potato-bean plants beyond chemical burns or other limited effects (limiting or eliminating the application year's reproduction); however, the precise effects of such targeted herbicides on Price's potato-bean have not been studied, so they should still be used with caution.

In summary, all vegetation control methods that use herbicides may adversely affect Price's potato-bean if used in occupied habitat. Adverse effects from herbicide management activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, appropriate application and timing of herbicide treatment, conservation spraying, or another targeted herbicide application technique, such as spot application.

3.3.4. Effects of Debris Management on Price's Potato-Bean

All debris management techniques used by TVA have some potential to adversely affect Price's potato-bean. The aspect of debris removal most likely to affect the species is physical disturbance associated with manual or mechanized handling of debris. This disturbance could result from soil disturbance by machinery or dragging of debris over plants. At the requests of landowners, vegetation debris may be left for landowner's personal use under appropriate circumstances. TVA's facilitation of landowner use of wood has similar potential for small impacts as manual debris management methods.

Mechanical mulching is not expected to generate enough mulch to adversely affect Price's potato-bean. However, such mulching may cause physical disturbance to the plants or soil, resulting in damage or death of individuals.

In summary, all debris management activities are likely to adversely affect price's potato-bean. Adverse effects from mechanical clearing activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, and avoiding the use of heavy equipment that may result in soil disturbance.

3.4. Conclusion for Price's Potato-Bean

The purpose of a BO under §7(a)(2) of the ESA is to determine whether a Federal action is likely to:

- jeopardize the continued existence of species listed as endangered or threatened; or
- result in the destruction or adverse modification of designated CH.

"Jeopardize the continued existence" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).[4]

In this section, we interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) for the Prices's potato-bean relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action will have localized adverse effects to Price's potato-bean. If any plants are adversely affected, they will likely represent only a small portion of any given population within the Action Area. We anticipate no populations will be extirpated by proposed vegetation management activities, given that TVA follows its AMMs, BMPs and SOPs. Other non-federal actions in the Action Area that are reasonably certain to occur and that may affect Price's potato-bean include the use of broadcast herbicide on adjacent agricultural lands, use of broadcast herbicides at ROW intersections (*e.g.* railroad crossings, roads), and timber management activities on adjacent lands (cumulative effects; see Section 2.8). We also anticipate that the Action will result in beneficial effects to Price's potato-bean by removing competing vegetation, which will in turn increase light availability and promote reproduction.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of Price's potato-bean. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only a fraction of the known, rangewide populations (one population out of a total of 59) exists within the Action Area, and less than five percent of that population (approximately two or three individuals, based on recent survey data) is found within the ROW; therefore, only a very small percentage of plants in the species range would be affected by the Action.

[4] This text identifies the purposes of a biological opinion and the definition of jeopardy and is applicable to all other plant species included in Section 3 of this biological opinion. This text is incorporated by reference for each subsequent Conclusion section in the biological opinion but has not been repeated in those sections to reduce redundancy in the document.

4. BRAUN'S ROCK-CRESS

4.1. Status of Braun's Rock-Cress

This section summarizes best available data about the biology and current condition of the Braun's rock-cress (*Arabis* [=*Boechera*] *perstellata*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the species as endangered on January 3, 1995 (60 FR 56-61).

4.1.1. Description of Braun's Rock-Cress

The Braun's rock-cress is a perennial herb that is distinguished from other members of the genus *Arabis* by the white, star-shaped hairs on stems and leaves that give the plant a grayish appearance. The fruit is a round, elongate, and densely, hairy silique. Flowers are produced from late March to early May; fruits mature from mid-May to early June (USFWS 1997).

4.1.2. Life History of Braun's Rock-Cress

Braun's rock-cress occurs on the slopes of calcareous mesophytic and sub-xeric forest types. The occurrence of this species does not appear to be limited to a particular slope aspect, elevation, or moisture regime within the slope forests. It is, however, sun intolerant and always occurs in at least partial shade. The largest and most vigorous populations occur on moist mid- to upper slope sites. Plants are often found around rock outcrops, protected sites on the downslope side of tree bases, and sites of natural disturbance, such as talus slopes and animal trails. It is rarely found growing among the leaf litter and herbaceous cover of the forest floor (USFWS 1997).

Braun's rock-cress is probably pollinated by insects, but the vector is not known nor is it clear whether it is self-fertile. It has no specific morphological mechanism for seed dispersal; it is likely that dispersal is occurring through wind or gravity, rather than animal movements. Seeds are probably most commonly dispersed downslope (USFWS 1997).

4.1.3. Numbers, Reproduction, and Distribution of Braun's Rock-Cress

Braun's rock-cress produces viable seeds, and plants can easily be grown from seeds under greenhouse conditions (USFWS 1997). It is not known, however, whether the plant depends on a seed bank to take advantage of opportunities for seed germination and establishment. Seedling survival may increase in years of high rainfall through the spring and early summer months. If suitable habitat is available, reproduction appears to be successful, but it is not clear whether it is successful at sufficient levels to maintain population viability (USFWS 1997).

The majority of Braun's rock-cress populations occur in Kentucky, and the last significant (rangewide) survey for Kentucky populations was conducted in 2012-2013 by the KSNPC, when 50 percent of populations were monitored. Within Kentucky, the species is currently restricted to 40 populations in three counties (Franklin, Henry, and Owen), all of which are associated with the Kentucky River or its tributaries (primarily Elkhorn Creek). Population trends in Kentucky indicate that two occurrences are increasing, seven are stable, 13 are declining, and 18 are of unknown status (USFWS 2018a).

Within Tennessee, all occurrences are monitored by TDEC every three to five years, with the most recent comprehensive survey completed in 2018 (USFWS 2018a). The six extant Tennessee populations (12 occurrences) occupy portions of three counties, Rutherford, Smith, and Wilson, with the majority of these situated along the Stones River (USFWS 2018a). Population trends in Tennessee indicate that three occurrences are increasing, three are declining, and six are of unknown status (USFWS 2018a).

4.1.4. Conservation Needs of and Threats to Braun's Rock-Cress

At the time of listing, Braun's rock-cress was threatened primarily by destruction or adverse modification of its habitat (USFWS 1997). Specifically, these threats included residential, commercial, or industrial development; livestock grazing and trampling; timber harvesting; and competition with native and exotic weedy species, especially the European garlic mustard (*Alliaria petiolata*). These threats are on-going (USFWS 2018a). The species could benefit from additional survey efforts, including evaluations of associated forest quality (2019-2020), studies on garlic mustard management, increased seed banking efforts, and increased augmentation and introductions to high quality sites that contain fewer invasive plants.

4.2. Environmental Baseline for Braun's Rock-Cress

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Braun's rock-cress, its habitat, and ecosystem within the Action Area.

4.2.1. Action Area Numbers, Reproduction, and Distribution of Braun's Rock-Cress

No Kentucky Braun's rock-cress populations are known on TVA ROW. In Tennessee, however, Braun's rock-cress is known to occur in forests abutting three sections of TVA's TL ROW. One occurrence is on Scales Mountain in Rutherford County and the other two are associated with Walnut and Pilot knobs along the Wilson/Smith County line. Botanists from the Tennessee Natural Heritage Program (TNHP) surveyed the Scales Mountain population in 2015 and noted that 47 individual plants occurred on the site and that no plants were on the ROW. This data supports TVA's botanist's observations of the site from 2016 that noted no plants occurred on the ROW (or immediately adjacent to it) and that activities restricted to the cleared ROW (*i.e.*, ROW floor work) would not affect the species at this location.

TVA botanists first surveyed the ROW in Wilson County in 2013 and found about 200 - 250 individual plants at three areas located adjacent to the northern ROW. Most of these plants were near the edge of the ROW, in a previously unmaintained area that had been recently cleared of trees. The plants appeared healthy and vigorous at the time of the survey. A 2018 follow-up survey of the site found no plants in the ROW, but healthy plants were found on the ROW edge.

The site occurring on the southern ROW in Smith County was first identified in 2016. The 30-40 plants observed were all outside of the open ROW.

Additional undocumented occurrences of Braun's rock-cress may occur adjacent to the TVA ROWs. Approximately 2,600 ac of TVA ROW are situated in the three Tennessee counties where Braun's rock-cress is known to occur. While not all sections of TVA ROW are potential habitat for Braun's rock-cress, TVA botanists have used the O-SAR process to designate about 1,200 and 470 ac of ROW as Plants Class 1 and Plants Class 2, respectively. TVA believes that a small portion of the area covered by these O-SAR polygons likely contains Braun's rock-cress (TVA 2018).

4.2.2. Action Area Conservation Needs of and Threats to Braun's Rock-Cress

The conservation needs and threats of Braun's rock-cress within the Action Area have not been fully assessed; however, TVA ROW maintenance includes conservation measures to avoid and minimize effects to the species at known locations. In addition, removal of invasive species could improve habitat conditions at some sites.

4.3. Effects of Vegetation Management on Braun's Rock-Cress

This section analyzes the direct and indirect effects of the Action on Braun's rock-cress. An effects analysis summary of the effects of various methods of vegetation management on Braun's rock-cress and the other 17 listed LAA plant species from the BA has been included in Appendix II.

4.3.1. Effects of Manual Vegetation Clearing on Braun's Rock-Cress

Manual clearing is routinely used to avoid and minimize effects to listed plant species, including Braun's rock-cress. Use of hand tools in clearing activities is highly selective, used on relatively small scales, and, therefore, is unlikely to result in direct effects to Braun's rock-cress. Chainsaws may be used to remove individual trees from the transmission ROW floor, margins of the border zone, and danger trees within or adjacent to the ROW. Manual clearing of select trees in previously unmaintained parts of the ROW margin would have little direct effect on Braun's rock-cress if done to protect individual plants, but the resulting increase in sunlight could indirectly effect plants by exposing them to too much light.

4.3.2. Effects of Mechanical Clearing on Braun's Rock-Cress

Braun's rock-cress is normally found on steep slopes with rock outcrops that physically preclude the use of wheeled and tracked equipment. However, because the species is known to occur on the edges of ROWs, there is the potential that mechanical vegetation clearing activities could intersect habitat occupied by Braun's rock-cress. If Braun's rock-cress is present where bulldozers are being used, individual plants could be crushed by trees that are pushed over or damaged when plants or tree roots are dislodged. Sidewall trimming, either from the air or the ground, would directly affect trees being pruned, but would have few other effects, other than a marginal increase in light levels due to removal of individual limbs. Any soil disturbance from ground-based sidewall trimming would be minimal and short-term. The species is restricted to forests and ecotones between the forest and ROW and does not occupy open portions of the ROW. Therefore, mowing, which is restricted to regularly maintained areas within the ROW floor, is not likely to adversely affect the species.

4.3.3. Effects of Herbicide Use on Braun's Rock-Cress

Vegetation control methods that utilize herbicides are likely to adversely affect Braun's rock-cress if used in occupied habitat. Spot treatment with herbicide is highly targeted and not likely to adversely affect Braun's rock-cress because localized herbicide application is restricted to the existing ROW (where Braun's rock-cress typically does not grow). However, spot treatment could potentially adversely affect individual plants via direct contact. Individual plants that occur at the edge of the ROW could be inadvertently exposed to localized herbicide application if they are growing adjacent to an undesirable tree seedling. Broadcast herbicide could affect plants growing on and near the ROW edge; however, the steep terrain where Braun's rock-cress typically occurs would prevent the use of ground-based, broadcast spray treatments, and the relatively dense population and mixed land use of areas where Braun's rock-cress occurs would make use of aerial application of herbicide unlikely.

4.3.4. Effects of Debris Management on Braun's Rock-Cress

Debris management techniques used by TVA could result in the physical disturbance of individual plants associated with manual or mechanized handling of material. This disturbance could result from dragging of debris over plants or minor soil disturbance from operating machinery in the area, but is not expected to result in the death of individual plants. Given the steep, rocky terrain in local areas supporting Braun's rock-cress, it is unlikely chipping and mulching would occur in areas supporting the species; however, if it did occur, plants could be crushed by machinery or buried by mulch/chips. Burning would occur in the open ROW and would not affect Braun's rock-cress. TVA's facilitation of landowner use of wood materials in the ROW would have a similar potential for minor impacts as the other debris management methods.

4.4. Conclusion for Braun's Rock-Cress

In this section, we interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) for the Braun's rock-cress relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to Braun's rock-cress. We do expect some damage or loss of individual plants that could result in local population declines; however, we expect those populations to persist. Additionally, canopy thinning and removal of invasive species could benefit the Braun's rock-cress in the future. Cumulative effects to Braun's rock-cress that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the Braun's rock-cress. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) While 46 known populations of the species occur in portions of Kentucky and Tennessee, none of these occur within TVA's ROW. Three occurrences do abut separate, existing sections of TVA ROW in Tennessee, with only one of these occurrences containing more than 200 individuals and a high probability of viability.

5. PYNE'S GROUND-PLUM

5.1. Status of Pyne's Ground-Plum

This section summarizes best available data about the biology and current condition of Pyne's ground-plum (*Astragalus bibullatus*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list Pyne's ground-plum as endangered on September 26, 1991 (56 FR 48748 48751).

5.1.1. Description of Pyne's Ground-Plum

Pyne's ground-plum is a rare member of the pea family (Fabaceae). The following description of Pyne's ground plum is adapted from Barneby and Bridges (1987) and Somers and Gunn (1990): a herbaceous perennial, stems simple, 5 to 15 centimeters (cm) (2 to 6 in) tall, loosely tufted and arising from a shallowly buried root-crown attached to a stout vertical taproot, glabrous and leafless at base, usually bearing five to ten leaves with petioles 2 cm (0.79-in), once-pinnate with 19 to 27 elliptic or ellipticobovate leaflet. The inflorescence is a raceme supporting 10 to 16 purple flowers. The fruits are fleshy pods that usually mature in May and June; at maturity, the pods are colored red above and yellow below (USFWS 2011a).

5.1.2. Life History of Pyne's Ground-Plum

Pyne's ground-plum flowers from late April through early May. Fruiting begins in early May with seed dispersal beginning around the first of June. As many as 26 above-ground stems and 50 fruits have been observed on one plant (USFWS 2011a). Dispersal mechanisms appear to be limited to abiotic factors including gravity and water (Morris *et al*. 2002). At a few sites, bush-hogging to control woody vegetation encroachment appears to have facilitated an increase in the number of plants, likely due to reduction of shade and enhanced seed dispersal (USFWS 2011a).

Characteristics of Pyne's ground-plum seeds and habitat favor the development of a large, persistent seed bank that is stratified by age (Morris *et al*. 2002). The seeds of Pyne's ground-plum have a hard, impermeable seed coat that imposes a strong physical germination barrier. Soils in cedar glade habitats, where the species is found, contain an abundance of unconsolidated rock fragments in a soil matrix that is granular in structure (U.S. Department of Agriculture/Soil Conservation Service 1977); such soils, in combination with repeated frost-heaving and sedimentation processes, promote migration of Pyne's ground-plum seeds down through the soil column over time, likely stratifying seeds of different ages (Morris *et al*. 2002).

The pollinating agents for this plant are not known, but flying insects play a role in many other legumes. Factors relating to population structure and dynamics have not been researched. Population size seems to fluctuate dramatically in colonies from year to year, possibly in response to the amount of rainfall and the amount of disturbance (Somers and Gunn 1990).

5.1.3. Numbers, Reproduction, and Distribution of Pyne's Ground-Plum

Pyne's ground-plum is endemic to the limestone cedar glades in the Central Basin Section of the Interior Low Plateau in Tennessee (USFWS 2011a). The habitats of *Astragalus* species in the southeastern U.S. tend to be on rocky or sandy soils, providing a more arid contrast to the generally moist habitats found in the region (Weakley 2008), and this is true of native *Astragalus* in Tennessee. Pyne's ground-plum is known from eight extant occurrences, all occurring in the Stones River watershed in the vicinity of Murfreesboro, Rutherford County, Tennessee. Five of the eight occurrences are located on public lands. Four of these are designated SNAs, owned by TDEC. Three occurrences are located entirely on privately owned land (USFWS 2011a); the remaining occurrence is located on NPS lands. Table 5.1 provides a general summary of all extant and historic (extirpated) Pyne's ground-plum occurrences (USFWS 2011a).

Until 2006, the known occupied range of Pyne's ground-plum was restricted to an approximately 90 square kilometers (km2) (35 mi²) area, and no occurrences were separated by a distance greater than approximately 18 kilometers (km) (11 mi). An occurrence that TVA biologists discovered during a 2007 survey of a power line ROW extended the known range approximately 16 km (10 mi) to the southwest and expanded the area encompassing the species' range to approximately 235 km2 (90 mi²). TVA biologists discovered the occurrence in a small opening in an otherwise heavily wooded cedar forest, which would likely not have been recognized as suitable habitat for the species. This occurrence, in a small opening within a matrix of presumably unsuitable habitats, is located approximately 10 mi from the nearest historic or extant occurrence of Pyne's ground-plum (USFWS 2011a).

There are believed to be three extirpated wild occurrences of Pyne's ground-plum (Table 5.1), all from Rutherford County. The first was collected near the city of La Vergne by Augustin Gattinger, probably in 1881 (Barneby and Bridges 1987), and is represented by a specimen in the Smithsonian Institution [Gattinger s.n. (US-70229)] (Wurdack 2011). Vegetative material collected in June 1948 from a site near the Rutherford/Davidson County line by botanists from the University of Tennessee at Knoxville is represented in the University of Tennessee Herbarium (Wofford 2011); the site is now under Percy Priest Reservoir. Examinations of glades in both counties adjacent to the reservoir have failed to locate any additional Pyne's ground-plum. The third site occurred on private land that was commercially developed in the

Table 5.1. Summary of all extant and historic (denoted with a "*") occurrences of Pyne's ground-plum.[5]

EO Number	Ownership	Site Name	Population Data
1	TDEC	Flat Rock Cedar Glades and Barrens Designated SNA	1,000 – 2,800
2*	Private		<100
3	TDEC, Private	Flat Rock Cedar Glades and Barrens DSNA	50 - 200
4	TDEC	Overbridge Designated SNA	10 - 45
5	Private		20 - 200
6	Private		100 – rumored to have been planted
8*	Public		n/a
9	Public	Manus Road Cedar Glade Designated SNA	250 - 520
10*	Private		n/a
13	NPS	Stones River NB	110 individuals planted in 2001; 2 found in 2008
16*	TDEC	Sunnybell Cedar Glade Designated SNA	Failed introduction
18	Private		<300

mid-1990s. Recent surveys in this area have failed to locate any additional plants. Therefore, it is unlikely that this species still exists at these three sites. Occurrence number 16 is listed as extirpated in Table 5.1, but actually represents a failed attempt to establish a new occurrence on a designated SNA by transplanting nursery propagated plants into the habitat.

5.1.4. Conservation Needs of and Threats to Pyne's Ground-Plum

Pyne's ground-plum is extremely vulnerable because of its limited range and its specific use of limestone cedar glade habitat. The primary threat to the species is the loss, alteration, and/or degradation of habitat from residential, commercial, and/or industrial development from the nearby city of Murfreesboro; livestock grazing and trampling; encroachment of competing vegetation; and illegal ORV use. Only one of the eight known occurrences of Pyne's ground-plum is currently threatened by impacts from livestock grazing. All the known Pyne's ground-plum occurrences are threatened by the encroachment of more competitive herbaceous vegetation and/or woody plants, such as eastern red cedar (*Juniperus virginiana*), that produce shade and compete for limited water and nutrients. Habitat alteration and/or degradation due to invasive, encroaching exotic plant species also pose a threat to the species. Invasive exotic plants that currently are either being managed or have been noted as potential threats at Pyne's ground-plum occurrence sites include spotted knapweed (*Centaurea biebersteinii*), Japanese

[5] The column labeled "EO Number" refers to the element occurrence number assigned by TDEC. Site names are provided only for element occurrences on public lands. Population data are primarily from TDEC (2005) and represent approximate ranges from counts or estimates of abundance; where given, population data for extirpated occurrences are historic.

honeysuckle (*Lonicera japonica*), privet (*Ligustrum spp.*), and sericea lespedeza (*Lespedeza cuneata*), among others. Drought poses a potential threat to this species, as evidenced by the most severe drought in recorded history in middle Tennessee during summer 2007. It is possible that alterations in precipitation and drought frequency or severity that might accompany climate change could pose a growing threat to Pyne's ground-plum in the future (USFWS 2011b).

Due to the 2006 discovery of Pyne's ground-plum by TVA biologists approximately 10 mi from the nearest known occurrence of the species (see section 4.1.3), the cedar glade ecosystem of the Stones River Basin within Davidson, Rutherford, and Wilson counties should be considered the geographic range for recovering this species (USFWS 2011a). Conservation measures that have been implemented for Pyne's ground-plum include federal and state regulatory protection; investigating the species' biology, ecology, and life history; preserving germplasm and establishing or augmenting occurrences; site protection and management; and surveys and monitoring. Similar conservation approaches should continue in the future.

Five of the eight Pyne's ground-plum occurrences are located on public lands, providing them added protection. Four of these are designated SNAs, owned by TDEC, three of which were purchased using Recovery Land Acquisition grants funded through section 6 of the ESA. Of the remaining four occurrences, one was planted at the Stones River NB, one is located on private lands and managed under a SNA registry, and only three of the occurrences are on private lands and unprotected. TDEC manages and protects habitats at the occurrences on designated SNAs and at the site managed under a SNA registry.

5.2. Environmental Baseline for Pyne's Ground-Plum

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Pyne's ground-plum, its habitat, and ecosystem within the Action Area.

5.2.1. Action Area Numbers, Reproduction, and Distribution of Pyne's Ground-Plum

In the Action Area, the Pyne's ground-plum has been documented from one location in Rutherford County, Tennessee along a TVA ROW. This small population was found in 2007 by TVA botanists as part of an environmental review for a proposed new TL and exists immediately off the TVA ROW on private land (A. Datillo, TVA, pers. comm., April 19, 2019). The TL was initially designed to pass through the center of a very small glade opening that comprises the entirety of the habitat for the species. TVA realigned the ROW to the east, prior to construction, so that the species would not be affected. While the species is not currently in the TVA ROW easement, plants do occur 25 to 30 ft from the ROW edge.

Intact cedar glade habitats are not mutually exclusive with ROW vegetation management, and it is not inconceivable that other undocumented occurrences intersect the transmission system. TVA botanists have reviewed all TLs located in Rutherford County using the O-SAR process. Given the propensity for glades (and ROW near glades) to harbor listed plant species and the ease which these habitats can be identified using aerial photos, TVA botanists have classified many areas as Class 2 Plants.

The vast majority of these areas, including one ROW just north of a more recently discovered population (2009) of Pyne's ground plum located near Flat Rock Cedar Glades and Barrens designated SNA, were subsequently field surveyed. These field surveys have resulted in discovery of multiple new populations of state and federally listed plant species on TVA ROW in Rutherford County, but no new occurrences of Pyne's ground plum. Few if any sizable, unsurveyed glades co-occurring on ROW remain in Rutherford County.

5.2.2. Action Area Conservation Needs of and Threats to Pyne's Ground-Plum

Few if any sizable, unsurveyed glades on TVA ROW remain in the Action Area. TVA botanists have conducted field surveys of nearly all of these sites and it is unlikely new populations of Pyne's ground-plum will be located on ROW. Threats to existing occurrences include loss, alteration, and/or degradation of habitat from residential, commercial, and/or industrial development; livestock grazing and trampling; encroachment of competing vegetation, including exotics; and illegal ORV use. Conservation measures could include managing or eradicating competing vegetation, augmenting occurrences and site protection.

5.3. Effects of Vegetation Management on Pyne's Ground-Plum

This section analyzes the direct and indirect effects of the Action on Pyne's ground-plum. An effects analysis summary of the effects of various methods of vegetation management on Pyne's ground-plum and the other 17 listed LAA plant species from the BA has been included in Appendix II.

5.3.1. Effects of Manual Vegetation Clearing on Pyne's Ground-Plum

Manual vegetation clearing has the potential to adversely affect Pyne's ground-plum. However, provided it does not intentionally disturb the soil, it is unlikely to result in the death of individual plants. Pyne's ground-plum is tolerant of sun, though it does not typically inhabit the interior of cedar glades. If tree clearing resulted in increased light on sites where it occurred, the effect would not likely be detrimental. The species would be susceptible to physical damage caused by clearing activities, but the shallow rocky soils characteristic of cedar glades do not rut easily and the species could resprout after the discrete widely-spaced instances of tree clearing.

Manually clearing vegetation on previously unmaintained ROW is a one-time event because these areas will subsequently be treated as ROW floor. Danger tree clearing occurs as needed. Danger tree clearing may never be needed in Pyne's ground-plum habitat near glades because the soils are not deep enough to support growth of trees tall enough to impact power lines.

5.3.2. Effects of Mechanical Clearing on Pyne's Ground-Plum

All mechanical vegetation control methods utilized by TVA have the potential to adversely affect Pyne's ground plum. However, as long as the method does not intentionally disturb the soil it is unlikely to result in the death of individual plants. Mowers are generally set 10 to 12 inches off the ground and would likely miss low-growing Pyne's ground-plum; if damaged, all but the weakest plants would resprout.

5.3.3. Effects of Herbicide Use on Pyne's Ground-Plum

Vegetation control methods that utilize herbicides are likely to adversely affect Pyne's ground-plum. Spot treatment with herbicides is highly targeted and not likely to adversely affect Pyne's ground-plum, but could affect individual plants via direct contact. Cut stump and hack and squirt applications could be used when cutting larger trees to prevent resprouting and as an AMM to control smaller trees in occupied habitat within the ROW floor. Pyne's ground-plum could occupy the floor of ROW and, therefore, be affected by localized herbicide applications, which are commonly used to control woody species in the open ROW.

While off target herbicide damage could kill individual plants, it is unlikely that entire populations would be extirpated. This is because habitats where Pyne's ground-plum is most likely to occur do not have significant numbers of tree seedlings in the ROW. These dry, rocky areas do not support rapid tree growth, and woody plant species are typically widely-spaced. This increases the odds that Pyne's ground-plum plants, if undocumented populations occur on TVA ROW, would survive instances of localized application of herbicide. Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW. However, it is unlikely that this tool would be used in relatively densely populated areas of Rutherford County, Tennessee, where this species is likely to occur.

5.3.4. Effects of Debris Management on Pyne's Ground-Plum

All debris management techniques used by TVA have a small potential to adversely affect Pyne's ground-plum. The aspect of debris removal most likely to affect the species is physical disturbance associated with manual or mechanized handling of debris. This disturbance could result from dragging of debris over plants or the marginal soil disturbance that would be expected from use of machinery. The soil disturbance would be minimal because of the rocky habitats preferred by Pyne's ground-plum, which are well-drained and resistant to deep rutting. Neither form of disturbance would be likely to result in the death of individual plants. Pile burning could conceivably result in loss of individual plants, but the infrequent use of the tool, combined with the extreme rarity of the species, make the likelihood of this occurring very small. TVA's facilitation of landowner use of wood has similar potential for small impacts as manual debris management methods.

If mulching machines were used in Pyne's ground-plum habitat, it would not likely generate enough mulch to bury the species. This is because the amount of mulch or chips generated by the machine is directly proportional to the amount of vegetation the site supports. Dry glade margins stunt woody plant growth, and the layer of mulch left in these areas is often discontinuous and less than 1-in deep.

5.4. Conclusion for Pyne's Ground-Plum

In this section, we interpret the findings of the previous sections for the Pyne's ground-plum (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to Pyne's ground-plum and result in no more than a few individual plants within the Action Area being adversely affected. Some non-federal actions in the Action Area are reasonably certain to occur and may affect the Pyne's ground-plum. For example, a small population currently exists immediately off of the TVA ROW on private land (A. Datillo, TVA, pers. comm., April 19, 2019) that is at risk of potentially being affected by future management activities.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the Pyne's ground-plum. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW (i.e., A small, single population, comprised of a few plants, is currently located 25 to 30 ft from the ROW edge.). (3) Only a fraction of known total populations (one out of a total of eight) occurs within the Action Area, and the single population is located off of the ROW, where individual plants would be less likely to be adversely affected.

6. MOREFIELD'S LEATHER-FLOWER

6.1. Status of Morefield's Leather-Flower

This section summarizes best available data about the biology and current condition of the Morefield's leather-flower (*Clematis morefieldii*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the species as endangered on May 20, 1992 (57 FR 2156-21564).

6.1.1. Description of Morefield's Leather-Flower

Morefield's leather-flower is a perennial vine in the buttercup family (Ranunculaceae) that can grow up to 16 ft (5 meters [m]) long. This species has compound leaves, reaching lengths of 8 inches (2 decimeters [dm]), arranged in 9–11 leaflets, with terminal leaflets (one-three) forming tendrils. The flowers, which are present from May to July, are pinkish in color and 20–25 mm (0.8–1.0 in.) long. Fruits are clusters of hairy achenes (a type of simple, dry fruit containing only one seed). This species is a member of the *Viornae* subsection of *Clematis*, which is noted for its narrow endemics (Kral 1987). *Clematis* in this subsection are distinguished by urnshaped flowers which occur singly, or in few-flowered groups, in leaf axils. Their primary flower stalks (peduncles) are subtended by leafy bracts. Morefield's leather-flower is closely related to vasevine (*Clematis viorna*), a more variable species, but Morefield's leather-flower is distinguished from this species by the dense, white hairs on shoots, velvety lower leaf surfaces, and stouter, usually shorter (15–25 mm or 0.6–1.0 inches long) peduncles with sessile to nearly sessile bracts at the base (Kral 1987).

6.1.2. Life History of Morefield's Leather-Flower

Morefield's leather-flower blooms from May to July. Pollinated flowers are capable of producing abundant (15 or more per flower) achenes (Crabtree 2014). Little information on effective pollinators is available, but Crabtree (2011) observed bumblebees (*Bombus* spp.) visiting flowers of Morefield's leather-flower. Various studies and observations indicate that flower and fruit production are positively correlated with precipitation (Emanuel 2000; Boyd and Paris 2013; Crabtree 2014; Paris *et al*. 2015, 2016). Herbivory by vertebrates and insects is apparently common for Morefield's leather-flower (Boyd and Paris 2013; Paris *et al*. 2015, 2016) and can reduce a plants' flower and fruit production (Paris *et al*. 2015). Small flower buds are particularly vulnerable to herbivory by Lepidopteran larvae (Paris *et al*. 2016). A study by Paris *et al*. (2015) indicated that insecticide use could be an effective management tool to increase sexual reproduction of Morefield's leather-flower.

Seeds may remain dormant during their first year after dispersal, with many seeds germinating in the second year post-dispersal (Paris *et al*. 2016). Paris *et al*. (2016) noted that post-dispersal predation of achenes was generally low during a multi-year study. Crabtree (2011) repeatedly observed Morefield's leather-flower seedlings along deer trails, suggesting that white-tailed deer (*Odocoileus virginianus*) may be potential dispersal agents of the species' seeds, but additional research is needed to elucidate this putative relationship.

6.1.3. Numbers, Reproduction, and Distribution of Morefield's Leather-Flower

Morefield's leather-flower is endemic to limestone drains and outcrops on the Cumberland Plateau escarpments in northeast Alabama, northwest Georgia, and south-central Tennessee. This species occupies a narrow range, spanning fewer than 70 mi east to west and under 50 mi north to south, and is restricted to areas underlain by calcareous bedrocks (such as limestone) along south to southwest facing slopes within the Plateau Escarpment ecoregion. Plants occur at elevations of 700 - 1700 ft and are often found near seeps and springs in red cedar-hardwood forests, particularly within transitional zones between dry calcareous forests and mesic forests (Kral 1987; Weber 1991; Cook 2018; T. Crabtree, TDEC 2018; USFWS 1994a, 2018b).

Populations were not explicitly defined in the listing rule (57 FR 21562-21564), recovery plan (USFWS 1994a), or 2010 5-year review (USFWS 2010) for Morefield's leather-flower. In the most recent 5-year review for Morefield's leather-flower (USFWS 2018b), a provisional population definition of 1 km (0.6-mi) is used to delimit individual populations, which is in line with both the TNHP (2018) and the ANHP (2018) EOs. As such, individuals or groups of

Morefield's leather-flower that are separated by at least 1 km from their nearest known neighbors are considered to be a distinct population. Alternatively, Crabtree (2011) suggested that a separation distance of 500 m (1640 ft), based on flight distances of bumblebees (*Bombus spp.*) as potential pollinators, might be appropriate. However, this may underestimate flight distances, as recent studies have shown that maximum distances for various bumblebee species can range from 450 m (1476 ft) to 2.5 km (1.5 mi) (Knight *et al.* 2005; Osborne *et al.* 2008; Hagen *et al.* 2011). Indeed, Georgia Department of Natural Resources (GDNR) (2018) staff have suggested a 1.5-km separation distance may be appropriate. However, the region's rugged terrain and development (*e.g*., roads) may limit potential pollinator movement between sites (Bhattacharya *et al*. 2003). Given this and the consistency between two of the three responsible state natural heritage programs (SNHPs), using a 1-km separation distance to delineate populations is appropriate at this time. Revisions to the current provisional population definition based on pollinator flight distances, and associated potential pollen and gene flow, or based on genetic studies and/or other factors (*e.g.*, topography) will likely alter the number of discrete populations and should be adopted if determined to be appropriate upon further evaluation (USFWS 2018b).

Under the 1-km provisional population definition, there are 34 known populations of Morefield's leather-flower across three states (Alabama, Tennessee, and Georgia), with 32 populations considered extant and two considered extirpated. With 20 extant populations in two counties, Franklin (18) and Grundy (2), Tennessee is home to nearly two-thirds of known populations (TNHP 2018). Six of Tennessee's populations, Franklin County (5) and Grundy County (1), have been discovered since 2010 (TNHP 2018). Alabama has 11 extant populations in two counties, Jackson (2) and Madison (9) (ANHP 2018). A previously unknown population was discovered in Walker County, Georgia in 2015 (GDNR 2018), which represents an extension of the species' known range into Georgia. No other occurrences from Georgia are known.

SNHPs in Alabama, Georgia, and Tennessee have tracked and ranked a combined 34 populations of Morefield's leather-flower in their states (ANHP 2018; GDNR 2018; TNHP 2018). Two of these tracked populations are thought to be extirpated; one population in Alabama was destroyed by a residential development in the 1980s (ANHP 2018), and one of Tennessee's populations was not found during surveys in 2009 and is presumed extirpated due to earlier road widening (T. Crabtree pers. comm. 2010; TNHP 2018). Another population in Alabama has been damaged by residential development in the state (Weber 1994). Of the remaining 32 presumed extant Morefield's leather-flower populations, four are considered to have excellent viability (ranked as "A"), while nine have been ranked as having good ("B") or good to fair ("BC") viability. Most (19) populations have been ranked as having fair ("C") or poor ("D") viability, 16 of which occur in Tennessee. However, over half (20) of extant populations have not been visited and assessed in more than five years and their current status may be different from their available ranked status.

As reported in the latest 5-year review (USFWS 2018b), current population size data are limited, and no systematic population monitoring and survey protocols are known for Morefield's leather-flower. The only known monitoring program for the species occurs in Tennessee, which is funded by the USFWS's ESA section 6 cooperative grant program and is conducted by TNHP (Bailey 2005; Crabtree 2011, 2014). While population size data are available for 31 of the 32 extant populations (no population size data are available for Georgia's only known population), only 20 populations have data available that were collected since the 2010 5-year review, 11 of which have data that are five years old or less. Available population data for the remaining 11 populations were collected between 1990 and 2009. Together, these data, ranging from one to 28 years old, indicate that the total population size of Morefield's leather-flower may be potentially as large as 16,000 individuals (Boyd and Paris 2013; Paris 2013; ANHP 2018; T. Cook, Huntsville Botanical Garden, pers. comm. 2018; TNHP 2018). Based on these latest available observations, one population supports over 7,000 individuals, two populations are greater than 1,000 individuals, 17 populations (over half of all extant populations) have fewer than 100 individuals, and 11 populations have 20 individuals or less. The lack of recent (less than five years), systematic survey and monitoring data for many populations increases the uncertainty of our assessment of individual population sizes, the species' total population size, and population trends.

Sixteen populations of Morefield's leather-flower occur entirely, or partially, on conservation lands. Of these 16 populations, six are ranked as having excellent or good viability (four in Alabama and two in Tennessee) by their respective SNHPs (ANHP 2018; TNHP 2018), while one, Georgia's only population, is ranked as having good to fair viability (GDNR 2018). Nine populations are ranked as having fair or poor viability (eight in Tennessee [TNHP 2018]; one in Alabama [ANHP 2018]). Nine populations occur on state-owned lands (one in Alabama; one in Georgia; seven in Tennessee), three populations are found on lands owned by the University of the South (Sewanee) in Tennessee, two populations are on TNC lands in Alabama, and one Alabama population occurs on lands of mixed public (City of Huntsville) and private conservation organization (LTNA) ownership (Paris 2013; ANHP 2018; Cook 2018; GDNR 2018; TNHP 2018). Populations occurring on conservation lands are not uniformly protected, however, with most lands managed primarily for wildlife, recreation, and/or mixed uses (*i.e.*, few of these conservation lands are apparently managed primarily for their biodiversity values and/or rare species). While at least some state-owned sites periodically receive management to improve Morefield's leather-flower habitat, such as clearing encroaching woody species (*e.g.*, T. Crabtree pers. comms. 2015, 2018), specific management and monitoring regimes for Morefield's leather flower are not known for many populations on conservation lands. As such, much of Morefield's leather-flower habitat management is likely ancillary to management for other conservation and land use priorities. However, it is likely that these populations are protected from outright habitat destruction and conversion.

6.1.4. Conservation Needs of and Threats to Morefield's Leather-Flower

Threats to Morefield's leather-flower include habitat destruction or modification due to urban development, timber management, roadside maintenance, and other activities. These activities have caused the loss or decline of populations and remain persistent threats to populations that are not under secure ownership by public or private conservation agencies and organizations. Conservation needs for Morefield's leather-flower include continued surveying and monitoring across the species' range; site protection and management; and additional research pertaining to the species' biology, ecology and life history. While periodic monitoring is ongoing for some populations, overall, it has been inconsistently implemented across all populations. Additionally, the discovery of new populations of Morefield's leather-flower in Tennessee and Georgia indicate the continued need for additional surveys throughout the species' range and, particularly, expansion of these surveys into Georgia (USFWS 2018b). Some former privately-owned sites in Tennessee have recently been acquired by the state. Continued work to protect and manage remaining privately-owned sites is needed. Limited studies have begun to elucidate some of the habitat parameters necessary for the species' survival and to assist with identifying additional survey areas. Management plans that specifically address the needs of Morefield's leather-flower and its habitat are not known for many sites; however, management activities to specifically benefit this species have been implemented. Expanding habitat management activities, such as implementation of prescribed fire and canopy thinning, are expected to improve the species' overall status.

6.2. Environmental Baseline for Morefield's Leather-Flower

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Morefield's leather-flower, its habitat, and ecosystem within the Action Area.

6.2.1. Action Area Numbers, Reproduction, and Distribution of Morefield's Leather-Flower

While Morefield's leather-flower has not yet been observed in field surveys of TVA ROW, TVA is reasonably certain this species is present within the Action Area, given the TVA transmission system occurs on the Cumberland Plateau Escarpment slope in northeast Alabama and south-central Tennessee, where this species is known to occur. Additionally, only one-third of the roughly 5,300 ac of TVA ROW found within the counties where Morefield's leather-flower is known to occur have been surveyed, leaving much of the Action Area unsurveyed. While not all sections of TVA ROW are potential habitat for Morefield's leather-flower, TVA botanists have used the O-SAR process to designate about 3,200 and 250 ac of suitable habitat for Morefield's leather-flower in the Action Area as Plants Class 1 and Class 2, respectively. TVA botanists have field surveyed about 1,800 ac of ROW in the counties where Morefield's leather-flower is known to occur and have not found new populations. However, given the limited area surveyed for the species and presence of suitable habitat in the Action Area, TVA is reasonably certain that Morefield's leather-flower occurs within some of the O-SAR polygons.

Since field surveys have been conducted on about one-third of the ROW in those counties, and no new populations have been recorded, TVA believes that ROW are unlikely to provide primary habitat for the species. While Morefield's leather-flower has not been observed on TL ROW, it does do well (at least temporarily, data are limited) in gaps exposed to light within closed canopy forest. This suggests it could potentially persist along ROW edges, though ROW would not comprise the core habitat for this species. The ability of Morefield's leather-flower to exploit light gaps suggests the species may occupy edge habitats found along TVA TL ROW. As such, it is unlikely that undocumented populations would be confined to the ROW. Most plants in undocumented populations that intersect TVA ROW probably extend well off the ROW. As such, it is likely that only small portions of any individual population would intersect ROW vegetation management activities.

6.2.2. Action Area Conservation Needs of and Threats to Morefield's Leather-Flower

Populations of this species on ROW and power line corridors are threatened by maintenance of the areas through application of herbicides, mowing, tree clearing and debris management activities. Conservation measures for Morefield's leather flower in the Action Area include site protection (buffers, flagging), avoiding the use heavy equipment that may result in soil disturbance, and recognition of the species occurrence in undocumented areas.

6.3. Effects of Vegetation Management on Morefield's Leather-Flower

This section analyzes the direct and indirect effects of the Action on Morefield's leather-flower. An effects analysis summary of the effects of various methods of vegetation management on Morefield's leather-flower and the other 17 listed LAA plant species from the BA has been included in Appendix II.

6.3.1. Effects of Manual Vegetation Clearing on Morefield's Leather-Flower

Manual vegetation clearing has the potential to adversely affect Morefield's leather-flower. While tree clearing would increase light levels on site, potentially resulting in a benefit to Morefield's leather-flower, direct physical disturbance of the species is likely to occur. The disturbance could result from trampling, cutting, or soil disturbance. Increased light could benefit the species by spurring growth and reproduction, or it could favor more aggressive species like Japanese honeysuckle (*Lonicera japonica*) to the detriment of Morefield's leather-flower (USFWS 2010). Manual removal of single danger trees may have a positive effect on the species by providing a boost in light levels that could increase productivity and reproduction without fundamentally changing the vegetation structure and light regime in the immediate vicinity of the plant.

In summary, manual vegetation clearing is likely to adversely affect Morefield's leather-flower if conducted in occupied habitat. Adverse effects from mechanical clearing activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, and avoiding the use of heavy equipment (to and from the site) that may result in soil disturbance.

6.3.2. Effects of Mechanical Clearing on Morefield's Leather-Flower

If mechanical vegetation control methods utilized by the TVA ROW program intersect habitat occupied by Morefield's leather-flower, the species could be adversely affected. Morefield's leather-flower typically occurs in rocky, calcareous forests and is most likely to be found on the edge of a ROW; it is unlikely to inhabit the open portions of the ROW floor. Therefore, mowing, which is restricted to regularly maintained areas within the ROW floor, is not likely to adversely affect the species. Mechanical clearing and side-wall trimming could all adversely affect Morefield's leather-flower, though some of these methods have more potential to adversely affect than others. Mechanical clearing would adversely affect Morefield's leather-flower, if used in habitats where the species occurs, but the likelihood of using this type of equipment where the species occurs is small, given this species is found on steep slopes with rock outcrops that physically preclude the use of wheeled and tracked equipment.

In summary, mechanical tree clearing and side-wall trimming are likely to adversely affect Morefield's leather-flower. Mechanical mowing is unlikely to adversely affect Morefield's leather-flower. Adverse effects from mechanical clearing activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, and avoiding the use of heavy equipment that may result in soil disturbance.

6.3.3. Effects of Herbicide Use on Morefield's Leather-Flower

Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW edge if it were used in occupied habitat; however, all areas of the Cumberland Plateau Escarpment slope within the range of Morefield's leather-flower have either been field surveyed or are designated as Class 1 or 2 Plants in O-SAR. This O-SAR restriction prohibits the use of broadcast herbicide either from the air or ground. Therefore, the potential for broadcast herbicide to adversely affect Morefield's leather-flower is discountable.

Spot treatment of herbicide is highly targeted and unlikely to affect Morefield's leather-flower at the population level, but could result in isolated, direct adverse effects on individual plants. Cut stump and hack and squirt applications could be used when cutting trees to prevent resprouting. These methods could also be used as an AMM to control smaller trees in occupied habitat. If the trees did not need to be cut immediately, but would present a threat to TL reliability in the future, spot treatment could be used to kill the trees while minimizing direct effects to Morefield's leather-flower. Localized herbicide is likely to adversely affect Morehead's leather-flower particularly at the ROW edge. In this area, individual plants growing adjacent to tree seedlings could be inadvertently affected by overspray.

In summary, all methods of herbicide use, except for broadcast herbicide application, would likely adversely affect Morefield's leather-flower. Adverse effects from herbicide management activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, appropriate application and timing of herbicide treatment, conservation spraying, or another targeted herbicide application technique such as spot application.

6.3.4. Effects of Debris Management on Morefield's Leather-Flower

Debris management techniques used by TVA may affect Morefield's leather-flower, particularly any physical disturbance associated with manual or mechanized handling of debris occurring on the open ROW edge. Effects from manual clearing are more likely to occur, given the rocky terrain where the species occurs would preclude the use machinery. These effects would include physical damage resulting from cutting or dragging trees, but would not likely result in death of individuals. The terrain would also likely prevent chipping and mulching from occurring due to equipment access limitations. If mulching/chipping did occur, the species could be directly affected by crushing from machinery and burial/smothering by mulch/chips. Burning would occur in the open ROW away from suitable habitat for Morefield's leather-flower and would not likely affect the species, but debris handling by machinery during burning operations could affect individual plants on the ROW edge. On landowner request, vegetation debris may be left for landowner use. TVA's facilitation of landowner use of wood has similar potential for small impacts as manual debris management methods.

In summary, all debris management activities are likely to adversely affect Morefield's leather-flower. Adverse effects from mechanical clearing activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, appropriate timing of debris management, and avoiding the use of heavy equipment that may result in soil disturbance.

6.4. Conclusion for Morefield's Leather-Flower

In this section, we interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) for the Morefield's leather-flower relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would, at most, have localized adverse effects to Morefield's leather-flower and result in only a few individual plants within the Action Area being adversely affected, if any. Although closed canopy forests comprise the primary habitat for the species, data suggests that the species does well when exposed to light gaps, such as those resulting from ROW edges. Other non-federal actions in the Action Area that are reasonably certain to occur and that may affect Morefield's leather-flower include the use of broadcast herbicide on adjacent agricultural lands, use of broadcast herbicides at ROW intersections (*e.g.* railroad crossings, roads), and timber management activities on adjacent lands (cumulative effects; see Section 2.8).

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the Morefield's leather-flower. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only a small fraction of rangewide populations could potentially occur within the limited amount of suitable habitat in the action area; 32 known extant populations of the species occur in Alabama, Georgia, and Tennessee, but no occurrences have yet been observed on TVA ROW. All documented populations are located well off of the ROW.

7. ALABAMA LEATHER-FLOWER

7.1. Status of Alabama Leather-Flower

This section summarizes best available data about the biology and current condition of the Alabama leather-flower (*Clematis socialis*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the Alabama leather-flower as endangered on September 26, 1986 (51 FR 34420-34422).

7.1.1. Description of Alabama Leather-Flower

The Alabama leather-flower is a small, perennial herb in the buttercup family (Ranunculaceae), found in the Coosa River Valley in damp, silty-clay neutral soils, generally in sunny, open, herb-dominated locations. Fire or other natural disturbances may be necessary to limit competition from tall woody plants, such as trees and shrubs.

The genus *Clematis* is composed of mostly vigorous, woody, climbing vines/lianas. Alabama leather-flower, in contrast, forms clumps of small, upright stems that reach only about 1-ft in height, rising from an underground network of rhizomes. Stems from a single rhizome are genetically identical clones of the original stem. The rhizomes branch out over time, producing large patches of above-ground stems that emerge from the ground, generally in March, as temperatures begin to rise. Leaves form on the stems in pairs and vary in shape. Lower leaves are often simple (with a single, entire blade), whereas upper leaves are composed of multiple leaflets. The thick, leathery sepals (the structures that encase the flower buds prior to opening) are the source of the species' common name (Boyd 2015).

7.1.2. Life History of Alabama Leather-Flower

Alabama leather-flower blooms in late April to May, produce fruits by June, and die back to underground rhizomes in late summer. The distinctive bell-shaped flowers are produced singly at the top of above-ground stems. When pollinated, the flower produces a cluster of hairy single-seeded fruits, or achenes, each about 1-in long. Plants are hard to see in tall grasses, but fruits are distinctive all summer (Chaffin 2008, Boyd 2015). Scientists have not observed new plants growing from seed. Survival of the species over time depends mainly on the long-lived rhizomes. Genetic sampling of populations in Alabama revealed that genetically-distinct individuals can be quite large, spreading to at least 36 ft via underground rhizomes (Goertzen *et al.* 2011). These data, coupled with earlier estimates that Alabama leather-flower's rhizomes grow approximately 4 inches per year (Goertzen and Boyd 2007), indicate that the species is relatively long-lived and can live at least 55 years.

7.1.3. Numbers, Reproduction, and Distribution of Alabama Leather-Flower

The plant first was discovered on a highway ROW in 1980 in St. Clair County, Alabama. It was known only from the type locality until 1985, when a second population was discovered 40 mi away on a highway ROW in Cherokee County, Alabama. A total of eight natural populations have been located in northeastern Alabama (Cherokee, Etowah, and St. Clair counties) and northwestern Georgia (Floyd County), but only six are extant. The species' entire known range spans less than 90 mi, with individual populations typically separated by 30 or more miles from their nearest neighbors (plants or groups of plants that are separated by at least 1-mi are considered to be distinct populations). All known populations occur within the Ridge and Valley physiographic province. Transplant efforts to establish a second Georgia population on land held under conservation easement by TNC have had limited success, and the population is not currently viable (USFWS 2017).

The Georgia population is owned by the Georgia Department of Transportation and managed by the Georgia Department of Natural Resources. A population in St. Clair County, Alabama, is owned by TNC. Most extant populations are small, occupying substantially less than 1 ac of habitat (USFWS 2017), and all populations continue to require active management to control competing vegetation and maintain suitable, open habitat conditions (Boyd 2015, USFWS 2017).

7.1.4. Conservation Needs of and Threats to Alabama Leather-Flower

Habitat for this species has been reduced through development, logging operations, and conversion to agriculture and pine (*Pinus spp.*) plantations (Boyd 2015). Remaining populations are threatened by inadequate management, particularly a lack of mowing, prescribed fire, and/or hand clearing. Alabama leather-flower is apparently a poor competitor; it is most vigorous in open areas with little competing vegetation and open canopies. The species benefits from occasional, limited disturbance (such as periodic mowing or prescribed fire), which reduces encroachment of competing vegetation, but individuals and/or populations may be affected by incompatible mowing regimes and errant herbicide application (USFWS 2017).

Alabama leather-flower's limited number of extant populations and relatively small, local population sizes increase the species' vulnerability to anthropogenic impacts and stochastic events. Small population sizes also increase the risks posed by inbreeding and genetic drift, which may limit the species' adaptive capacity and ability to cope with future stressors (Ellstrand and Elam 1993). However, the unexpectedly high level of genetic diversity maintained within Alabama leather-flower populations studied thus far (Goertzen and Boyd 2007, Goertzen *et al.* 2011), may limit some of the genetic threats posed by the species' small number of populations and overall small population size.

Climate change has potential to affect distribution and abundance of plants by influencing seasonal weather patterns, frequency and timing of severe weather events, and myriad plant physiological responses. Davenport (2007) suggested that Alabama leather-flower may be adversely affected by climate change if available habitat is reduced under drier conditions. Climate change may disrupt plant-pollinator interactions, shifting the timing of flowering and/or pollinator activity (Memmott *et al.* 2007, Hawkins *et al.* 2008) and reducing the already-low rate of sexual reproduction of Alabama leather-flower.

7.2. Environmental Baseline for Alabama Leather-Flower

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Alabama leather-flower, its habitat, and ecosystem within the Action Area.

7.2.1. Action Area Numbers, Reproduction, and Distribution of Alabama Leather-Flower

Alabama leather-flower has not been observed on TVA ROW. However, sections of the ROW overlap with the range of the species and not all ROW has been surveyed. Given the known range of the species, the only plausible overlap of Alabama leather-flower and the TVA transmission system is along ROW near Centre, Alabama, within a few miles of Weiss Lake in the Coosa River valley. This area is along the southern edge of the TVA transmission system and less than 20 mi of ROW intersect places on the landscape that could support habitat for the plant. Much of the ROW in this area now supports highly disturbed habitats like agricultural, industrial, or residential land uses, but there are ROW within the range of Alabama leather-flower that do support natural vegetation. Field surveys for Alabama leather-flower and other rare plants have been conducted over more about 90 percent of these areas, but the plant has not been found. There is a reasonable likelihood that undocumented occurrences of Alabama leather-flower exist on TVA ROW, but it is unlikely that more than a handful of undocumented occurrences occur on TVA ROW.

7.2.2. Action Area Conservation Needs of and Threats to Alabama Leather-Flower

The primary threats to Alabama leather-flower in the Action Area include potential herbicide affects and competition from aggressive, competing vegetation.

The species benefits from occasional, limited disturbance, such as periodic mowing or prescribed fire, which reduces shading and encroachment of competing vegetation.

7.3. Effects of Vegetation Management on Alabama Leather-Flower

This section analyzes the direct and indirect effects of the Action on Alabama leather-flower. An effects analysis summary of the effects of various methods of vegetation management on Alabama leather-flower and the other 17 listed LAA plant species from the BA has been included in Appendix II.

7.3.1. Effects of Manual Vegetation Clearing on Alabama Leather-Flower

Manual clearing could adversely affect individual Alabama leather-flower plants, although the magnitude of the negative effect would likely be small. Clearing trees would increase light levels, potentially resulting in a benefit to Alabama leather-flower. However, there is potential for direct physical disturbance as a result of trampling, cutting, or minor soil disturbance.

7.3.2. Effects of Mechanical Clearing on Alabama Leather-Flower

Effects to Alabama leather-flower from mechanical clearing would be similar to those described under 7.3.1 for manual clearing. In addition, if mechanical vegetation control methods utilized by the TVA ROW program intersect habitat occupied by Alabama leather-flower, there is the potential that the species could be affected. The species occurs in areas disturbed by human activities and prospers in open conditions like those found along TL ROW. Alabama leather-flower could occur within the open floor of the ROW or along the relatively shady edges. Therefore, mowing, which is restricted to regularly maintained areas within the ROW floor could adversely affect individual plants, especially if the mowing was conducted during the flowering period or before fertilized plants could disperse seed. Although mowing can temporarily reduce woody species concentration, repeated mowing in wetter habitats, which are most likely to support Alabama leather-flower, would shatter the stumps of individual trees and shrubs located within the ROW. This would promote sprouting and the proliferation of woody species within the ROW over time, and, therefore, could be detrimental to Alabama leather-flower. However, given the dependence of Alabama leather-flower on asexual reproduction from underground rhizomes, it is unlikely mechanical vegetation control measures implemented by TVA for ROW vegetation management would remove the species from a site.

7.3.3. Effects of Herbicide Use on Alabama Leather-Flower

Vegetation control methods that utilize herbicides are likely to adversely affect Alabama leather-flower if used in occupied habitat, though the magnitude of effect would not likely be large enough to remove the species from a site. Spot treatment of herbicide is highly targeted and unlikely to adversely affect Alabama leather-flower at the population level, but could result in isolated, direct adverse effects on individual plants. Cut stump and hack and squirt applications could be used when cutting trees to prevent resprouting. These methods could also be used as an AMM to control smaller trees in occupied habitat. If the trees did not need to be cut immediately, but would present a threat to TL reliability in the future, spot treatment could be used to kill the trees while minimizing direct effects to Alabama leather-flower.

Even though localized herbicide application targets woody species within the ROW floor, the use of that tool could have some level of adverse effects on the species. If individual Alabama leather-flower plants occur within a few feet of a tree seeding treated with localized herbicide application, chances are high that the plant would experience some level of herbicide related damage. This damage may rise to the level of individual plant death. Broadcast herbicide, either from the air or ground, could adversely affect plants growing on and near the ROW edge if it were used in occupied habitat. However, all areas of the ROW near Centre, Alabama, within the range of Alabama leather-flower have either been field surveyed or are designated as Plants Class 1 and 2 in O-SAR. This O-SAR restriction prohibits the use of broadcast herbicide either from the air or ground. Therefore, the potential for broadcast herbicide to adversely affect Alabama leather-flower is discountable.

7.3.4. Effects of Debris Management on Alabama Leather-Flower

Debris management techniques used by TVA have a small potential to adversely affect Alabama leather-flower. Any physical disturbance associated with manual or mechanized handling of debris occurring on the open ROW edge could directly affect plants. These effects would include physical damage resulting from cutting or dragging trees and would not likely result in death of individuals. If mulching/chipping did occur, the species could be directly affected by crushing from machinery and burial by mulch/chips. Pile burning could conceivably result in the loss of individual plants, but the infrequent use of the tool combined with the extreme rarity of the species make the likelihood of this occurring small. TVA's facilitation of landowner use of wood has similar potential for small impacts as manual debris management methods.

7.4. Conclusion for Alabama Leather-Flower

In this section, we interpret the findings of the previous sections for the Alabama leather-flower (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects on Alabama leather flower and result in no more than a few individual plants within the Action Area being adversely affected. The species could also benefit from occasional, limited disturbance, such as periodic mowing or prescribed fire, which reduces shading and encroachment of competing vegetation. Cumulative effects to Alabama leather-flower that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the Alabama leather-flower. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only a fraction of the known rangewide populations would potentially occur on the TVA ROW because less than 20 mi of unsurveyed ROW intersect places on the landscape that could support habitat for the plant, and much of that remaining unsurveyed area is highly disturbed.

8. LEAFY PRAIRIE-CLOVER

8.1. Status of Leafy Prairie-Clover

This section summarizes best available data about the biology and current condition of leafy prairie-clover (*Dalea foliosa*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list leafy prairie-clover as endangered on May 1, 1991 (56 FR 19953-19959).

8.1.1. Description of Leafy Prairie-Clover

Leafy prairie-clover is a member of the legume family or Fabaceae. Leafy prairie-clover is easily distinguished from most other species of the genus *Dalea* east of the Mississippi River on the basis of the leaflet number, which ranges from nine (Barneby 1977) to 31 (Gleason and Cronquist 1963), but typically is between 20 and 27 (Fernald 1950). Leafy prairie-clover is a glabrous, stout perennial herb, with one to several stems 2 to 8 dm (8 to 31 in) long arising from a hardened root crown. The dense conic to cylindric flowering heads are between 0.4 and 8.9 cm (0.15 to 3.5 in) long and 0.6 to 1.0 cm (0.24 to 0.4 in) wide (DeMauro and Riddle, unpublished data) on short peduncles, 0 to 2 mm (0 to 0.08 in) long, with lance-ovate, long acuminate bracts which surpass the small (up to 5 mm [0.2 in] long) lavender-purple calyx that has five petals and five strongly exerted anthers with orange pollen (Fernald 1950, Gleason and Cronquist 1963, Wemple 1970, Barneby 1977).

8.1.2. Life History of Leafy Prairie-Clover

Leafy prairie-clover is a short-lived, herbaceous perennial forb that has no capacity for vegetative spread (Baskin and Baskin 1973; Schwegman and Glass, unpublished data). In March, new ramets (stems) begin to grow from buds on the root crown just below the soil surface. By July, these ramets are 40 to 65 cm (15.7 to 25.6 in) tall (Baskin and Baskin 1973). Non-flowering plants have from one to four ramets, and flowering plants have from one to 20 ramets. A single ramet will develop one or more inflorescence buds in late June (USFWS 1996a).

Flowering begins in late July, peaks in mid-August, and can continue until late August. Plants may take up to three years to flower (Baskin and Baskin 1989). Mature plants may have from one to ten (or more) flowering ramets. The average number of flowering ramets per plant varies from 0.58 to nearly three in extant leafy prairie-clover populations throughout the species' range (USFWS 1996a). The number of flowers per inflorescence varies from 40 to 495 (mean of 158.95 + 97.04 standard deviation) (DeMauro and Riddle, unpublished data). Leafy prairie-clover seeds ripen by early October and disperse from the erect dead ramets from late fall to early spring (Baskin and Baskin 1973). Potential dispersal vectors include wind, gravity, birds, and small mammals. Dormant seeds are capable of forming a persistent seed bank. Under natural conditions, several years are required to soften the hard seed coat, although mechanical scarification yields high germination rates in fresh seeds (Baskin and Baskin 1973, 1989). Germination occurs in April and, by late May, the seedlings have several leaves (Baskin and Baskin 1973).

Seedlings are killed by summer drought and frost heave and very few survive to maturity (Baskin and Baskin 1973; Schwegman and Glass, unpublished data). The oldest living plants monitored to date have reached seven to eight years of age (Schwegman and Glass, unpublished data). Dormancy has been observed in mature plants; some plants have been dormant for two consecutive years. Mature plants may not flower every year and may show decreased vegetative growth following a year of exceptionally vigorous growth (USFWS 1996a).

8.1.3. Numbers, Reproduction, and Distribution of Leafy Prairie-Clover

Leafy prairie-clover is currently known from north-central Alabama, northeastern Illinois, and central Tennessee. The plant occurs only in open habitats with thin, calcareous soils. In Tennessee and Alabama, the preferred habitat is limestone or dolomite glades, while in Illinois, this plant is restricted to very rare dolomite prairie habitat (USFS 2018).

Alabama

In Alabama, there are three known extant populations, one in Franklin County and two in Lawrence County (Schotz 2011; Adam Dattilo pers. comm. 2019). There are four occurrences of uncertain status, located in Franklin, Jefferson, and Morgan counties. No other occurrences are known to have been extirpated from Alabama besides those reported in the recovery plan (USFWS 1996a), all within these same counties.

According to the most recent survey data included in the BA, biologists from TVA observed 52 plants in one Lawrence County population in 2018 (this is a well-documented population that was first observed in 1989); this population was estimated to consist of 30 to 40 plants in 1989. The second Lawrence County population was first observed by TVA in 2012 and supported 65 plants; more recent 2018 survey data, included in the BA, indicates that there are 336 plants now at this site. There were 72 plants at the Franklin County site as of 2011 (Schotz 2011).

Illinois

There currently are 14 known extant populations in Illinois, ranging in size from a few hundred to several thousand individuals (Redmer and Lah 2008, J. Armstrong pers. comm. 2012, C. Pollack pers. comm. 2015). One population is located in Cook County, four in DuPage County, and the others are in Will County. A population at Midewin National Tallgrass Prairie in Will County was discovered in 1997 (Molano-Flores 2004). The Cook County population was first observed in 2002 (Illinois Department of Natural Resources 2008). Contrary to the statement in the recovery plan that the population at Lockport Prairie East was extirpated, we have concluded based on information in our records that this population is represented by the Will County population that was discovered in 2001 at Dellwood Park West (Barbers and Wilhelm 2005). The leafy prairie-clover was extirpated from Kane, Kankakee, and LaSalle counties in the late 1800s (USFWS 1996a).

Monitoring data for the population at Lockwood Prairie NP in Will County display considerable interannual variability with respect to abundance in each of three stages: seedling/juvenile, non-flowering adult, and flowering adult. Between 1990 and 2004, 11 leafy prairie-clover censuses were conducted at this site. Total number of plants ranged from a high of 5,636 in 1990, to a low of 1,056 in 2000. The total number rebounded to 5,022 in 2004 (Key 2004). This population increased to a total of 13,345 total individuals in 2006 (J. Armstrong pers. comm. 2012).

Monitoring was conducted in 2002 and 2004 at the Dellwood Park West site in Lockport, where a leafy prairie-clover population was discovered in 2001. The total number of plants increased over this period from 154 to 1,289, apparently in response to removal of invasive woody plants and subsequent fire management (Barbers and Wilhelm 2005). In 2014, there were 1,410 plants at this site, 1,002 of which were flowering or fruiting (C. Pollack pers. comm. 2015).

The total number of plants at Romeoville Prairie NP in Will County, inclusive of all life history stages, peaked at 2006, the last year during which a population census was conducted.

Considerable variability has also been observed in the population at Midewin National Tallgrass Prairie in Will County from 2002 through 2014, during which time the total number of plants ranged from a low of 92 in 2002, to a high of 839 in 2014, 375 of which were flowering or fruiting (USFS no date; C. Pollack pers. comm. 2015).

The Illinois Natural History Survey began monitoring a population of leafy prairie-clover at Keepataw Forest Preserve in Will County in 2005, under contract with the Illinois Toll Highway Authority (Taft *et al*. 2010). There are five colonies at this site, from which census data are collected for four life history stages: seedlings, juveniles, non-flowering adults, and flowering adults. The data from 2005-2006 display an increase, followed by a decrease in total numbers of plants from 2006-2010. Despite the fact that the total number of plants recorded was lowest in 2010, both the number of flowering adults and inflorescence spikes per adult reached their recorded peak, yielding the greatest potential reproductive output in 2010 compared to the five prior years (Taft *et al*. 2010).

<u>Tennessee</u>
There currently are 55 known extant occurrences in Tennessee in the following counties: Bedford (1), Davidson (7), Marshall (2), Maury (14), Rutherford (15), Williamson (1), and Wilson (15). Ten of these occurrences were found in surveys conducted during 2001 through 2003, mostly on public lands or private conservation lands (TDEC 2004a). In addition to the 55 sites reported by TDEC (2004a), two occurrences have been found in TVA ROW (TDEC 2015). There are 11 occurrences that are considered either historic or extirpated, distributed among the following counties: Davidson (2), Maury (1), Rutherford (5), Sumner (1), Williamson (1), and Wilson (1) (TDEC 2004a). No occurrences are known to have been extirpated from Tennessee besides those reported in the recovery plan (USFWS 1996a).

From 1996 through 2001, TVA monitored six leafy prairie-clover occurrences that are located within the Yanahli WMA and Duck River Complex Designated SNA. The TVA monitored no more than two of these occurrences per year, and TDEC assumed responsibility for monitoring these occurrences in 2003 (TDEC 2004b). Because of the inconsistencies among occurrences with respect to the years that monitoring occurred and sampling design used, we only discuss here the general trends reported by TDEC (2004b). Site names and element occurrence (EO) numbers, in parentheses, for the monitored occurrences include:

- Blue Springs (049)
- Columbia Glade (005)
- Columbia Glade East (054)
- Sowell Mill North Glade (028)
- Sowell Mill North Glade A.T.&T. ROW(068)
- Nancy Branch (047).

TDEC (2004b) reported a general decline during the period 1996 through 2003 in numbers of plants, stems, flowering stems, and flowering heads at all of these occurrences besides 005 and

068. Increases were observed in numbers of flowering stems and flowering heads at 005, despite a decrease in total number of plants, and in all leafy prairie-clover metrics at 068. The most notable decline was observed at 047, where total numbers of plants declined from 1,589 plants in 2000 to 32 plants in 2003. Given the considerable inter-annual fluctuation that has been observed at locations that have been monitored more consistently in Illinois, inferring trends from the data for these six occurrences is difficult due to inconsistency among monitoring years and methods. Monitoring data has demonstrated the importance of monitoring populations at a sufficient frequency, ideally annually, for detecting trends and cyclical variation in leafy prairie-clover populations (USFWS 2015b).

TDEC conducted general surveys of 18 leafy prairie-clover occurrences during 2004, to provide current data on numbers of plants (Table 8.1) (TDEC 2005). Beginning in 2009, TDEC began annual monitoring using permanent plots at 16 protected sites in Tennessee (TDEC 2014). This monitoring approach does not allow for tracking changes within entire populations present at each protected site, but does provide a means for examining variability in density over the full range of monitored sites. Data are recorded for the following variables in each plot: flowering plants, flowering stems, non-flowering plants (excluding seedlings), non-flowering stems, seedlings, and browsed stems (USFWS 2015b).

As is the case for monitoring data collected from Illinois, preliminary analysis of these monitoring data, conducted for this status review, demonstrate considerable variability both among sites and among years for all sites combined. The mean number of plants per square meter (m^2) for all stages combined decreased from 2009 through 2012, but peaked at 23.9 during 2014. The number of flowering plants/m^2 peaked at 13.17 in 2010, but was less than 4 in all other years. Non-flowering plants, excluding seedlings, were most abundant in 2009 (16.27/m^2), decreased through 2012, but increased during 2013 and 2014. The mean number of seedlings/m^2 has remained low throughout all years, with a high in 2013 of 2.27. Based on these preliminary analyses, these 16 protected leafy prairie-clover have fluctuated considerably, and mean numbers of flowering and non-flowering plants per m^2 suggest some decline since 2009. However, assessment of the species' overall status require additional years of data and more careful analysis before reaching firm conclusions (USFWS 2015b).

As noted above, analyzing data for trends across all 16 monitored populations does not effectively examine trends within individual sites or groups of sites. In the future, these data will be analyzed to provide insight into trends at individual sites. This will be necessary due to the variability in leafy prairie-clover abundance among the sites and differences in threats affecting them, as well as varying levels of management to address those threats (USFWS 2015b).

8.1.4. Conservation Needs of and Threats to Leafy Prairie-Clover

There currently are 44 occurrences on protected lands throughout the species' range. Nonetheless, several of the threats to leafy prairie-clover habitat identified in the recovery plan still have the potential to negatively affect this species even in protected sites, namely, degradation due to invasive exotic or native species encroachment, illegal ORV use, and incompatible management of utility ROW. The main threat to protected sites comes from the

Table 8.1. Results from general surveys of 18 *D. foliosa* occurrences conducted in Tennessee in 2004 ("- -" indicates data not collected) (TDEC 2005).

Site Name	EO Number	Non-flowering	Flowering	Total Plants
Flat Rock/Adams #3 Glade	011	--	544	544+
Couchville South	014	23	6	29
Cedars of Lebanon – S. of Cedar Forest Road	018	3	6	9
Cedars of Lebanon – Richmond Shop Barren	024	0	5	5
Long Hunter State Park – Wet Barren	031	--	--	37
Hall Farms Glades	032	--	559	559+
Cedars of Lebanon – Rowland Barren	033	--	187	187+
Jones Mill Glade / Campbell Road	037	--	--	70
Hamilton Creek Glade	040	--	--	442
Cedars of Lebanon State Forest – Quarry Creek	044	--	14	14
Cedars of Lebanon – Cedars Natural Area, Moccasin Road	052	0	0	0
Rocky Hill Glade	057	--	28	28
Cedars of Lebanon – Cedar Forest Road West 8	059	--	244	244
Long Hunter State Park	060	--	--	51
Cedars of Lebanon State Forest	064	--	80	80+
Flat Rock / Adams #2 Glades, Roadside, Trailside	065	0	0	0
Couchville North	066	0	1	1
Hall Farm Glades	067	--	824	824+
TOTALS		26+	2934+	3118+

potential for either exotic or native, invasive plant species to displace leafy prairie-clover from otherwise suitable habitat. The final listing rule for leafy prairie-clover (56 FR 19953) stated that all known populations were threatened by encroachment from competing herbaceous vegetation and/or woody plants, and this remains largely true today (USFWS 2015b). In addition to the threat of habitat degradation, the combined threats of small population size, low genetic variability, and accelerated climate change could increase the risk of localized extinction facing many leafy prairie-clover populations (Barrett and Kohn 1991; Molano-Flores and Bell 2012).

Conservation needs for leafy prairie-clover include: 1) increased use of prescribed fire, or other techniques to maintain open conditions with limited competing vegetation in areas with sufficient soil depth to support the plant, 2) continued efforts to reintroduce/augment Illinois populations, 3) development of a population viability analysis for the species across its entire range to provide a better estimation of the extinction risk faced by individual populations and the species as a whole, and 4) increasing the frequency of monitoring in Tennessee and Alabama populations.

8.2. Environmental Baseline for Leafy Prairie-Clover

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the leafy prairie-clover, its habitat, and ecosystem within the Action Area.

8.2.1. Action Area Numbers, Reproduction, and Distribution of Leafy Prairie-Clover

In the Action Area, leafy prairie-clover has been documented from active TVA ROW in three discrete areas in Tennessee and two sites in Alabama. One of the Tennessee populations is located just north of Cedars of Lebanon State Forest and was first observed by TVA botanists in 2008. While there are cedar glades occurring with 500 ft of known locations of leafy prairie-clover, there is no off-ROW habitat immediately adjacent to this population.

Without the existence of the ROW, the plants would not occur on-site because the adjacent forest is unsuitable for the species. The small population was comprised of seven individual plants in 2008. During the most recent visit of the site in 2014, TVA botanists noted the population had increased to approximately 20 individual plants. The shallow soils found on the site retard invasion of woody species and result in a relatively low woody stem count and a diverse herbaceous plant community.

The other two Tennessee populations were both first observed several miles southeast of the city of Columbia in 2009 during field surveys for a proposed new TL. At both sites, the proposed new TL was sited parallel to an existing TVA TL that crossed through a natural cedar glade complex. The majority of leafy prairie-clover plants found at both locations were situated on the existing ROW. The initial observation of one population noted that about 125 individual plants occurred in the existing ROW, while an additional 20 plants occurred adjacent to a cedar glade off the ROW. After construction of the new TL, all leafy prairie-clover plants at this site remained in an open ROW. Subsequent surveys in 2018 noted that 52 plants remained on the site. Approximately 23 individual leafy prairie-clover plants were initially observed at the second site. The area was heavily grazed by horses, to the extent that it was surprising to find the plants present on the site. Leafy prairie-clover was restricted to small, wet portions of the glade. Subsequent surveys in 2018 found no plants extant in this population. The cause of the apparent declines at these sites is difficult to ascertain and could be the result of action taken by the private landowner (grazing), TVA vegetation management, or some combination of the two.

The two leafy prairie clover sites in Alabama lie on the northern edge of the William Bankhead NF. One of the sites is a well-documented site that was first observed in 1989 by botanist, David Webb. The TL ROW intersects a limestone cedar glade complex that supports a number of state and globally rare plant species. On this site, leafy prairie clover inhabits dry ROW and has never been observed outside of the TL easement. The site has not been systematically monitored, but botanists have made detailed observations multiple times since the site was first discovered.

Population counts have fluctuated over time, but appear relatively stable. Individual plant counts of this population include: 30-40 (1989); 100-200 (1993); 21 (2008); 40 (2012); 56 (2014); 31 (2016); and 52 (2018). The recent increase in the frequency of monitoring efforts is linked to TVA's ROW floor vegetation management, which occurs every third year. TVA botanists survey the site before work takes place.

The second population was first observed by TVA botanists in 2012. This occurrence is comprised of three sub-sites that span about 4,000 ft of ROW. This population is situated on the same TL ROW as the other population, but about 1-mi to the southeast. At this site, there are no open cedar glades adjacent to the ROW and no off-ROW habitat for leafy prairie-clover. The population appears stable based on available plant count data: 65 (2012), 290 (2014), 200 (2016), and 336 (2018). The low value in 2012 may be the result of the timing of survey, which was the third week in May. This is too early in the season to effectively monitor leafy prairie-clover, but late enough in the season for TVA botanists to find small plants growing in the ROW.

8.2.2. Action Area Conservation Needs of and Threats to Leafy Prairie-Clover

In Tennessee, the primary threats to leafy prairie-clover in the Action Area are encroachment by competitive herbaceous and woody vegetation into suitable habitat for the species and adverse land use activities by private landowners *(e.g.*, grazing suitable habitat). In Alabama, TVA vegetation management, primarily localized herbicide applications used to control woody vegetation in ROW, is the primary threat and may result in limited inadvertent adverse effects to the leafy prairie-clover. Reducing these threats may be best addressed by continued coordination with TVA regarding maintenance of ROW.

8.3. Effects of Vegetation Management on Leafy Prairie-Clover

This section analyzes the direct and indirect effects of the Action on leafy prairie-clover. An effects analysis summary of the effects of various methods of vegetation management on leafy prairie-clover and the other 17 listed LAA plant species from the BA has been included in Appendix II.

8.3.1. Effects of Manual Vegetation Clearing on Leafy Prairie-Clover

Manual vegetation clearing, when utilized by TVA, has the potential to adversely affect leafy prairie-clover. However, provided clearing does not intentionally disturb the soil, it is unlikely to result in the death of individual plants. Leafy prairie-clover prefers sunny conditions, though it does not typically inhabit the interior of cedar glades. Plants frequently inhabit ROW edges. If tree clearing resulted in increased light on ROW edges where leafy prairie-clover occurred, the effect would not likely be detrimental. The species would be susceptible to physical damage from clearing activities, but the shallow rocky soils, characteristic of cedar glades, do not rut easily, and the species could resprout after tree clearing.

Clearing previously unmaintained ROW is a one-time event because these areas would subsequently be treated as ROW floor. Danger tree clearing occurs as needed. Danger tree clearing may never be needed in leafy prairie-clover habitat near glades because the soils are not sufficiently deep to support growth of taller trees.

8.3.2. Effects of Mechanical Clearing on Leafy Prairie-Clover

All of TVA's mechanical vegetation control methods have the potential to adversely affect leafy prairie-clover. Mowers are generally set 10 to 12 inches off the ground and would likely miss leafy prairie-clover if mowing occurred before June. If damaged during mowing, all but the weakest plants would resprout because TVA mowing would not be employed more frequently than once every three years.

8.3.3. Effects of Herbicide Use on Leafy Prairie-Clover

Vegetation control methods that utilize herbicides are likely to adversely affect leafy prairie-clover. Spot treatment of herbicide is highly targeted and unlikely to adversely affect leafy prairie-clover at the population level, but could result in isolated, direct adverse effects on individual plants. Cut stump and hack and squirt applications could be used when cutting larger tree to prevent resprouting and as an AMM to control smaller trees in occupied habitat within the ROW floor. Leafy prairie-clover often occurs on the floor of ROW and could, therefore, be affected by localized herbicide applications, which are commonly used to control woody species in the open ROW.

While off target herbicide damage could kill individual plants, it is unlikely that whole populations would be extirpated. This is because habitats where leafy prairie-clover is most likely to occur do not have significant stringers of tree seedlings in the ROW. These dry, rocky areas do not support rapid tree growth, and woody plant species are typically widely-spaced. This increases the odds that leafy prairie-clover plants, if any undocumented populations occur on TVA ROW, would survive instances of localized application of herbicide. Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW. However, it is unlikely that this tool would be used in areas that might support leafy prairie-clover because nearly all glade and barrens habitat that could potentially support the species has been field surveyed by TVA botanists or is restricted with a Class 1 or 2 Plants O-SAR polygon, which restricts use of broadcast herbicide.

8.3.4. Effects of Debris Management on Leafy Prairie-Clover

All debris management techniques used by TVA have a small potential to adversely affect leafy prairie-clover. The aspect of debris removal most likely to affect the species is physical disturbance associated with manual or mechanized handling of debris. This disturbance could result from dragging of debris over plants or the marginal soil disturbance that would be expected from use of machinery. The soil disturbance would be minimal because of the rocky habitats preferred by leafy prairie-clover, which are usually well-drained and resistant to deep rutting. Neither form of disturbance would likely result in death of individual plants. Pile burning could conceivably result in loss of individual plants, but the infrequent use of the tool, combined with the extreme rarity of the species, make the likelihood of this occurring slight.

TVA's facilitation of landowner use of wood has similar potential for small impacts as manual debris management methods.

If mulching machines were used in leafy prairie-clover habitat, it would not likely generate enough mulch to bury the species. This is because the amount of mulch or chips generated by the machine is directly proportional to the amount of vegetation the site supports. Dry glade and barrens margins stunt woody plant growth, and the layer of mulch left in these areas is often discontinuous and less than 1-in deep.

8.4. Conclusion for Leafy Prairie-Clover

In this section, we interpret the findings of the previous sections for the leafy prairie-clover (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to leafy prairie-clover and result in only a few individual plants within the Action Area being adversely affected. The species only occurs on TVA ROW because of the existence of the ROW; the open conditions of the ROW provide suitable habitat, whereas the plants do not occur in adjacent forested areas because such habitat is unsuitable for leafy prairie-clover. Cumulative effects to leafy prairie-clover that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the leafy prairie-clover. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) The ROW provides suitable cedar glade habitat conditions for the five populations in the Action Area, thus supporting the conservation of the species. (4) Only a fraction of the known rangewide population (five small populations out of a total of 71) exists within the Action Area; therefore, only a small percentage of plants in the species range would be adversely affected by the Action.

9. WHORLED SUNFLOWER

9.1. Status of Whorled Sunflower

This section summarizes best available data about the biology and current condition of whorled sunflower (*Helianthus verticillatus*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list whorled sunflower as endangered on August 1, 2014 (79 FR 44712- 44718).

9.1.1. Description of Whorled Sunflower

A member of the aster family (Asteraceae), whorled sunflower is a perennial herb arising from horizontal, tuberous-thickened roots with slender rhizomes, producing stems that can reach 4 m (13 ft) or more in height (Matthews *et al*. 2002). The leaves are opposite on the lower stem, verticillate (whorled) in groups of three to four at the mid-stem, and alternate or opposite in the inflorescence (flower-bearing portion of a plant). Individual leaves are firm in texture and have a prominent mid-vein, but lack the prominent lateral veins found in many members of the genus. The leaves are linear-lanceolate in shape, narrowing at the tip to a point, and 7.5 to 18.5 cm (3 to 7.2 in) long and 0.7 to 2.0 cm (0.3- to 0.8 in) wide. The flowers are arranged in a branched inflorescence, typically consisting of three to seven heads, each with deep yellow ray flowers and lighter yellow disk flowers. Achenes are 0.4 to 0.5 cm (0.16 to 0.2 in) long.

9.1.2. Life History of Whorled Sunflower

Whorled sunflower is found in moist-soiled areas ranging from degraded sites along roadsides, railroads, and agricultural fields to higher integrity prairie remnants in openings in woodlands and adjacent to creeks. Creation and maintenance of whorled sunflower habitat requires managing for open conditions by controlling invasive plants and competing woody vegetation with careful herbicide application, prescribed fire, and/or properly-timed mechanical thinning.

Whorled sunflower appears to be a habitat specialist, occurring in natural wet meadows or prairies and calcareous barrens. Despite the commonly degraded condition of these habitats, the list of associated species in these areas indicates a community with strong prairie affinities as specified in Schotz (2001); Matthews *et al*. (2002); Tennessee Division of Natural Areas (TDNA) (2008a).

9.1.3. Numbers, Reproduction, and Distribution of Whorled Sunflower

Whorled sunflower is endemic to the Loess Plains, Northern Hilly Gulf Coastal Plain, and Southern Shale Valleys ecoregions. There are five known extant whorled sunflower populations found in four states including Alabama (1), Georgia (1), Mississippi (1), and Tennessee (2) and one known historical population in Tennessee. A general summary of all extant whorled sunflower occurrences can be found in Table 9.1. The Georgia population is located in Floyd County and composed of four subpopulations. The Alabama population is located in Cherokee County and composed of two subpopulations. The populations in Georgia and Alabama are less than 2 km (1.2 mi) apart. In Tennessee, there is one population composed of six subpopulations in McNairy County and the second population composed of four subpopulations in Madison County. A small, roadside population was found in Marshall County, Mississippi, in 2017 (Collection Manager, University of Memphis Herbarium, pers. comm., August 12, 2017). Follow-up searches in 2018 discovered more plants growing upstream of the original site within a forested riparian corridor between agricultural fields (D. Brandon pers. comm., August 29, 2018). Table 9.1 lists these populations and subpopulations, and relates them to EO numbers used by state conservation agencies to track their status. Given this recent discovery, expansion of surveys may discover more whorled sunflower populations in northern Mississippi and/or southwestern Tennessee.

Table 9-1. Summary of extant whorled sunflower populations and subpopulations by state and county, with corresponding site names and EO numbers from state conservation agency databases in Alabama, Georgia, and Tennessee.[6]

Population (County, State)	Site Name	EO Number	Subpopulation Number(s)
Cherokee, AL	Kanady Creek Prairie	AL 1	1
	Locust Branch Prairie	AL 2	2
Floyd, GA	Jefferson Road Wet Prairie	GA 1	1
	Kanady Creek Wet Prairie	GA 4	2
	Upper Mud Creek Wet Prairies	GA 5	3
	Sunnybell Prairie	GA 7	4
Marshall, MS	Clear Creek	n/a	n/a
Madison, TN	Turk Creek	TN 2	1–6
McNairy, TN	Prairie Branch	TN 3	1–4

Whorled sunflower is a self-incompatible, clonal perennial and flowers from August–October (Matthews *et al*. 2002; Ellis and McCauley 2009). Self-incompatibility is a common strategy of flowering plants to promote outcrossing and prevent inbreeding (Silva and Goring 2001). Whorled sunflower propagates clonally via rhizomes, as well as by sexual reproduction (*i.e.*, flowering and seed production); thus, many stems that appear to be individual plants are genetically identical to their neighbors, resulting in a clumped distribution (Ellis *et al*. 2006; Mandel 2010). Clumped distribution combined with the species' self-incompatibility and short flight distances of potential pollinators (*e.g.*, two-spotted long-horned bees [*Mellisodes bimaculatus*] and honeybees [*Apis mellifera*] have been observed visiting flowers of the species) increase the likelihood of geitonogamous self-pollination (transfer of pollen between flowers of this same genetic individual) that will result in unsuccessful pollination (Ellis 2008; Mandel 2010). Whorled sunflower lacks adaptations for wind pollination, so pollinating invertebrates are likely required for successful reproduction, although studies to determine effective pollinators of this species have not been conducted.

The species is easily cultivated and seed germination is high in the laboratory. Upon transplanting, this species has been shown to reproduce rapidly from rhizomes, creating dense colonies of stems that can reach over 4 m (13 ft.) in height (Matthews *et al*. 2002). However, Ellis and McCauley (2009) reported lower germination rates in seeds produced from crosses between plants from the Madison County, Tennessee, population compared to plants from the larger Alabama population. Lower rates of seed viability were also observed in second-

[6] Due to its recent discovery, some data was not available for the Mississippi population.

generation (F2) crosses of the Tennessee versus Alabama plants. These results suggest a possible influence of population size on individual fitness in whorled sunflower populations.

9.1.4. Conservation Needs of and Threats to Whorled Sunflower

Loss and degradation of habitat represent the greatest threats to whorled sunflower. Past and ongoing risks of adverse effects from mechanical or chemical vegetation management for industrial forestry, ROW maintenance, or agriculture threaten three of the five extant populations of this species. Degradation of the species' remnant prairie habitats, due to shading and competition resulting from vegetation succession, also threatens these three populations, limiting growth and reproductive output of whorled sunflower. Whorled sunflower is vulnerable to localized extinction because of its extremely restricted distribution and small population sizes at most known locations. Small population size may affect reproductive fitness of whorled sunflower by limiting availability of compatible mates and/or by causing higher rates of inbreeding among closely related individuals. Extant populations vary in size, but are relatively small and isolated, making it more difficult for the species to withstand and recover from stochastic or catastrophic events. Furthermore, the species is likely suffering genetic isolation and reduced adaptive capacity. These threats are expected to continue into the foreseeable future absent conservation efforts to intervene.

9.2. Environmental Baseline for Whorled Sunflower

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the whorled sunflower, its habitat, and ecosystem within the Action Area.

9.2.1. Action Area Numbers, Reproduction, and Distribution of Whorled Sunflower

In the Action Area, whorled sunflower has been previously reported in close proximity to one small section of a TVA ROW in McNairy County, Tennessee, associated with Prairie Creek. Plants were originally observed by TDNA biologists in 2006. Individuals were recorded from multiple locations along the railroad easement, creek banks, agricultural field edges, and roadsides. No whorled sunflower plants have been documented in the TVA ROW near the Prairie Creek population, which was last visited by TVA botanists in 2013. The nearest plants to the ROW were located about 700 ft to the south along the margins of a soybean field. The initial discovery of whorled sunflower in Mississippi in 2017 (D. Brandon pers. comm., August 12, 2017) was along the U.S. Highway 72 ROW at Clear Creek, and surveys conducted since then have discovered several additional plants growing along Clear Creek in the same general vicinity. This known location is also within 0.5-mi of an existing TVA ROW.

The ability of whorled sunflower to occupy disturbed, open habitat suggests that the species could occupy other sites on TVA TL ROW. TVA botanists have surveyed 480 ac (46 percent) of the 1,100 ac of TVA ROW area situated in counties where whorled sunflower is known to occur. While not all sections of TVA ROW contain suitable habitat for whorled sunflower, TVA botanists have used the O-SAR process to designate about 560 and 70 ac of ROW as Plants Class

1 and Class 2, respectively. It is impossible to quantify with certainty, but given the limited area surveyed for the species and presence of suitable habitat in the Action Area, TVA is reasonably certain that whorled sunflower occurs within the O-SAR polygons.

9.2.2. Action Area Conservation Needs of and Threats to Whorled Sunflower

Threats to this species in the Action Area include mechanical and chemical vegetation management for industrial forestry, ROW maintenance (*i.e.*, incompatible mowing regimes, indiscriminate herbicide application); agriculture; shading and competition resulting from vegetation succession; and limited distribution and small population sizes.

Management of whorled sunflower habitat requires maintaining open conditions by controlling invasive plants and woody vegetation with careful herbicide application, prescribed fire, and/or properly timed mechanical thinning (*e.g.*, mowing).

9.3. Effects of Vegetation Management on Whorled Sunflower

This section analyzes the direct and indirect effects of the Action on whorled sunflower. An effects analysis summary of the effects of various methods of vegetation management on whorled sunflower and the other 17 listed LAA plant species from the BA has been included in Appendix II.

9.3.1. Effects of Manual Vegetation Clearing on Whorled Sunflower

Manual vegetation clearing has the potential to adversely affect whorled sunflower. While tree clearing would increase light levels on-site, potentially resulting in a benefit to whorled sunflower, direct physical disturbance of the species is likely to occur. The disturbance could result from trampling, cutting, or soil disturbance. Given the ability of whorled sunflower to reproduce asexually from underground rhizomes, it is unlikely manual vegetation clearing would completely remove the species from a site. Likewise, the presence, if any, of a soil seed bank of whorled sunflower may limit the effects of such activities on local populations.

In summary, manual vegetation clearing is likely to adversely affect whorled sunflower if conducted in occupied habitat. Adverse effects from manual clearing activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, and avoiding the use of heavy equipment (to and from the site) that may result in soil disturbance.

9.3.2. Effects of Mechanical Clearing on Whorled Sunflower

All mechanical vegetation control methods used by TVA have the potential to adversely affect whorled sunflower. Whorled sunflower occurs in areas disturbed by human activities and thrives in open conditions like those found along TL ROWs. Whorled sunflower could occur within the open floor of the ROW or along the relatively shady edges. The effects caused by mechanical clearing are similar to those from manual vegetation clearing. In addition, mowing, which is restricted to regularly maintained areas within the ROW floor, could adversely affect individual plants, especially if the mowing was conducted during the flowering period or before fertilized plants could disperse seed. Even though mowing can temporarily reduce woody species concentration, repeated mowing in moist-soil habitats, most likely to support whorled sunflower, would shatter the stumps of individual trees and shrub, thereby promoting sprouting and the proliferation of woody species. Allowing a woody canopy to develop within the ROW may be detrimental to whorled sunflower over time.

Mechanical clearing and side-wall trimming will increase light levels on-site, potentially resulting in a benefit to whorled sunflower. However, there is a potential for direct physical disturbance with all methods. The disturbance could result from trampling, cutting, or soil disturbance resulting from machinery (*e.g.*, rutting from tires, and tracked equipment/vehicles).

In summary, all mechanical vegetation control methods used by TVA are likely to adversely affect whorled sunflower. Adverse effects from mechanical clearing activities can be minimized by implementing the same BMPs (TVA 2017) and AMMs described under 9.3.1.

9.3.3. Effects of Herbicide Use on Whorled Sunflower

Broadcast herbicide, either from the air or ground, will adversely affect plants growing on and near the ROW edge if used in occupied habitat. Broadcast herbicide used in an agricultural setting and for vegetation management along the nearby railroad have been detrimental to whorled sunflower in the Prairie Creek population. Many TVA ROWs in west Tennessee that have non-native, naturalized vegetation have been assigned a Class 1 Plants O-SAR polygon, but the fairly ubiquitous nature of whorled sunflower habitat makes it difficult to effectively identify areas that might harbor the species using the O-SAR process. In addition, while not currently used, broadcast herbicide could be used in the future in the isolated parts of the TVA study area, such as west Tennessee. If broadcast herbicide would be used in a TVA ROW that contained whorled sunflower, the population could be severely damaged.

Spot treatment with herbicide is highly targeted and unlikely to adversely affect whorled sunflower at the population level, but could result in isolated, direct adverse effects on individual plants if a broad spectrum herbicide is used in close proximity to individuals. Cut stump and hack and squirt applications could be used when cutting trees to prevent resprouting. These methods could also be used as an AMM to control smaller trees in occupied habitat. If trees do not need to be cut immediately, but may threaten future TL reliability, spot treatments can be used to kill the trees without directly affecting whorled sunflower. Although localized herbicide application targets woody species within the ROW floor, the use of that tool would have some level of adverse effects on the species. If individual whorled sunflower plants occur within a few feet of a of a localized herbicide application, chances are high that the plant would experience some level of herbicide related damage. This damage may rise to the level of individual plant death. These targeted applications may be less likely to damage whorled sunflower plants beyond chemical burns or other limited effects (limiting or eliminating the application year's reproduction); however, the precise effects of such targeted herbicides on whorled sunflower have not been studied, so they should still be used with an abundance of caution.

In summary, all vegetation control methods that use herbicides are likely to adversely affect whorled sunflower if used in occupied habitat. Adverse effects from herbicide management activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, appropriate application and timing of herbicide treatment, conservation spraying, or another targeted herbicide application technique such as spot application.

9.3.4. Effects of Debris Management on Whorled Sunflower

Debris management techniques used by TVA are likely to adversely affect whorled sunflower. Any physical disturbance associated with manual or mechanized handling of debris occurring on the open ROW edge could directly affect plants. These effects include physical damage resulting from cutting or dragging trees and would not likely result in death of individuals. If mulching/chipping is used, the species could be directly affected by crushing and grinding from machinery and smothering by mulch/chips. Pile burning could conceivably result in the loss of individual plants, but the infrequent use of the tool, combined with the extreme rarity of the species, make the likelihood of this occurring small. At the requests of landowners, vegetation debris may be left for landowner's personal use under appropriate circumstances. TVA's facilitation of landowner use of wood has similar potential for small impacts as manual debris management methods.

In summary, all debris management activities are likely to adversely affect whorled sunflower. Adverse effects from mechanical clearing activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, appropriate timing of debris management, and avoiding the use heavy equipment that may result in soil disturbance.

9.4. Conclusion for Whorled Sunflower

In this section, we interpret the findings of the previous sections for the whorled sunflower (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects on whorled sunflower and result in a few individual plants, if any, within the Action Area being damaged or destroyed. Other non-federal actions in the Action Area, that are reasonably certain to occur and that may affect whorled sunflower, include the use of broadcast herbicide on adjacent agricultural lands, use of broadcast herbicides at ROW intersections (*e.g.*, railroad crossings, roads), and other timber management activities on adjacent lands (cumulative effects; see Section 2.8).

After reviewing the current status of whorled sunflower, the environmental baseline for the Action Area, the effects of the proposed Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the whorled sunflower. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only a fraction of the known rangewide populations (one population out of six) exists within the Action Area, and this population is located 700 ft from the ROW, where individual plants would likely not be affected by the Action. (4) The species has the ability to occupy disturbed, open habitat; therefore, the plant would likely persist following removal of vegetation in the Action Area.

10. SMALL WHORLED POGONIA

10.1. Status of Small Whorled Pogonia

This section summarizes best available data about the biology and current condition of small whorled pogonia (*Isotria medeoloides*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the small whorled pogonia as endangered on September 9, 1982 (53 FR 39827-39831). On October 6, 1994, the USFWS reclassified the species from endangered to threatened (59 FR 50852-50857).

10.1.1. Description of Small Whorled Pogonia

Small whorled pogonia is a perennial herb in the orchid family with long, pubescent roots and a smooth, hollow stem, 3.7 to 9.8 inches tall, terminating in a whorl of five or six light green, elliptical leaves that are somewhat pointed and measure up to 3.1 x 1.6 inches. A flower, or occasionally two flowers, is produced at the top of the stem. Small whorled pogonia's nearest relative is the purple five-leaf orchid (*Isotria verticillata*), which is similar looking, but can be distinguished by its purplish stem and by differences in the flower structure. The purple five-leaf orchid is much more common and widespread than the small whorled pogonia. When not in flower, young plants of Indian cucumber-root (*Medeola virginiana*) also resemble small whorled pogonia. However, the hollow stout stem of the small whorled pogonia will separate it from the genus *Medeola*, which has a solid, more slender stem (USFWS 1992).

10.1.2. Life History of Small Whorled Pogonia

Small whorled pogonia is a forest species and is often found in colonies. The species tends to occupy mesic, second-growth deciduous or deciduous coniferous forest with a robust herb layer (NatureServe Explorer 2018a). It prefers areas with a layer of leaf litter and decaying material, but it can sometimes occupy edges and disturbed successional forests, such as those that may be found along a ROW margin. Flowering typically occurs May-June, although some individuals within a colony may remain underground in a dormant state for several years, making it difficult to determine population size and viability.

10.1.3. Numbers, Reproduction, and Distribution of Small Whorled Pogonia

Small whorled pogonia is a small orchid that is wide ranging, occurring in 22 states from Georgia to Maine. There are about 150 populations of small whorled pogonia throughout its range. Rangewide, the status of the species is considered to be stable. There are approximately 61 populations of small whorled pogonia in the states containing TVA TL ROW including: seven in North Carolina, 33 in Virginia, 19 in Georgia, and two in Tennessee. Most southeastern populations number less than 25 plants, although Georgia has two populations numbering about 100 plants each. In the Southeast, North Carolina has two protected sites, both of which are viable; and Georgia has seven protected sites, four of which are viable (USFWS 2008). Recent data is sparse and many populations have not been monitored. The most recent report (from a small whorled pogonia workshop in 2016) indicated that Georgia had five extant populations ranging in size from 1 to 30 plants and only one population had more than five individuals. The patterns for North Carolina were reported to be similar. Of the 18 populations found in North Carolina between 1978 and 2013, nine populations were extirpated or had not been found since 2004 and the population size ranged from one to 15 plants. Six populations in North Carolina were reported to be stable, and three populations were declining (Isotria Workshop 2016).

10.1.4. Conservation Needs of and Threats to Small Whorled Pogonia

Of the known populations of small whorled pogonia in the southeast, few are provided long-term protection. Primarily, protection of small whorled pogonia populations in the southeast has transpired as a result of surveys documenting populations on state and federal lands (USFWS 2008). Also, because the species can remain dormant for years, monitoring and collection of data to assess the health of populations is difficult. The limitations, associated with monitoring of small whorled pogonia, create data gaps and difficulty in assessing population density and viability. Additional research and monitoring of known populations, rangewide surveys to locate previously unknown populations, and mechanisms to ensure long-term protection and management of populations are needed to aid in recovery of this species.

The primary threat to small whorled pogonia is the loss of populations and degradation of habitat from urban development. Forestry practices have also been known to degrade or eliminate suitable habitat for the species. Other lesser threats that can lead to habitat degradation or loss of individual plants are recreational activities and trampling.

10.2. Environmental Baseline for Small Whorled Pogonia

The environmental baseline is a “snapshot” of the species’ health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the small whorled pogonia, its habitat, and ecosystem within the Action Area.

10.2.1. Action Area Numbers, Reproduction, and Distribution of Small Whorled Pogonia

Small whorled pogonia is an interior forest species and is very unlikely to occur on the floor of a TL ROW. Although there are no known occurrences of small whorled pogonia in the Action

Area, there are a number of populations in the TVA PSA and within proximity of TVA ROWs. Most known occurrences of small whorled pogonia in the PSA inhabit mountain slopes and are at least 5 mi distance from the nearest TVA TL ROW. The nearest documented location for small whorled pogonia in North Carolina is 12 mi from the eastern edge of the PSA; the other occurrences are more than 20 mi distance. Similarly, the Lee County, Virginia record for the species is more than 20 mi north of the nearest TVA ROW. In Georgia, where the majority of occurrences of small whorled pogonia occur in the TVA PSA, all records are more than 5 mi away from the nearest TV TL. Tennessee records of the species are generally closer to the TVA ROW with the Hamilton, Washington, and Marion county records being about 4, 1, and 0.15-mi away, respectively, but these populations are small, averaging about four plants per population.

10.2.2. Action Area Conservation Needs of and Threats to Small Whorled Pogonia

Because small whorled pogonia is restricted to forests and ecotones between the forest and ROW and does not occupy open portions of ROW floor, mowing in regularly maintained areas within the ROW is not likely to adversely affect the species. However, other vegetation management activities, such as manual and mechanical tree clearing and trimming, and herbicide use in and adjacent to areas of suitable habitat, could affect small whorled pogonia. Debris management techniques (*e.g.*, piling, chipping, and burning of brush) also have the potential to affect small whorled pogonia when utilized adjacent in the ROW edges.

Although there are no known populations of small whorled pogonia adjacent to TVA ROWs, suitable habitat does occur adjacent to TVA ROW. For this reason, it is likely small whorled pogonia populations could occur where vegetation management actions will take place. Though the probability is low, there is the possibility that vegetation management and debris management activities could affect small whorled pogonia.

10.3. Effects of Vegetation Management on Small Whorled Pogonia

This section analyzes the direct and indirect effects of the Action on small whorled pogonia. An effects analysis summary of the effects of various methods of vegetation management on small whorled pogonia and the other 17 listed LAA plant species from the BA has been included in Appendix II.

10.3.1. Effects of Manual Vegetation Clearing on Small Whorled Pogonia

Manual vegetation management activities, such as tree clearing, have the potential to affect small whorled pogonia by crushing or cutting individual plants, disturbing the soil profile, and/or changing lighting regimes. Large increases in sunlight from canopy removal could result in adverse effects to plants occurring in the area; however, some canopy clearing in densely vegetated areas could result in increased light levels that could increase productivity and reproduction without fundamentally changing the vegetation structure and light regime in the immediate vicinity of the plant, but this is unclear (NatureServe Explorer 2018a).

10.3.2. Effects of Mechanical Clearing on Small Whorled Pogonia

Mechanical vegetation management activities, such as ROW sidewall trimming, also have the potential to affect small whorled pogonia by crushing or cutting individual plants, disturbing the soil profile, and/or changing lighting regimes. Effects and potential benefits to small whorled pogonia from mechanical vegetation management are similar to those described in section 10.3.1.

10.3.3. Effects of Herbicide Use on Small Whorled Pogonia

Vegetation control methods that use herbicides are likely to adversely affect small whorled pogonia if used in occupied habitat, though the probability of herbicides intersecting the species is small. Spot treatment with herbicides is highly targeted and unlikely to adversely affect small whorled pogonia at the population level, but could result in isolated, direct adverse effects on individual plants. Because it is restricted to the ROW floor where small whorled pogonia does not grow, localized herbicide application is not likely to intersect the species. There is a potential nexus with localized herbicide application and small whorled pogonia at the ROW edge. In this area, individual plants growing adjacent to tree seedlings could be inadvertently affected by overspray. Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW edge. The chances of broadcast herbicide being used adjacent to small whorled pogonia are very small because areas in Tennessee and Georgia most likely to support the species have been given a Class 1 Plants designation in the O-SAR database, which prohibits the use of broadcast spray. These restricted areas include TVA ROW that bisects higher elevation, natural forests within counties where small whorled pogonia is known to occur.

10.3.4. Effects of Debris Management on Small Whorled Pogonia

Debris management techniques used by TVA have a small potential to adversely affect small whorled pogonia. Any physical disturbance associated with manual or mechanized handling of debris occurring on the open ROW edge could directly affect plants, but the removal of trees preceding debris management activities could ultimately result in plants occurring there dying over time. If chipping and mulching did occur, the effect could be direct affected by crushing from machinery and burial by mulch/chips. Burning would occur in the open ROW and would not affect small whorled pogonia, but debris handling by machinery could affect individual plants on the ROW edge. TVA's facilitation of landowner use of wood have similarly low potential for effects as other debris management methods.

10.4. Conclusion for Small Whorled Pogonia

In this section, we interpret the findings of the previous sections for the small whorled pogonia (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would at most have localized adverse effects to small whorled pogonia and result in only a few individual plants within the Action Area being adversely affected. Cumulative effects to small whorled pogonia that may be relevant to this consultation are unknown.
After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the small whorled pogonia. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The species is currently unknown to occur on the TVA ROW (i.e., Because the species inhabits interior forests, it is unlikely that it would occur on the ROW.). (3) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near the TVA ROW. (4) Rangewide, there are 150 populations in 22 states, including 61 known populations in four of the states within TVA's PSA; the nearest known populations to the TVA ROW occur about 4.1 and 0.15-mi from the ROW in Tennessee, averaging only four plants per population, and, therefore, any adverse effects would occur to only a small proportion of the rangewide population.

11. FLESHY-FRUIT GLADECRESS

11.1. Status of Fleshy-Fruit Gladecress

This section summarizes best available data about the biology and current condition of fleshy-fruit gladecress (*Leavenworthia crassa*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list fleshy-fruit gladecress as endangered on August 1, 2014 (79 FR 44712-44718).

11.1.1. Description of Fleshy-Fruit Gladecress

Fleshy-fruit gladecress (Family: Brassicaceae) is a glabrous, having no trichomes (bristles or hair-like structures), winter annual known from Lawrence and Morgan counties, Alabama. It usually grows 10 to 30 cm (4 to 12 in) tall. The leaves are mostly basal, forming a rosette, and entire to very deeply, pinnately (multiple leaflets attached in rows along a central stem) lobed or divided, to 8 cm (3.1 in) long. Flowers are on elongating stems, and the petals are approximately 0.8 to 1.5 cm (0.3- to 0.6 in) long, obovate to spatulate, and emarginate (notched at the tip). Flower color is either yellow with orange or white with yellow, usually with both color forms intermixed in a single population. The fruit is globe-shaped or slightly more elongate and about 1.2 cm (0.5-in) long with a slender beak at the tip, which is 0.25 to 0.60 cm (0.1- to 0.24 in) in length. Seeds are dark brown, nearly round in shape, and winged.

11.1.2. Life History of Fleshy-Fruit Gladecress

Fleshy-fruit gladecress is an annual, spring-flowering member of the mustard family (Brassicaceae). As an annual, the seeds germinate in the fall, overwinter as rosettes, and commence a month-long flowering period beginning in mid-March. The first seeds mature in late April, and during most years the plants dry and drop seed by the end of May. It is unlikely that all seeds produced in spring germinate the next fall, but the length of dormancy in the soil is not known (McDaniel and Lyons 1987), and we do not know whether the species is capable of forming a seed bank. Native bees in the families Andrenidae and Halictidae (sweat bees), including the species *Halictus ligatus*, were observed carrying pollen from fleshy-fruit gladecress and Alabama gladecress (*Leavenworthia alabamica*) in northern Alabama (Lloyd 1965).

Fleshy-fruit gladecress was described by Rollins (1963) from material collected in 1959 in Morgan County, Alabama. Rollins (1963) delineated the species into two varieties (var. *crassa* and var. *elongata*) based on differences in fruit length. However, herbarium and field studies have shown var. *elongata* to have variation in fruit length within the range of fruit lengths for var. *crassa* (McDaniel and Lyons 1987). Thus, the species is treated as one taxon.

11.1.3. Numbers, Reproduction, and Distribution of Fleshy-Fruit Gladecress

Fleshy-fruit gladecress is endemic to a 21-km (13-mi) radius area in north central Alabama within Lawrence and Morgan counties (Rollins 1963). A 1961 record from Lauderdale County, Alabama has never been confirmed (McDaniel and Lyons 1987). Surveys by Lyons (*in litt.* 1981 to R. Sutter), McDaniel and Lyons (1987), and Hilton (1997) were unsuccessful at locating a number of historical sites for fleshy-fruit gladecress. McDaniel and Lyons (1987) failed to locate eight sites previously reported by Rollins (1963), and Lloyd (1965) and Hilton (1997) were unsuccessful at locating seven sites listed in McDaniel and Lyons (1987).

Currently, there are seven known extant occurrences of fleshy-fruit gladecress documented, three in Morgan County and four in Lawrence County, Alabama (Table 11-1). One of these occurs on USFS lands. The majority of other sites are actively grazed, a practice that has, for the most part, maintained favorable growing conditions for the species. However, adjusting grazing patterns to take place during the species' dormant cycle would greatly reduce potential mortality of reproducing plants, while maintaining ideal habitat conditions.

Table 11-1 lists these populations and subpopulations, and relates them to EO rank used by state conservation agencies to track their status. The EO final rank is a summary of ranking criteria that includes quality, condition, viability, and defensibility of the population. The ranking is given based on a scale from A to D, with A meaning excellent, B meaning good, C meaning marginal, and D meaning poor.

Table 11-1. List of fleshy-fruit gladecress populations by county, with corresponding site names and EO rank from state conservation agency databases in Alabama.

County	Designation	EO Rank	Land Ownership
Lawrence	Bluebird Glades	D	Private & State ROW Stover Branch Glades
	Glades	C	Private
	Indian Tomb Hollow	A	Federal--USFS Glade
	Hillsboro Glade	*	Private
Morgan	Cedar Plains South	C	Private
	Cedar Plains North	B	Private
	Massey Glade	C	Private

*Recently discovered population.

11.1.4. Conservation Needs of and Threats to Fleshy-Fruit Gladecress

Fleshy-fruit gladecress is endemic to cedar glade areas in north-central Alabama that have been significantly altered from their original condition. More than a 50 percent loss in glade habitat has occurred since European settlement (Hilton 1997), with resulting glade habitats reduced to remnants fragmented by agriculture and development. Hilton (1997) conducted a thorough survey of cedar glade communities in northern Alabama using historical records, soil maps, topographic maps, geology, and aerial photography; 22 high priority glades were identified. However, field surveys found only five of these to be in good condition and restorable, and only two of these were considered high quality sites. Threats to fleshy-fruit gladecress from habitat destruction and modification are occurring throughout the entire range of the species. These threats include agricultural conversion or incompatible practices, maintenance of transportation ROW, residential and industrial development, and shading and competition. The conservation efforts of the USFS have removed threats associated with ORV use and encroachment of invasive species at one site; however, maintenance of transportation ROW and use of ORV could adversely affect the remaining six extant populations. The population-level effects from these activities are expected to continue into the future. State and federal regulations that might help conserve rare species on state highway ROW, including avoidance or minimization of habitat destruction, as well as regulations that protect plants from herbicide applications, can help protect this species. However, no existing regulations protect the species on privately owned land, where most of the remnant gladecress populations are found.

Fleshy-fruit gladecress is vulnerable to localized extinction because of the small number of occurrences and the small population sizes within the species' limited range. Small population sizes decrease the resilience of individual fleshy-fruit gladecress occurrences to recover from effects of other threats affecting the species' habitat. There are only seven remaining fleshy-fruit gladecress occurrences, and only one of these is protected. The loss of any occurrence would significantly affect the species' viability by reducing its redundancy on the landscape, which would increase its vulnerability to stochastic environmental stressors and reduce the species' resilience to recover from effects of threats. Three of the seven populations of fleshy-fruit gladecress are small in size as a result of effects of habitat loss. The loss of populations and reductions in population sizes have resulted in spatial isolation between these remnant populations. These isolated populations are vulnerable to extinction by reductions in genetic variation among the populations (Klank *et al.* 2012; Schotz, pers. comm., 2013). Genetic variation is low in self-compatible populations of fleshy-fruit gladecress (Koelling *et al.,* 2011), which could limit their adaptive potential to respond to environmental change (Primack 1998). Habitat disturbance or unintentional human movement resulting in contact between populations of fleshy-fruit gladecress and Alabama gladecress could also increase the threat of hybridization, but, at this time, these species do not occur together in the wild and the potential for hybridization is reduced by incompatibility between them (Koelling and Mauricio 2010).

Based on this information, we conclude that the small number of populations and the small size of populations within the species' limited range are significant threats to fleshy-fruit gladecress.

11.2. Environmental Baseline for Fleshy-Fruit Gladecress

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the fleshy-fruit gladecress, its habitat, and ecosystem within the Action Area.

11.2.1. Action Area Numbers, Reproduction, and Distribution of Fleshy-Fruit Gladecress

Fleshy-fruit gladecress has been documented from one location on TVA ROW about 2.5 mi south of the town of Hillsboro in Lawrence County, Alabama. This site was first identified by TVA botanists during desktop O-SAR reviews while examining aerial photos, topographic maps, and TVA Natural Heritage data. This site was subsequently surveyed in the field, which resulted in the discovery of seven state-listed plant species, as well as the population of fleshy-fruit gladecress. No population estimate was made during the initial observation, but a 2018 field survey noted that thousands of flowering fleshy-fruit gladecress occur within the ROW. The population may sound large, but the species is less than 5 cm tall and viable habitat within the ROW only covers a few thousand square feet.

No high quality habitat occurs adjacent to the ROW; most habitat off-ROW is closed canopy forest or agricultural fields and pasture. Fleshy-fruit gladecress can be found in these suboptimal open habitats, but populations in these situations are often ephemeral due to the dynamic nature of plant communities found there. Intact cedar glade habitats are not mutually exclusive with ROW vegetation management and it is not inconceivable that other undocumented occurrences of fleshy-fruit gladecress intersect the transmission system in Alabama. However, TVA botanists have reviewed all TL located in northern Alabama using the O-SAR process. Given the propensity for glades (and ROW near glades) to harbor listed plant species and the ease which these habitats can be identified using aerial photos, TVA botanists have classified many areas as Class 2 Plants in O-SAR. The vast majority of these areas have been subsequently field surveyed. Multiple new populations of state and federally listed species have been found on TVA ROW in this part of Alabama, including other rare gladecress species, but no new occurrences of fleshy-fruit gladecress. Few, if any, sizable, unsurveyed glades co-occurring on ROW remain in northern Alabama.

11.2.2. Action Area Conservation Needs of and Threats to Fleshy-Fruit Gladecress

Conservation efforts involve using hand removal of invasive plants to maintain the open, well-lit conditions fleshy-fruit gladecress favors. The population at Hillsboro glade along the power line ROW seems to respond well to management that maintains open, well-lit conditions.

ROW floor work would use timing restrictions, and other AMMs, as discussed in Section 2.4 to eliminate the risk of herbicide applications inadvertently affect the population. If new populations of fleshy-fruit gladecress are documented from TVA ROW, the location would be added to the O-SAR database and subsequent vegetation management would seek to avoid impacts using AMMs.

11.3. Effects of Vegetation Management on Fleshy-Fruit Gladecress

This section analyzes the direct and indirect effects of the Action on fleshy-fruit gladecress. An effects analysis summary of the effects of various methods of vegetation management on fleshy-fruit gladecress and the other 17 listed LAA plant species from the BA has been included in Appendix II.

11.3.1. Effects of Manual Vegetation Clearing on Fleshy-Fruit Gladecress

Manual vegetation clearing, when utilized by TVA, has the potential to adversely affect fleshy-fruit gladecress. However, provided clearing does not intentionally disturb the soil, it is unlikely to result in the death of individual plants. Fleshy-fruit gladecress prefers sunny conditions; and typically inhabits the interior of cedar glades. If tree clearing resulted in increased light on ROW edges where fleshy-fruit gladecress occurred, the effect would not likely be detrimental. The species is susceptible to physical damage from clearing activities, but the shallow rocky soils, characteristic of cedar glades, do not rut easily, and the species could resprout after tree clearing.

Clearing previously unmaintained ROW is a one-time event because these areas would subsequently be treated as ROW floor. Danger tree clearing occurs as needed. Danger tree clearing may never be needed in fleshy-fruit gladecress habitat near glades because the soils are not sufficiently deep to support growth of taller trees.

11.3.2. Effects of Mechanical Clearing on Fleshy-Fruit Gladecress

All mechanical vegetation control methods utilized by TVA have the potential to adversely affect fleshy-fruit gladecress. Effects to the species from mechanical clearing are similar to those described under manual clearing. As long as the clearing method would not intentionally disturb the soil, it is unlikely to result in death of individual plants.

Mowers are generally set 10 to 12 inches off the ground and would likely miss the low-growing fleshy-fruit gladecress.

11.3.3. Effects of Herbicide Use on Fleshy-Fruit Gladecress

Vegetation control methods that utilize herbicides are not likely to affect fleshy-fruit gladecress, but an adverse effect resulting from this control technique is not impossible. The low probability of herbicide adversely affecting fleshy-fruit gladecress is related to two factors: seasonality of herbicide application in relation to species life cycle and habitat preferences of the plant. Fleshy-fruit gladecress is a winter annual, which means that seeds germinate in the fall, overwinter as a rosette, flower in the spring, and die by June of any given year. TVA cannot spray herbicide until tree species growing in the ROW have leafed out sufficiently. This is because without enough leaf area on any given tree, foliar herbicides will not be taken up by an individual plant, which would result in low efficacy of the application. Therefore, herbicide treatments often do not start until mid-May in many parts of the TVA system. Fleshy-fruit gladecress would be setting seed and nearing the end of its life cycle at this time. In addition, fleshy-fruit gladecress grows in flat, limestone outcrops that often have soil depths of less than 1 cm. These areas are dry in summer and typically do not support tree growth characteristics that are targeted for herbicide application.

Even if ROW containing undocumented locations for fleshy-fruit gladecress were sprayed using low-volume foliar application of herbicide, the chemical would be unlikely to intersect the species because few trees would be present. Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW, if applications were made early in the season. However, it is unlikely that this tool would be used in areas where fleshy-fruit gladecress might occur because the region is characterized by a patchwork of land uses, making broadcast spray a less desirable option.

11.3.4. Effects of Debris Management on Fleshy-Fruit Gladecress

All debris management techniques used by TVA have a small potential to adversely affect fleshy-fruit gladecress. The characteristic of debris removal most likely to affect the species is physical disturbance associated with manual or mechanized handling of material. This disturbance could result from dragging of debris over plants or the marginal soil disturbance that would be expected from use of machinery. The soil disturbance would be minimal because of the rocky habitats preferred by fleshy-fruit gladecress, which are well drained and resistant to deep rutting. Neither form of disturbance would be likely to result in the death of individual plants. Pile burning could conceivably result in the loss of individual plants, but the infrequent use of the tool, combined with the extreme rarity of the species, make the likelihood of this occurring very small. TVA's facilitation of landowner use of wood has similar potential for small impacts as other debris management methods.

If mulching machines were used in fleshy-fruit gladecress habitat, it would not likely generate enough mulch to bury the species. This is because the amount of mulch or chips generated by the machine is directly proportional to the amount of vegetation a site supports. Dry glade margins stunt woody plant growth and the layer of mulch left in these areas is often discontinuous and less than 1-in deep.

11.4. Conclusion for Fleshy-Fruit Gladecress

In this section, we interpret the findings of the previous sections for the fleshy-fruit gladecress (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to fleshy-fruit gladecress and result in only a few individual plants within the Action Area being adversely affected. The plant responds well to vegetation clearing because suitable habitat for the species includes open, well-lit conditions. Cumulative effects to fleshy-fruit gladecress that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the fleshy-fruit gladecress. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) We do not expect to lose the single population on the ROW due to benefits (increased light conditions) provided by TVA's ongoing maintenance, which offsets the likelihood of adverse effects on the species. (4) While the population on TVA's ROW is substantial (i.e., several thousand plants), it is only one of seven populations, and the loss of this population is not expected as discussed in #3 above.

12. LYRATE BLADDERPOD

12.1. Status of Lyrate Bladderpod

This section summarizes best available data about the biology and current condition of lyrate bladderpod (*Lesquerella* [=*Paysonia*] *lyrata*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list lyrate bladderpod as threatened on September 28, 1990 (55 FR 39864-39868).

12.1.1. Description of Lyrate Bladderpod

Lyrate bladderpod, an annual, herbaceous member of the mustard family (Brassieaceae), is 10 to 30 cm (4 to 12 in) tall. The plants are shortly pubescent and usually branched at the base. The stem leaves are alternate, ovate to elliptic in shape, smoothed or toothed on the margins, with prominent ear-like projections at the bases. The flowers are ascending, on the stalks 10 to 15 mm (0.4 to 0.6 in) long, with yellow petals 5 to 7 mm (0.2 to 0.3 in) in length. The fruits are silques, globose in shape 2.5 to 3.5 mm (0.1 in) long and 3 to 4 mm (0.1 to 0.2 in) wide (USFWS 1990). The species resembles the Duck River Bladderpod (*Lesquerella densipila,*), which has fruits and styles that are pubescent, but the lyrate bladderpod has glabrous fruits and styles.

12.1.2. Life History of Lyrate Bladderpod

The lyrate bladderpod is endemic to cedar glade areas in northern Alabama. The species appears to be an early successional species that historically colonized shallow soils on or adjacent to cedar glade habitats. The lyrate bladderpod slowly disappears as the soil layer develops and other competing plants establish themselves (USFWS 1996b). Lyrate bladderpod has an annual dormancy/non-dormancy cycle, with dormancy loss occurring in the summer and dormancy induction in late autumn/winter. Seeds are dormant at maturity in May and have a high temperature requirement to break dormancy; whereas, low temperatures cause non-dormant seeds to reenter dormancy (Baskin and Baskin 2000). After germination and initial growth, young plants overwinter as rosettes (USFWS 1990). The growth period for the lyrate bladderpod is from September/October into May. Flowering takes place usually from mid-March to April, and seed dispersal generally occurs from the end of flowering until mid-May (USFWS 1990).

12.1.3. Numbers, Reproduction, and Distribution of Lyrate Bladderpod

Populations of lyrate bladderpod in Franklin and Colbert counties are located near growing urban areas (Schotz 2008). At the time of this species' listing in 1990, a large number of individual plants were observed in cultivated fields; however, these areas are no longer cultivated, and plants today are located in pasturelands. The population in Lawrence County is located in pastureland that is lightly-grazed outside of the growing season and is thriving; however, remaining populations have shown declines in numbers due to field abandonment (Webb and Kral 1986; USFWS 1990, 1996b).

12.1.4. Conservation Needs of and Threats to Lyrate Bladderpod

Most cedar glades have been unable to escape human disturbances, including those glades that naturally supported populations of the lyrate bladderpod (Webb and Kral 1986; McDaniel 1987; USFWS 1990, 1996b; Hilton 1996). Shading causes decreased vigor and death and decreases the number of seeds at the site (Baskin and Baskin 1998, 2000). In typical glade habitats, the shallow, droughty soils inhibit the establishment of competing plants. Cedar glades have been fragmented by agriculture and development and mostly exist as remnants today.

Housing development, trash dumping, adverse agricultural practices, and road building have destroyed or negatively impacted a number of cedar glade systems, including those associated with the lyrate bladderpod (USFWS 1990, 1996b). Urban and residential development poses a threat to populations in Franklin and Colbert counties (Schotz 2008). Plants extend onto roadsides at several sites, and mowing or herbicide application prior to seed set would negatively affect these populations (USFWS 1990, 1996b). Certain agricultural practices are compatible with the survival of this species. Plowing associated with row crop farming and grazing on pasturelands, provides the needed disturbance to arrest succession in these populations. Row crop farming incompatibility comes into play when plowing takes place prior to seed set and when pre-emergent herbicides are used.

12.2. Environmental Baseline for Lyrate Bladderpod

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the lyrate bladderpod, its habitat, and ecosystem within the Action Area.

12.2.1. Action Area Numbers, Reproduction, and Distribution of Lyrate Bladderpod

Within the Action Area, the lyrate bladderpod has not been documented in the TVA ROW. Multiple TVA TLs occur within Colbert, Franklin, and Lawrence counties, Alabama, but the vast majority of these ROW do not possess suitable habitat for the species. Cedar glade habitat is easily identifiable during O-SAR desktop reviews, and all sections of TVA ROW that have significant potential to contain lyrate bladderpod have already been identified in O-SAR and field surveyed. One section of TVA ROW, located about 2.5 mi southeast of the Prairie Grove Glades population of lyrate bladderpod, possesses extensive suitable cedar glade habitat within the ROW. Field surveys of the site documented ten state-listed plant species in the ROW, but lyrate bladderpod was not present. Few, if any, sizable, unsurveyed glades are co-occurring on ROW in northern Alabama.

12.2.2. Action Area Conservation Needs of and Threats to Lyrate Bladderpod

TVA should make every effort to locate and protect all remaining cedar glade habitat in TVA ROW that could potentially support lyrate bladderpod. Loss and disturbance of these areas is the one threat to lyrate bladderpod in the Action Area.

12.3. Effects of Vegetation Management on Lyrate Bladderpod

This section analyzes the direct and indirect effects of the Action on lyrate bladderpod. An effects analysis summary of the effects of various methods of vegetation management on lyrate bladderpod and the other 17 listed LAA plant species from the BA has been included in Appendix II.

12.3.1. Effects of Manual Vegetation Clearing on Lyrate Bladderpod

All manual vegetation control methods utilized by TVA have the potential to adversely affect lyrate bladderpod if they occurred in undocumented habitat for the species. However, as long as manual clearing does not intentionally disturb the soil, it is unlikely to result in death of individual plants. Lyrate bladderpod requires sunny conditions and typically inhabits the interior of cedar glades away from the shade cast by trees. If tree clearing resulted in increased light on sites where it occurred, the effects would not likely be detrimental. The species would be susceptible to physical damage caused by clearing activities, but the shallow rocky soils, characteristic of cedar glades, do not rut easily.

Danger tree clearing occurs as needed. Danger tree clearing may never be needed in lyrate bladderpod habitat near glades because the soils are not sufficiently deep to support growth of taller trees.

12.3.2. Effects of Mechanical Clearing on Lyrate Bladderpod

Similar to manual vegetation clearing, all mechanical vegetation control methods utilized by TVA would have the potential to adversely affect lyrate bladderpod. Mowers are generally set 10 to 12 inches off the ground and would likely miss the low-growing lyrate bladderpod.

12.3.3. Effects of Herbicide Use on Lyrate Bladderpod

Vegetation control methods that utilize herbicides in occupied lyrate bladderpod habitat could result in adverse effects, but the probability of that occurring is low. The low probability of herbicides affecting lyrate bladderpod is related to two factors: seasonality of herbicide application in relation to species life cycle and habitat preferences of the plant. Lyrate bladderpod is a winter annual, which means that seeds germinate in the fall, overwinter as a rosette, flower in the spring, and die by June of any given year. TVA cannot spray herbicides until tree species growing in the ROW have leafed out sufficiently. This is because without enough leaf area on any given tree, foliar herbicides will not be taken up by an individual plant, which would result in low efficacy of the application. Therefore, herbicide treatments often do not start until mid-May in many parts of the TVA system. Lyrate bladderpod would be setting seed and nearing the end of its life cycle at this time.

In addition, lyrate bladderpod grows in flat, limestone outcrops that often have soil depths of less than 1 cm. These areas are dry in summer and typically do not support tree growth characteristics that are targeted for herbicide application. Even if ROW containing undocumented locations for lyrate bladderpod were sprayed using low-volume foliar application of herbicide, the chemical would be unlikely to intersect the species because few trees would be present. Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW if applications were made early in the season. However, it is unlikely that this tool would be used in areas where lyrate bladderpod might occur because the region is characterized by a patchwork of land uses, making broadcast spray a less desirable option.

12.3.4. Effects of Debris Management on Lyrate Bladderpod

All debris management techniques used by TVA have a small potential to adversely affect lyrate bladderpod. The aspect of debris removal most likely to affect the species is physical disturbance associated with manual or mechanized handling of material. This disturbance could result from dragging of debris over plants or the marginal soil disturbance that would be expected from use of machinery. The soil disturbance would be minimal because of the rocky habitats preferred by lyrate bladderpod, which are well drained and resistant to deep rutting. Neither form of disturbance would be likely to result in death of individual plants.

If mulching machines were used in lyrate bladderpod habitat it would not likely generate enough mulch to bury the species. This is because the amount of mulch or chips generated by the machine is directly proportional to the amount of vegetation the site supports. Dry glade margins stunt woody plant growth, and the layer of mulch left in these areas is often discontinuous and less than 1-in deep.

Pile burning could conceivably result in the loss of individual plants, but the infrequent use of the tool combined with the extreme rarity of the species make the likelihood of this occurring very small. TVA's facilitation of landowner use of wood have similarly low potential for impacts as other debris management methods.

12.4. Conclusion for Lyrate Bladderpod

In this section, we interpret the findings of the previous sections for the lyrate bladderpod (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to lyrate bladderpod, resulting in only a small percentage of undocumented, individual plants within the Action Area being affected, if any; no populations would be extirpated by TVA ROW vegetation management activities. Cumulative effects to lyrate bladderpod that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the lyrate bladderpod. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) The species' range is restricted to three counties in northern Alabama, and several areas on TVA ROW in one of these counties possess suitable cedar glade habitat; the species has not been observed at these sites during surveys, so the potential for adverse effects is limited.

13. SPRING CREEK BLADDERPOD

13.1. Status of Spring Creek Bladderpod

This section summarizes best available data about the biology and current condition of Spring Creek bladderpod (*Lesquerella* [=*Paysonia*] *perforata*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list Spring Creek bladderpod as endangered on December 23, 1996 (61 FR 67493-67497).

13.1.1. Description of Spring Creek Bladderpod

The following description of Spring Creek bladderpod is adapted from Kral (1983) and Rollins (1955): a herbaceous annual, stems several to many, outer ones usually decumbent at base, inner ones erect, simple or branched, 10 to 15 cm (3.9 to 5.9 in) tall, stems and leaves are covered with fine or coarse hairs. The stem leaves are sessile, articulate, oblong to obovate, with few to many teeth on the margins. The cross-shaped flowers are arranged in a raceme, have white to pale lavender petals with a yellow base, and are 7 to 9 mm (0.28- to 0.35-in) long. The fruits are broadly obovoid to pear-shaped, very inflated, 4 to 7 mm (0.16- to 0.28-in) long, and divided into two halves (USFWS 2006).

13.1.2. Life History of Spring Creek Bladderpod

Spring Creek bladderpod is a winter annual that germinates between September and early October, over-winters as a small rosette of leaves, and fully develops and flowers the following spring. Full sun is a requirement for optimum growth. Flowering usually occurs in March and April. The fruit splits open upon maturity in late April and early May, and the enclosed seeds are dispersed and lie dormant until autumn (USFWS 2006). The plant dies back soon after the fruits mature. Germination can only occur when the correct temperature coincides with adequate moisture (Pearson 1967). Upon germination, the cycle starts over again.

The life history and the seed dispersal mechanism of Spring Creek bladderpod result in many seeds, continuous turnover, and easy movement to new sites. Each of these characteristics favor the ability to persist as long as habitat is available and competing vegetation does not crowd it out (USFWS 2006).

13.1.3. Numbers, Reproduction, and Distribution of Spring Creek Bladderpod

While Spring Creek bladderpod habitat does occur in cedar glades, it is more often found in scour zones and dynamic riparian areas associated with Spring Creek and Bartons Creek in Wilson County, Tennessee. When the Recovery Plan for Spring Creek bladderpod was published in 2006 (USFWS 2006), there were 21 known occurrences of the species, all in the vicinity of the City of Lebanon. Of those 21 occurrences, six were located along Spring Creek, 11 along Bartons Creek and its tributaries, and four along Cedar Creek. All sites occurred on private or municipally owned land, which remains the case today. Based on information in USFWS files and data provided to USFWS by TDEC (2011a), there currently are 22 extant occurrences of Spring Creek bladderpod. The current distribution of Spring Creek bladderpod includes:

<u>Barton's Creek</u>
There currently are 11 occurrences considered extant in the Barton's Creek drainage (TDEC 2011a). One occurrence (EO 34) in this drainage, estimated to contain greater than 1,000 plants,

was discovered during 2008. Only three occurrences have management agreements, but those agreements are non-binding, and occur in the Barton's Creek drainage (EOs 4, 11 and 21).

Cedar Creek

There currently are four occurrences considered extant in the Cedar Creek drainage (TDEC 2011a). One occurrence (EO 28) was thought to have been extirpated by excavation that was first noted during 2004. The site was visited again during 2006, at which time no plants were observed, but plants were observed there in 2011. No other historic or extirpated occurrences are known from this drainage.

Spring Creek

There currently are seven occurrences considered extant in the Spring Creek drainage (TDEC 2011a). EO 24 has not been observed since 1997, thus its status is questionable. One new occurrence (EO 32) was discovered in 2006 following publication of the recovery plan.

13.1.4. Conservation Needs of and Threats to Spring Creek Bladderpod

Habitat destruction or modification from development, cattle grazing, and cropland farming practices (*i.e.*, soil disturbances from tillage and lack of conservation practices) are the primary threats to the Spring Creek bladderpod. Private lands in the City of Lebanon, primarily in Barton's Creek drainage, remain at high risk of loss to urbanization. Increased cattle grazing has transpired across all three drainages in the species' range. Ground disturbance, largely as a result of cropland cultivation between September 15 and May 15, has adversely affected seed bank maintenance for the species (TDNA 2008b; USFWS 2011c).

Based on knowledge of the species' seed ecology and life cycle, Fitch *et al*. (2007) proposed that cropland management for Spring Creek be conducted as follows:

- Planting, field preparation, or other soil disturbance for cultivation should occur after mid-May when seeds disperse, but before seeds are photostimulated. Once seeds are photostimulated, by about mid-July under current climatic conditions, they would be prone to higher germination rates than if they were buried during cultivation prior to this time. While higher germination rates might seem desirable, excessive germination rates could result in seed bank depletion over time.
- Crops should be harvested before seeds germinate in early September to minimize disturbance to newly germinated plants.
- Fields should not be disturbed from September until completion of the above-ground life cycle of the plant, in May.

Additional Spring Creek bladderpod sites need to be enrolled in cooperative management agreements to assist in protection and recovery of the species. Currently, only three sites are enrolled in cooperative management agreements, and inconsistencies in management at these sites have contributed to fluctuations in habitat condition and Spring Creek bladderpod abundance over time. The remaining sites are all located on private lands, primarily under agricultural uses. Additional coordination with landowners and refinement of cropland management practices will be necessary to manage the threat of habitat loss or decline on agricultural lands. Sites on private lands in the City of Lebanon also need to be protected from urbanization (USFWS 2011c).

13.2. Environmental Baseline for Spring Creek Bladderpod

The environmental baseline is a “snapshot” of the species’ health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Spring Creek bladderpod, its habitat, and ecosystem within the Action Area.

13.2.1. Action Area Numbers, Reproduction, and Distribution of Spring Creek Bladderpod

In the Action Area, the Spring Creek bladderpod has been documented from two areas within TVA ROW. The first site is located in the floodplain of Bartons Creek, and the species was first observed at this location in 1992. That area is now dominated by cool season grasses and used as a hayfield. During a 2009 site visit by TVA botanists, three flowering plants were observed within a portion of riparian area regularly scoured by high flows where there was bare soil and little competition from other species. The second site is within an urban area near downtown Lebanon and is under significant development pressure. The TVA ROW runs adjacent to a railroad bed and is very disturbed. In 2009, about 20 flowering plants were observed in the TVA ROW at this site. Searches were not systematically conducted off the TVA ROW, but several hundred plants were seen outside of the ROW that could be adversely affected by the TVA ROW vegetation management program.

13.2.2. Action Area Conservation Needs of and Threats to Spring Creek Bladderpod

Consistent with the threats described in Section 13.1.4., disturbances to the Spring Creek bladderpod in the Action Area include cropland agriculture and development associated with urbanization. Reducing these threats is best addressed by working with private landowners and the City of Lebanon to promote conservation and recovery of the species.

13.3. Effects of Vegetation Management on Spring Creek Bladderpod

This section analyzes the direct and indirect effects of the Action on Spring Creek bladderpod. An effects analysis summary of the effects of various methods of vegetation management on Spring Creek bladderpod and the other 17 listed LAA plant species from the BA has been included in Appendix II.

13.3.1. Effects of Manual Vegetation Clearing on Spring Creek Bladderpod

All manual vegetation control methods utilized by TVA have the potential to adversely affect Spring Creek bladderpod if they are carried out in habitat occupied by the species. The most likely effects would be from trampling or crushing individual plants, either from foot traffic or handling cut vegetation. While direct physical disturbances could result in adverse effects, the removal of overstory and consequential increases in light levels would result in future benefits to the affected population.

13.3.2. Effects of Mechanical Clearing on Spring Creek Bladderpod

Similar to manual vegetation clearing, all mechanical vegetation control methods utilized by TVA would have the potential to adversely affect Spring Creek bladderpod. The effects would result from trampling or crushing, handling cut vegetation, and machinery traffic. Mechanical clearing would also result in increased light levels, potentially benefitting future Spring Creek bladderpod populations. Mowers are generally set 10 to 12 inches off the ground and would likely miss the low-growing Spring Creek bladderpod.

13.3.3. Effects of Herbicide Use on Spring Creek Bladderpod

Herbicide use that adversely affects Spring Creek bladderpod is not probable, but adverse effects from herbicide application is possible. The low probability of herbicides adversely affecting Spring Creek bladderpod is related to two factors: (1) seasonality of herbicide application in relation to the species life cycle and (2) habitat preferences of the plant. Spring Creek bladderpod is a winter annual, which means that seeds germinate in the fall, overwinter as a rosette, flower in the spring, and die by June of the following year. TVA cannot spray herbicide until tree species growing in the ROW have leafed out sufficiently, because without enough leaf area on a tree, foliar herbicides will not be taken up by the tree. Therefore, herbicide treatments often do not start until mid-May in many parts of the TVA system. Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW if applications were made early in the season. However, it is unlikely that this tool would be used in areas where Spring Creek bladderpod might occur, because the region is characterized by a patchwork of land uses, making broadcast spray a less desirable option.

13.3.4. Effects of Debris Management on Spring Creek Bladderpod

All debris management techniques used by TVA have a small potential to adversely affect Spring Creek bladderpod. The debris removal phase most likely to affect the species is physical disturbance associated with manual or mechanized handling of material. This disturbance could result from dragging of debris over plants or the marginal soil disturbance that would be expected from use of machinery. The soil disturbance would be minimal because of the rocky habitats preferred by Spring Creek bladderpod, which are well drained and resistant to deep rutting. Neither form of disturbance would be likely to result in the death of individual plants. Pile burning could conceivably result in the loss of individual plants, but the infrequent use of the tool combined with the extreme rarity of the species make the likelihood of this occurring very small. TVA’s facilitation of landowner use of wood has similar potential for small impacts as other debris management methods.

If mulching machines were used in occupied Spring Creek bladderpod habitat it would likely generate enough mulch to bury, or partially bury, individual plants. This immediate effect would adversely affect the species, but Spring Creek bladderpod seed can remain viable for many years and the long-term increase in open habitat could benefit a population.

13.4. Conclusion for Spring Creek Bladderpod

In this section, we interpret the findings of the previous sections for the Spring Creek bladderpod (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to Spring Creek bladderpod and result in very few individual plants within the Action Area being adversely affected. Cumulative effects to Spring Creek bladderpod that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the Spring Creek bladderpod. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only two of the known 22 rangewide extant populations occur in the Action Area on TVA ROW, and these two populations total no more than 23 plants based on the most recent survey data, so only a very small percentage of plants in the species' range would be affected by the Action on the ROW. (4) Several hundred plants have been observed outside of the TVA ROW that could be adversely affected by the Action, but this risk is diminished due to the distance from ROW vegetation management activities, and no more than a few plants could be adversely affected.

14. MOHR'S BARBARA'S BUTTONS

14.1. Status of Mohr's Barbara's Buttons

This section summarizes best available data about the biology and current condition of Mohr's Barbara's buttons (*Marshallia mohrii*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list Mohr's Barbara's buttons as threatened on September 7, 1988 (53 FR 34698-34701).

14.1.1. Description of Mohr's Barbara's Buttons

Mohr's Barbara's buttons is a herbaceous perennial in the Aster family (Asteraceae) that occurs in the Cumberland Plateau and Ridge and Valley physiographic provinces from north central Alabama to northwestern Georgia. It is native to seasonally-wet, sandy-clay soils in prairie-like meadows, along margins of shale-bedded streams, on public utility/highway ROW, and in habitats with widely spaced trees (barrens or glades). Leaves form a basal rosette, with leaves decreasing in size and number upward on the stem. The leaves are elliptic to spathulate in outline, entire, slightly pubescent, and have three prominent veins (Chafin 2008; Alabama Herbarium Consortium 2019).

14.1.2. Life History of Mohr's Barbara's Buttons

Mohr's Barbara's button flowers mid-May to June (Patrick *et al.* 1995). Flowers are pollinated by beetles, butterflies, and other small insects and must be cross-pollinated to set viable fruit. To avoid self-pollination, flowers on a given plant produce pollen before that plant's stigmas become receptive (Chafin 2008). Flowers are produced in heads, with 1-10 in number held at the tip of the branches on long peduncles. Each head is composed of numerous five-lobed disc flowers. Buds and newly opened flowers are pink, while older flowers are white. The fruit is about 1/8-in long, seed-like, oblong, ribbed, and hidden among bracts of the flower head (Chafin 2008; Alabama Herbarium Consortium 2019). Seeds likely are dispersed by birds and other small animals (Chafin 2008).

14.1.3. Numbers, Reproduction, and Distribution of Mohr's Barbara's Buttons

Mohr's Barbara's buttons first was collected by Charles Mohr in Cullman County, Alabama, in 1882. It historically was known from 28 populations (22 in Alabama, 5 in Georgia, and 1 shared by both states); 19 of these populations are extant (Bibb, Calhoun, Cherokee, Jefferson, and Walker Counties, Alabama, and Floyd County, Georgia); 8 have not been found in recent years and are considered historical; and 1 is confirmed extirpated (USFWS 2016b). Current rangewide Mohr's Barbara's buttons population size may approach 10,000 plants (Schotz 2014; Alabama Army National Guard 2015; M. Hodges pers. comm. 2015; TVA 2015b). Individual sites may range from fewer than 20 plants to well over 1,000 (Schotz 2014; Alabama Army National Guard 2015; TVA 2015b); although, most (27 [79%]) of the 34 extant sites surveyed by Schotz support 200 or fewer plants. At this time, only eight of the extant populations and portions of populations receive some protection from habitat loss or lack of habitat management.

14.1.4. Conservation Needs of and Threats to Mohr's Barbara's Buttons

Primary anthropomorphic threats affecting the species include (as summarized in USFWS 2016):

- Timber harvest and conversion to pine plantation or agriculture;
- Damage associated with recreational uses, such as ATV use;
- Development and associated habitat destruction;
- Fire suppression that promotes vegetation succession and encroachment of invasive species (particularly Chinese privet), which can out-compete Mohr's Barbara's buttons for resources (*e.g.*, moisture, nutrients, light, and recruitment sites); and
- Herbicide use and incompatible mowing regimes on highway and utility ROW.

Most extant populations are small and vulnerable to anthropogenic impacts and stochastic events. Small population size increases the risks posed by inbreeding and genetic drift, which may limit the species' adaptive capacity and ability to cope with future stressors (Ellstrand and

Elam 1993). Climate change also has potential to affect distribution and abundance of plants by influencing seasonal weather patterns, frequency and timing of severe weather events, and myriad plant physiological responses. Davenport (2007) suggested that Mohr's Barbara's buttons may be adversely affected by climate change if available habitat is reduced under drier conditions. Climate change may disrupt plant-pollinator interactions, shifting the timing of flowering and/or pollinator activity (Memmott *et al*. 2007) and reducing the Barbara's buttons' sexual reproduction.

14.2. Environmental Baseline for Mohr's Barbara's Buttons

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Mohr's Barbara's buttons, its habitat, and ecosystem within the Action Area.

14.2.1. Action Area Numbers, Reproduction, and Distribution of Mohr's Barbara's Buttons

TVA scientists located Mohr's Barbara's buttons in 2014 at three sites on a TVA ROW in Jefferson County, Alabama. There is currently no off-ROW habitat for the species near these populations and, given the age of the surrounding forest, there has not been for many years. This suggests that ROW vegetation management is, overall, beneficial to the species. Absent the disturbance necessary to keep ROW free of woody species, Mohr's Barbara's buttons likely would not exist at these locations.

In 2014, Population 1 contained a large population that was reported to contain "many hundreds to 1000+ plants" (TVA 2018). The clonal nature of the species makes precise counts of plants difficult without intensive, consistent monitoring, but the cited numbers suggest the species was common over an approximate 2.5-ac area within the ROW where it occurred. The site was comprised of largely native and herbaceous species. Population 2 consists of "many hundreds of plants, many beginning to flower". Plants in this area were continuous in areas and formed extensive colonies over approximately 1.3 ac. Population 3 extended over about 0.5-mi of ROW (approximately 7.5 ac) and contained hundreds of plants. The number of woody stems in the ROW containing Mohr's Barbara's buttons was low.

There is a reasonable likelihood that undocumented occurrences of Mohr's Barbara's buttons occur elsewhere on TVA ROW. The most likely place the species would be found is on other portions of the Jefferson County ROW that is known to support the species. About 50 percent of the potential habitat for this species on TVA ROW in Jefferson County has been surveyed. All of the un-surveyed areas that could support the species have at least a Class 1 Plants polygon in the O-SAR database.

14.2.2. Action Area Conservation Needs of and Threats to Mohr's Barbara's Buttons

The TL has been in service since 1939, and previous ROW management included mowing, low-volume foliar herbicide application, and possibly broadcast aerial herbicide. As indicated under

Section 14.2.1, there currently is no off-ROW habitat for the species near these populations; this suggests that TVA ROW vegetation management is, overall, beneficial to the species, since it maintains the ROW free of woody species.

14.3. Effects of Vegetation Management on Mohr's Barbara's Buttons

This section analyzes the direct and indirect effects of the Action on Mohr's Barbara's buttons. An effects analysis summary of the effects of various methods of vegetation management on Mohr's Barbara's buttons and the other 17 listed LAA plant species from the BA has been included in Appendix II.

14.3.1. Effects of Manual Vegetation Clearing on Mohr's Barbara's Buttons

Manual vegetation clearing could adversely affect individual Mohr's Barbara's buttons plants, though the magnitude of the negative effect would likely be small. Clearing of trees would increase light levels on-site and potentially result in a benefit to Mohr's Barbara's buttons. However, there would also be a potential for direct physical disturbance. The disturbance could result from trampling or cutting. It is unlikely manual clearing implemented by TVA for ROW vegetation management would remove the species from a site.

14.3.2. Effects of Mechanical Clearing on Mohr's Barbara's Buttons

Mohr's Barbara's buttons could be adversely affected if mowing operations are conducted during the flowering period or before fertilized plants could disperse seed. The magnitude of the negative effect would likely be small, since mowing creates and maintains the open habitats required by the plant. Such negative effects could include disturbance due to trampling, cutting, or minor soil disturbance resulting from machinery. Repeated mowing, particularly in wetter situations, also can shatter the stumps of individual trees and shrubs located within the ROW, promoting sprouting and the proliferation of woody species. Promotion of this woody canopy within the ROW may be detrimental to Mohr's Barbara's buttons over time.

14.3.3 Effects of Herbicide Use on Mohr's Barbara's Buttons

Vegetation control methods that utilize herbicides are likely to adversely affect Mohr's Barbara's buttons if used in occupied habitat, though the magnitude of effect would not likely be large enough to remove the species from a site. Spot treatment of herbicide is highly targeted and unlikely to adversely affect Mohr's Barbara's buttons at the population level, but could result in isolated, direct adverse effects on individual plants. Cut stump and hack and squirt applications could be used when cutting trees to prevent resprouting. These methods could also be used as an AMM to control smaller trees in occupied habitat. Even though localized herbicide application targets woody species within the ROW floor, the use of that tool could have some adverse effects, including death, on individuals near a tree treated with localized herbicide application.

Broadcast herbicide, either from the air or ground, would affect plants growing on and near the ROW edge if it were used in occupied habitat. This would most likely degrade the overall quality of the habitat, as well as populations of Mohr's Barbara's buttons over time. Areas of potential habitat along un-surveyed portions of the TL known to contain the species have all been designated as Class 1 Plant areas in the O-SAR database. This prevents the use of broadcast spray at these locations.

14.3.4. Effects of Debris Management on Mohr's Barbara's Buttons

Debris management techniques used by TVA have a small potential to adversely affect Mohr's Barbara's buttons. Any physical disturbance associated with manual or mechanized handling of debris occurring on the open ROW edge could directly affect plants. These effects would include physical damage resulting from cutting or dragging of trees and would not likely result in death of individuals. If mulching/chipping did occur, the species could be directly affected by crushing from machinery and burial by mulch/chips. Pile burning could conceivably result in the loss of individual plants, but the infrequent use of the tool combined with the extreme rarity of the species make the likelihood of this occurring small. TVA's facilitation of landowner use of wood has similar potential for small impacts as other debris management methods.

14.4. Conclusion for Mohr's Barbara's Buttons

In this section, we interpret the findings of the previous sections for the Mohr's Barbara's buttons (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects on Mohr's Barbara's buttons and result in no more than a few individual plants within the Action Area being adversely affected. The TL has been in service since 1939 at the three sites in Jefferson County, Alabama, where the species is known to occur. Suitable habitat for the species includes open, disturbed sites, lacking woody vegetation. Off-ROW areas adjacent to these three populations are forested and unsuitable for the species. Therefore, the species is not found off-ROW. Mohr's Barbara's buttons would not exist in the ROW absent the disturbance necessary to keep the ROW free of woody species. TVA's vegetation management activities appear to have increased light levels and benefitted Mohr's Barbara's buttons, allowing it to persist on the ROW. Cumulative effects to Mohr's Barbara's buttons that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of Mohr's Barbara's buttons. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Relative to the rangewide population (19 individual populations believed to approach 10,000 plants), the three known ROW populations are comprised of several hundred plants each, so only a fraction of plants in the species' range would be affected by the Action.

15. CUMBERLAND SANDWORT

15.1. Status of Cumberland Sandwort

This section summarizes best available data about the biology and current condition of Cumberland sandwort (*Minuartia* [=*Arenaria*] *cumberlandensis*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list Cumberland sandwort as endangered on June 23, 1988 (53 FR 23745-23748).

15.1.1. Description of Cumberland Sandwort

Cumberland sandwort, a perennial, herbaceous member of the Pink family (Caryophyllaceae), is 4 to 6 inches (10 to 15 cm) tall, and has small white-petaled flowers and relatively long narrow leaves (USFWS 1996c). The species resembles the mountain sandwort (*Minuartia* [=*Arenaria*] *groenlandica*) and glabrous mountain sandwort (*Minuartia* [=*Arenaria*] *glabra*), but Kral (1983) states that it can be distinguished by "its longer, broader, thinner, veinier leaves, leafier upper stems, which produce fewer flowers as a rule, and by its distinctive seed sculpture."

15.1.2. Life History of Cumberland Sandwort

Cumberland sandwort generally occurs in several noncontiguous patches in one or more sandstone rock houses or cliff faces which are located in a linear or vertical pattern with no barriers present (USFWS 2013). The species flowers May through August and develops fruit September through November. The plants are probably self-incompatible, and dispersal is highly localized, as seedlings are typically distributed adjacent to previously reproductive adults (Winder 2004). Seed viability appears to be high in natural populations (Winder 2004). The plant has a narrow ecological niche requiring cool temperatures, perpetually moist sand, and deep shade. Associated species include: roundleaf catchfly (*Silene rotundifolia*), mountain meadow-rue (*Thalictrum clavatum*), littleflower alumroot (*Heuchera parviflora*), and Lucy Braun's snakeroot (*Ageratina luciae-brauniae*) (USFWS 1996c).

15.1.3. Numbers, Reproduction, and Distribution of Cumberland Sandwort

The species is currently known from the Cumberland Plateau of south-central Kentucky (McCreary County) and north-central Tennessee (Fentress, Pickett and Scott counties). Historically, the plant also occurred in Morgan County, Tennessee, but is now believed to be extirpated (USFWS 2013).

In order to evaluate the species' status in relation to recovery criteria, TDEC (2011b) developed specifications for delineating EOs of Cumberland sandwort. An EO is a fundamental unit of information in the NatureServe Natural Heritage methodology, and is defined as "an area of land and/or water in which a species or natural community is, or was present" (USFWS 2013).

There are 64 extant EOs of Cumberland sandwort, 34 of which TDEC and KYNPC consider viable, indicating that they likely are self-sustaining. Three of the viable EOs are located on privately owned lands in Fentress County, Tennessee. The remaining 31 are located on conservation lands, owned and managed by the NPS, TDNA, Tennessee State Parks, and Tennessee Division of Forestry. The county distribution of these occurrence sites is as follows: Fentress County, Tennessee (eight), McCreary County, Kentucky (one), Pickett County, Tennessee (21), and Scott County, Tennessee (one). Thus, there are only ten protected and presumably, self-sustaining occurrences located outside of Pickett County (USFWS 2013).

Monitoring data collected by TDEC provide a basis for assessing the persistence of EOs over time and documenting coarse changes in the area they occupy, but they do not provide insight into demographic processes, such as reproductive output, germination and recruitment, and mortality rates that influence population growth rates (USFWS 2013). The only data currently available concerning seed production and germination in the species are anecdotal observations by Winder (2004), who noted that populations he sampled for an investigation of genetic diversity in Cumberland sandwort produced copious viable seed during the years he observed them and that young seedlings were present frequently in most populations. Additional monitoring measures to understand demographic processes could become necessary at monitoring sites where declining trends become apparent from sustained decreases in estimates of area occupied by Cumberland sandwort. Conducting monitoring late in the growing season for Cumberland sandwort, rather than during the winter as it often occurs, would allow for an assessment of whether seed production and seedling germination are occurring at monitoring sites (USFWS 2013).

Winder (2004) found reduced levels of heterozygosity in individual populations of Cumberland sandwort, with some containing little or no heterozygosity despite having considerable haplotype diversity, and noted that this pattern is consistent with the effects of inbreeding. Winder (2004) suggested investigation factors that could influence breeding patterns in Cumberland sandwort, specifically suggesting two factors: (1) determining whether movement of pollen and seeds is highly restricted, potentially even within a single rock house population, and (2) conducting breeding system studies to determine whether there could be high rates of self-fertilization in populations of Cumberland sandwort.

15.1.4. Conservation Needs of and Threats to Cumberland Sandwort

Cumberland sandwort plants growing on rock house floors are vulnerable to trampling by hikers, campers, and picnickers on public lands where the species occurs. Trampling by persons who are rappelling poses a threat to plants growing on ledges or solution pockets on sandstone rock faces (USFWS 2013). Relic digging is one of the most destructive threats facing these habitats (Bailey and Shea 2000), despite the fact that the activity is illegal on public lands. In some rock houses, fire pits are present from historic or recent recreational use. In addition to these threats resulting from recreational activities, feral hogs have caused intensive soil disturbance at a few Cumberland sandwort sites (USFWS 2013).

Measures to prevent or reduce threats related to recreational activities have been installed in eight rock houses, located along trails at Big South Fork National Scenic River and Recreation Area (BISO), Pickett State Forest (PSF) and Pickett State Park (PSP). While these threats remain at many sites, they do not currently place Cumberland sandwort at imminent risk of extinction; therefore, the FWS consider them to continue to be moderate (USFWS 2013). Coordination with land managers at BISO, PSF, and PSP is encouraged to maintain existing and install additional protective measures to reduce or eliminate threats from recreational activities.

15.2. Environmental Baseline for Cumberland Sandwort

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Cumberland sandwort, its habitat, and ecosystem within the Action Area.

15.2.1. Action Area Numbers, Reproduction, and Distribution of Cumberland Sandwort

In the Action Area, the Cumberland sandwort has been recorded from a single location on a TVA ROW. This site is located on PSF at a location where an existing TL intersects a large rock house. Cumberland sandwort were first discovered at this site in 1979, but the population was not estimated until a March 2000 survey noted that, "100's of plants" were observed in the rock house (TVA 2018). A subsequent visit in 2007 noted, "1000 plants concentrated in 4 areas" at the site. However, during a 2012 site visit, one of the four areas, which had supported the largest number of Cumberland sandwort, no longer appeared to support the plants.

The TVA TL that intersects the rock house was first placed into service in 1951. While there is uncertainty about population trends at this site, the dispersal mechanism and the narrow habitat preferences of Cumberland sandwort suggest that the species has persisted with TVA ROW vegetation management for nearly 70 years. It is unlikely that other rock houses containing this species intersect TVA ROW because of the very restricted range of the species. Only one other TVA TL is located in the vicinity of a documented occurrence of Cumberland sandwort and that occurrence is within 4 mi of the TL.

15.2.2. Action Area Conservation Needs of and Threats to Cumberland Sandwort

Consistent with the threats described in Section 15.1.4., relic hunting has been noted in the Action Area at the single location known to support Cumberland sandwort; relic hunting can result in disturbance to plants via trampling and/or digging in the rock house. Reducing these threats is best addressed by coordination with PSF land managers to maintain existing and install additional protective measures to reduce or eliminate threats from relic hunting.

15.3. Effects of Vegetation Management on Cumberland Sandwort

This section analyzes the direct and indirect effects of the Action on Cumberland sandwort. An effects analysis summary of the effects of various methods of vegetation management on Cumberland sandwort and the other 17 listed LAA plant species from the BA has been included in Appendix II.

15.3.1. Effects of Manual Vegetation Clearing on Cumberland Sandwort

TVA has identified approximately 2,500 areas of transmission ROW, using their O-SAR database with habitat to support, or potentially could support, federally or state-listed plant species. The rock house habitat most frequently associated with the Cumberland sandwort does not support tree growth, but trees are found just outside of this habitat. Manual tree clearing would be unlikely to directly affect Cumberland sandwort, but tree removal adjacent to a rock house containing the species could result in increased light levels that may change soil moisture levels or result in increased competition. These affects could put Cumberland sandwort at a disadvantage compared to other plant species.

One occurrence, totaling several hundred Cumberland sandwort plants (< 1,000) over three areas, was last observed in a rock house; therefore, manual tree clearing could cause the permanent loss of some Cumberland sandwort due to increased light levels.

15.3.2. Effects of Mechanical Clearing on Cumberland Sandwort

Mechanical clearing could adversely affect Cumberland sandwort if used in habitats where the species occurs, but the likelihood of using this type of equipment where the species occurs is small. This is because rock hoses supporting the species are typically located in steep rocky areas that are inaccessible to this type of machinery. Similarly, mowing, which is restricted to regularly maintained areas within the ROW floor, is not likely to adversely affect the species. Side-wall trimming, if it were to occur adjacent to occupied habitat would have similar potential affects to manual tree clearing.

In summary, side-wall trimming could result in the permanent loss of some Cumberland sandwort due to increased light levels, but other types of mechanical clearing would not likely adversely affect the species.

15.3.3. Effects of Herbicide Use on Cumberland Sandwort

Vegetation control methods that utilize herbicides are likely to adversely affect Cumberland sandwort if used in occupied habitat, though the probability of herbicide intersecting the species is small. Spot treatment with herbicides is highly targeted and unlikely to adversely affect Cumberland sandwort at the population level, but could result in isolated, direct adverse effects on individual plants. These methods could be used as an AMM to control smaller trees adjacent to occupied habitat. Trees do not grow in rock houses where Cumberland sandwort occurs. Therefore, localized herbicide application, which targets woody species, would be unlikely to adversely affect Cumberland sandwort.

Broadcast herbicide, either from the air or ground, could affect plants growing in a rock house within a TVA ROW, but is not likely. All areas of potential habitat adjacent to the single TVA TL, located near documented locations for Cumberland sandwort have either been field surveyed or are designated as Class 1 or 2 Plants in O-SAR. This O-SAR restriction prohibits the use of broadcast herbicide either from the air or ground.

In summary, while the probability of effects would be low due to no additional occurrences of Cumberland sandwort being known in the Action Area and an O-SAR restriction prohibiting broadcast herbicide in areas designated as Class 1 or 2 Plants, Cumberland sandwort could be adversely affected by all types of herbicide application, but it would unlikely based on the rationale provided above.

15.3.4. Effects of Debris Management on Cumberland Sandwort

Debris management techniques used by TVA have a small potential to adversely affect Cumberland sandwort. Any physical disturbance associated with manual or mechanized handling of debris could directly affect plants, but the likelihood of any disturbance resulting from debris management negatively affecting Cumberland sandwort is negligible. The rock houses most likely to support the species do not support tree growth. Any handling of downed trees adjacent to a rock house would be at a sufficient distance from Cumberland sandwort to have no measurable effect on the plants. The terrain would also prevent chipping and mulching from occurring because equipment could not maneuver on the site. Burning would occur in the open ROW and would not affect Cumberland sandwort. TVA's facilitation of landowner use of wood would have similar small potential for impacts as the above debris management methods.

In summary, debris management techniques, including manual, mechanical, burning and landowner use, would not likely adversely affect the Cumberland sandwort.

15.4. Conclusion for Cumberland Sandwort

In this section, we interpret the findings of the previous sections for the Cumberland sandwort (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would at most have localized adverse effects to Cumberland sandwort and result in only a few individual plants within the Action Area being adversely affected. Cumulative effects to Cumberland sandwort that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the Cumberland sandwort. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only a fraction of the known rangewide populations (four populations out of 64 extant populations) have existed on TVA ROW within the Action Area, and no plants have been observed at the site of the largest of the four populations since 2012; therefore, very few plants would be affected by the Action. (4) Due to the location and rugged nature of the habitat, plants would largely be protected and away from TVA's vegetation management activities, minimizing their exposure to the Action.

16. SHORT'S BLADDERPOD

16.1. Status of Short's Bladderpod

This section summarizes best available data about the biology and current condition of Short's bladderpod (*Physaria globosa*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list Short's bladderpod as endangered on August 1, 2014 (79 FR 44712-44718).

16.1.1. Description of Short's Bladderpod

Short's bladderpod is an upright biennial or perennial plant in the mustard family (*Brassicaceae*) (79 FR 44712-44718). It grows up to 20 in tall. Clusters of small, yellow flowers top single and sometimes, multiple stems from April to early June. The scientific name of the plant is derived from the globe-shaped fruits it produces (USFWS 2018c).

16.1.2. Life History of Short's Bladderpod

Short's bladderpod typically grows on steep, rocky, wooded slopes and talus slopes and along tops, bases, and ledges of bluffs, often near rivers or streams and on south- to west-facing slopes. Most populations are closely associated with calcareous outcrops (Shea 1993).

Short's bladderpod lives for two years or longer. Preliminary results from research at the Missouri Botanical Garden indicate that seed viability is high in one of the Tennessee populations they studied and that seeds germinated at higher rates under greenhouse conditions approximating mean diurnal temperatures that occur during late spring/early autumn and summer, versus those approximating conditions that occur during early spring/late autumn (79 FR 44712-44718).

16.1.3. Numbers, Reproduction, and Distribution of Short's Bladderpod

Short's bladderpod is known to occur in Posey County, Indiana; Clark, Franklin, and Woodford counties, Kentucky; and Cheatham, Davidson, Dickson, Jackson, Montgomery, Smith, and Trousdale counties, Tennessee (79 FR 44712-44718). Populations of Short's bladderpod vary in size from two to about 1,500 individuals, with most populations containing fewer than 50 plants. In a 1992 status survey for Short's bladderpod, Shea (1993) observed the species at only 26 of 50 historical sites: one in Indiana, 14 in Kentucky, and 11 in Tennessee. The remaining 24 records were of sites from which the species had been extirpated or lacked sufficient location information to be relocated during the survey. Later surveys in Tennessee found Short's bladderpod extant at two of these sites, Tennessee EO numbers 8 and 12, which correspond to Shea's population numbers 34 and 29, respectively (Table 16.1) (78 FR 47109-47134).

Based on data provided by conservation agencies (Indiana Natural Heritage Data Center [INHDC]) 2012, Kentucky Natural Heritage Program [KNHP] 2012, Tennessee (Tennessee Natural Heritage Inventory Database [TNHID] 2012) in the states where the species occurs, the USFWS determined the current distribution and status of Short's bladderpod (78 FR 47109-47134). Difficulty in relating the species' distribution at the time of Shea's (1993) status survey to its current distribution was a result of state conservation agencies revising the mapping of some EOs in these databases. In two instances, pairs of occurrences that Shea (1993) considered distinct were combined into single EOs (Table 16.1). Conversely, TNHID (2012) treats as two distinct EOs the two locations that Shea (1993) mapped together as population number 23. One of these occurrences (TN EO number 22) was extant as of 2012 (Table 16.1), while the other (TN EO number 2) is extirpated (Table 16.2). Based on current mapping, state conservation agencies now recognize 24 EOs that correspond to populations that Shea (1993) found extant in 1992. Of these 24 occurrences, 18 were extant in 2012. Accounting for rediscovery of the two Tennessee occurrences that Shea (1993) did not find during 1992, and recent changes in EO mapping, a total of 20 occurrences that were documented by Shea (1993) were still considered extant as of 2012 (Table 16.1). The approximate range of abundance shown in Table 16.1 is primarily based on individual plants. As a result of location, it was impossible to enumerate individual plants. This resulted in are two instances where TNHID surveyed these populations from a boat and reported the approximate range in clusters (78 FR 47109-47134).

There are now eight known extant occurrences in Kentucky, 17 in Tennessee, and one in Posey County, Indiana (Table 16.1). Extant occurrences in Kentucky are distributed among Clark (1), Franklin (6), and Woodford (1) counties, and in Tennessee among Cheatham (5), Davidson (2), Dickson (1), Jackson (2), Montgomery (3), Smith (1), and Trousdale (2) counties. One Tennessee occurrence straddles the county line between Cheatham and Davidson counties. There are 19 occurrences in Kentucky and ten in Tennessee that have either been extirpated or for which inadequate information exists to relocate them. Adding the seven populations that Shea (1993) treated as either historical or lacking complete locality information, and which are not represented in state-maintained databases used to create Tables 16.1 and 16.2, these numbers rise to 20 for Kentucky and 16 for Tennessee. Thus, there is a total of 62 occurrences that have been reported for Short's bladderpod. However, when reporting percentages of all known occurrences that are now or historically were in the case of extirpated occurrences, affected by various threats, we only use the 55 records that have been verified and are currently tracked in state-maintained databases (78 FR 47109-47134).

Table 16.1. List of known extant Short's bladderpod occurrences by state and county, with E.O. numbers assigned by state natural heritage programs (INHDC (2012), KNHP (2012), TNHID (2012)), numbers assigned to populations reported in Shea (1993), and first and last years of known observations.

State	County	EO Number (Shea Population Number)	First Observed	Last Observed	Approximate Range of Abundance	Land Ownership
Indiana	Posey	1 (1)	1941	2012	3–1000s	IDNR
Kentucky	Clark	1 (3	1957	2009	2	Private
	Franklin	4 (11, 12)	1979	2011	100–500	Private
		7 (10)	1981	2004	1-100	Private
		11 (13)	1983	2003	1–52	Private
		18 (4)	1992	2012	20-350	City of Frankfort
		22 (9)	1990	2012	2-200	Private; KSNPC
		23 (14)	1990	2011	60-500	Private
	Woodford	28	2005	2010	few	Private
Tennessee	Cheatham	1 (18)	1956	2008	100s–1000s	COE; Private
		15 (17)	1955	2008	few–20	COE
		17 (16)	1953	2012	20– ~1500	Town of Ashland City; Private
		29	1998	2008	~50	COE; Private
		30	1998	2008	10–25	COE; Private
	Davidson; Cheatham	10 (21,22)	1935	2012	10s–1000s	Private
	Davidson	4 (19)	1971	2012	100s–1000s	Private; COE easement
		8 (34)	1886	2008	~50	Private; COE easement
	Dickson	32	2008	2008	~7 clusters	COE
	Jackson	26	1998	2008	3 clusters	COE
		27	1998	2008	~50	COE
	Montgomery	12 (29)	1946	2008	~50	Private; COE easement
		22 (23a)	1969	2008	20–50	Private; COE easement
		28	1998	2008	~300	Private; COE easement
	Smith	24	1998	2008	~10	COE
	Trousdale	3 (25)	1969	2008	40–500	COE; Private
		21 (26)	1992	2008	100–250	COE; Private

Table 16.2. List of extirpated Short's bladderpod occurrences by state and county, with EO numbers assigned by state natural heritage programs (INHDC (2012), KNHP (2012), TNHID (2012)), numbers assigned to populations reported in Shea (1993), and first and last years of known observations.

State	County	EO Number (Shea Population Number)	First Observed	Last Observed	Abundance	Land Ownership
Kentucky	Bourbon	* 19 (2)	1963	2005	10–120	Private
	Fayette	12 (38)	1931	1931	n/a	Private
		16 (37)	1892	1900	n/a	Private
	Franklin	* 2 (6)	1979	1992	11	Private
		* 3 (8)	1979	1994	4	Private
		5 (39)	1880	1880	n/a	Private
		8 (27)	1981	1981	-40	Private
		14 (40)	1856	1856	n/a	Private
		* 20 (5)	1992	1992	21	Private
		* 21 (7)	1992	1992	7	Private
	Jessamine	6 (42)	1942	1942	n/a	Private
		13 (32)	1939	1939	n/a	Private
		17 (28)	1991	2019	n/a	Private
		+ 27	1990	1993	1-7	Private
	Madison	10 (43)	1903	1903	n/a	Private
	Mercer	24 (44)	1916	1916	1-7	Private
	Nelson	25	1935	2019	n/a	Private
	Powell	15 (45)	1923	1923	n/a	Private
	Scott	* 9 (15)	1930	1992	2	Private
Tennessee	Cheatham	14 (33)	1969	1969	n/a	Private
	Davidson	* 9 (20)	1974	1998	20-29	Private; COE easement
		+ 23	1997	1997	-200	Private
	Jackson	+ 25	1998	1998	5	COE
	Maury	7 (31)	1955	1955	n/a	Private
	Montgomery	2 (23b	1968	1992	1	Private
		13 (30)	1975	1975	n/a	Private
		18 (35)	1967	1967	n/a	Private
		31	1979	1979	n/a	Private
	Smith	20 (24)	1992	1998	30	Private; COE easement

* Occurrences observed by Shea (1993), but which are now considered extirpated.
+Occurrences not documented in Shea (1993) that have been observed since 1992, but which are now considered extirpated.

Despite the rediscovery of the two Tennessee occurrences and the discovery of ten additional occurrences since the 1992 status survey, only 26 extant occurrences of Short's bladderpod are known to remain due to the loss of ten occurrences during the last 20 years (Table 16.2). Seven of the occurrences that Shea (1993) observed in 1992, and three others (Kentucky EO number 27 and Tennessee EO numbers 23 and 25) that were seen after 1992, have since been extirpated (Table 16.2). This constitutes a loss of 27 percent of all occurrences that were extant during 1992 or later (78 FR 47109-47134).

There are 19 extant Short's bladderpod occurrences that are located on city, state, or federal lands. The Indiana occurrence is on lands owned by the State of Indiana and managed by the Indiana Department of Natural Resources (IDNR). A portion of one occurrence in Kentucky is located in a state NP, owned and managed by the KSNPC, and another occurs in a park owned by the City of Frankfort, where access is limited, but no specific management is provided for the species or its habitat. In Tennessee, there are 15 occurrences that are entirely or partially located on lands owned or leased by the COE adjacent to the Cumberland River. Some of these COE lands are WMAs, cooperatively managed by TWRA. The plants at EO numbers 29 and 32 are located in TWRA's Cheatham WMA, and those at EO numbers 24 through 27 are located in TWRA's Cordell Hull WMA. Part of one occurrence in Tennessee is located on lands owned by Ashland City (78 FR 47109-47134).

Dr. Carol Baskin (Professor, University of Kentucky) observed low fruit set in the Indiana population and, based on lack of seed production from plants in a greenhouse from which pollinators were excluded, she concluded that the species likely is self-incompatible. Self-incompatibility has been reported in other species of Physaria (Bateman 1955; Claerbout et al. 2007; Edens-Meier et al. 2011; Tepedino et al. 2012), and the molecular mechanisms underlying self-recognition between pollen and stigma and subsequent pollen rejection have been well studied in the Brassicaceae (Takayama and Isogai 2005). Dr. Baskin also observed that seeds produced by Short's bladderpod apparently are capable of forming a seed bank, as seeds that were planted in a greenhouse were observed to germinate and produce seedlings over several years, rather than all germinating in the year they were planted (78 FR 47109-47134).

16.1.4. Conservation Needs of and Threats to Short's Bladderpod

The most significant threats to Short's bladderpod are the loss and degradation of its habitat. The main causes for habitat loss and degradation are potential future construction and ongoing maintenance of transportation ROW; prolonged inundation and soil erosion due to flooding and water level manipulation; and overstory shading due to forest succession and shading and competition from invasive, nonnative plant species (78 FR 47109-47134).

Conservation of Short's bladderpod should include continuation of monitoring known populations for status of threats, site condition, and abundance of plants, and surveying potential habitat for new populations. This species requires open areas, so manual removal of shrubs would help open up habitat, where it is declining due to being shaded. Controlled burning could also be beneficial in this situation. Mechanical disturbance of the area should be limited or avoided because the soils are thin where this species occurs (Pyne *et al.* 1995); soil compaction and damage to the seed bank could occur. Non-native plants should be controlled, so that they do not dominate the vegetation where this species grows (NatureServe Explorer 2018b).

16.2. Environmental Baseline for Short's Bladderpod

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Short's bladderpod, its habitat, and ecosystem within the Action Area.

16.2.1. Action Area Numbers, Reproduction, and Distribution of Short's Bladderpod

The TVA transmission system does not intersect habitat for Short's bladderpod in Kentucky or Indiana, but it does overlap the species range in Tennessee. In the Tennessee portion of the Action Area, Short's bladderpod occurs primarily in association with bluffs along the Cumberland River between RM 134 in Montgomery County in the vicinity of Clarksville upstream to RM 344 in Jackson County in the vicinity of White's Bend. There are 17 TVA TL crossings within this reach of the river. Topographic maps and aerial photos suggest that nine of the ROW crossings have no potential to support Short's bladderpod. These sections of ROW are flat, lacking prominent rock outcrops or bluff features, which typically serve as suitable habitat for the species. The remaining eight ROW crossings intersect potentially suitable habitat as evidenced by the presence of steep south and west facing slopes, broken canopied forest adjacent to the ROW, and the presence of exposed rock at the soil surface.

Field surveys have been performed at three of the Cumberland River locations where Short's bladderpod has been previously observed within a 1,000 ft of a TVA ROW; the species was not found in or adjacent to the TVA ROW at any of these locations. If an undocumented site for Short's bladderpod does occur at a TVA ROW Cumberland River crossing, the species would most likely occur in a spanned section of forest where the conductor is high enough above mature trees that clearing is unnecessary. This often occurs where TL cross large rivers because structures are usually placed on high points to allow conductors to span long crossings.

Some Tennessee populations of Short's bladderpod do not occur along bluffs and are found at more disturbed sites, such as road medians, eroding river banks, and riprap slopes. Therefore, it is difficult to predict where the species might occur in disturbed habitat in the Action Area.

16.2.2. Action Area Conservation Needs of and Threats to Short's Bladderpod

In the Action Area, the most likely threats to Short's bladderpod are habitat loss and degradation from overstory shading due to forest succession and shading and competition from invasive, nonnative plant species. These threats can be reduced by monitoring site conditions of known populations and manually removing shrubs, burning, and controlling invasive, non-native plants to open up habitat that is being shaded.

16.3. Effects of Vegetation Management on Short's Bladderpod

This section analyzes the direct and indirect effects of the Action on Short's bladderpod. An effects analysis summary of the effects of various methods of vegetation management on Short's bladderpod and the other 17 listed LAA plant species from the BA has been included in Appendix II.

16.3.1. Effects of Manual Vegetation Clearing on Short's Bladderpod

Direct physical disturbance associated with manual tree removal could adversely affect Short's bladderpod, but the increased sunlight associated with canopy removal has the potential to benefit plants suppressed by a dense forest canopy.

16.3.2. Effects of Mechanical Clearing on Short's Bladderpod

If mechanical vegetation control methods utilized by the TVA ROW program intersect habitat occupied by Short's bladderpod, there is the potential the species could be adversely affected. The species most often occurs in open, rocky calcareous forests, but it also tolerates higher light conditions and could theoretically occur, both, on the ROW floor and in adjacent forests. Mowing could adversely affect Short's bladderpod if implemented in occupied habitat in the ROW, but the species usually inhabits areas that are far too steep to allow the use of mowers. The likelihood of Short's bladderpod being adversely affected by TVA ROW mowing is very small. Similarly, mechanical clearing and side-wall trimming require equipment access, which would most likely be precluded by the steep slopes and rock outcrops. Therefore, though these tools could adversely affect Short's bladderpod if used in occupied habitat, the chances of these tools intersecting the species is very low because the terrain would likely prevent their application. Aerial side-wall trimming would result in more light reaching the herbaceous layer of vegetation, with no physical ground disturbance. This would most likely have beneficial effects if used in the vicinity of Short's bladderpod, but could result in small adverse effects depending on the situation.

16.3.3. Effects of Herbicide Use on Short's Bladderpod

Vegetation control methods that utilize herbicides are likely to adversely affect Short's bladderpod if used in occupied habitat. Spot treatment with herbicide is highly targeted and unlikely to adversely affect Short's bladderpod at the population level, but could result in isolated, direct adverse effects on individual plants. Cut stump and hack and squirt applications could be used when cutting trees to prevent resprouting and as an AMM to control smaller trees in occupied habitat. Localized herbicide application could affect plants in, both, the open ROW floor and along the edge of the ROW, especially if Short's bladderpod plants grow adjacent to woody plants targeted for removal. Broadcast herbicide, either from the air or ground, could affect plants growing on and in the vicinity of the ROW edge if this method were used in occupied habitat. However, all TVA ROW crossings of the Cumberland River that could potentially support Short's bladderpod have Class 1 or 2 Plants in O-SAR. This O-SAR restriction prohibits the use of broadcast herbicide either from the air or ground.

16.3.4. Effects of Debris Management on Short's Bladderpod

Debris management techniques used by TVA have a small potential to adversely affect Short's bladderpod. Any physical disturbance associated with manual or mechanized handling of debris occurring on the open ROW edge could directly affect plants. Effects from manual clearing are more likely because the rocky terrain where the species occurs would preclude the use of machinery. These effects would include physical damage resulting from cutting or dragging trees and would not likely result in death of individuals. The terrain would also likely prevent chipping and mulching from occurring because equipment could not maneuver on the site. If mulching/chipping did occur, the species could be directly affected by crushing from machinery and burial by mulch/chips. Burning is very unlikely to occur in the steep sections of ROW that could potentially support Short's bladderpod, but debris handling by machinery could theoretically affect individual plants on the ROW edge. TVA's facilitation of landowner use of wood has the similar potential for small impacts as manual debris management methods.

16.4. Conclusion for Short's Bladderpod

In this section, we interpret the findings of the previous sections for the Short's bladderpod (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to Short's bladderpod and result in very few individual plants within the Action Area being adversely affected, if any. Cumulative effects to Short's bladderpod that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the Short's bladderpod. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Rangewide, there are 26 known extant populations, and, in the Action Area, there are eight TVA ROW crossings supporting suitable habitat where the species may occur; therefore, only a very small percentage of plants (if present) in the species' range could potentially be affected by the Action. (4) The species would likely occur in a spanned section of forest, where the TVA conductor would be high above mature trees and vegetation clearing unnecessary, reducing the probability of the action adversely affecting plants.

17. WHITE FRINGELESS ORCHID

17.1. Status of White Fringeless Orchid

This section summarizes best available data about the biology and current condition of white fringeless orchid (*Plantanthera integrilabia*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list white fringeless orchid as threatened on September 13, 2016 (81 FR 62826-62833).

17.1.1. Description of White Fringeless Orchid

White fringeless orchid is a perennial herb with a light green, 60 cm long stem that arises from a tuber. The leaves are alternate with entire margins and are narrowly elliptic to lanceolate in shape. The white flowers are borne in a loose cluster at the end of the stem. The plants flower from late July through September, and the small narrow fruiting capsule matures in October (Shea 1992).

17.1.2. Life History of White Fringeless Orchid

White fringeless orchid typically inhabits wetlands that occur on mineral soils and do not accumulate peat. They often are located at stream heads and connected to ephemeral streams via dispersed sheet flow or concentrated surface flow in incipient channels. However, further study is needed to characterize the range of variation in soils, hydrology, physicochemistry, and origin of wetlands throughout the range of white fringeless orchid. Most sites where white fringeless orchid populations exist are on soils formed over sandstone bedrock, which usually are low in fertility and organic matter content and are acidic (Shea 1992). The species often occurs in swamps dominated by red maple (*Acer rubrum*) and blackgum (*Nyssa sylvatica*).

Like most terrestrial orchids, white fringeless orchid depends on a symbiotic relationship with mycorrhizal fungi to enhance seed germination and promote seedling development and establishment (Rasmussen and Whigham 1993). In addition to providing a carbon source for seedling development, mycorrhizal fungi enhance germination by promoting increased water uptake by orchid seeds (Yoder *et al*. 2000). Their small size permits dispersal of orchid seeds to new environments via wind currents; however, very few of the seeds likely encounter suitable habitats where host fungi are present (Yoder *et al*. 2010). This likelihood is further reduced in the case of species such as white fringeless orchid, which may rely on a single fungal host species, *Epulorhiza inquilina,* to complete its life cycle (Currah *et al.* 1997).

Known pollinators for white fringeless orchid include three diurnal species from two families of butterflies (Lepidoptera): silver spotted skipper (Hesperiidae: *Epargyreus clarus*), spicebush swallowtail (Papilionidae: *Papilio troilus*), and eastern tiger swallowtail (Papilionidae: *Papilio glaucus*) (Zettler *et al.* 1996). Based on floral characteristics, it is likely that more effective pollinators for white fringeless orchid exist in the nocturnal sphingid moth family (Zettler *et al.* 1996); however, this has not been confirmed.

17.1.3. Numbers, Reproduction, and Distribution of White Fringeless Orchid

White fringeless orchid has a self-compatible breeding system, allowing individuals to produce seed using their own pollen; however, the proportions of fruits produced through self-pollination versus cross-pollination are not known (Zettler and Fairey 1990). Zettler and McInnis (1992) speculated that higher rates of fruit set were probably more typical, historically, when larger populations provided greater opportunities for cross-pollination to occur.

The white fringeless orchid's distribution is concentrated in the Cumberland Plateau section of the Appalachian Plateaus physiographic province, with isolated populations scattered across the Blue Ridge, Piedmont, and Coastal Plain provinces (Fenneman 1938). The species' current distribution includes 35 counties where extant and uncertain occurrences exist in Kentucky, Alabama, Tennessee, Mississippi, South Carolina, and Georgia. More occurrences are included in the species' current distribution than were historically known to exist, likely as a result of increased survey effort; however, low numbers of flowering plants have been observed at most sites (80 FR 55304 - 55321). For example, fewer than 50 flowering plants have ever been observed at one time at 45 (64 percent) of the 70 extant and uncertain occurrences for which data are available. At 26 (37 percent) of these occurrences, fewer than 10 flowering plants have ever been recorded (81 FR 62826 - 62833).

17.1.4 Conservation Needs of and Threats to White Fringeless Orchid

Habitat modification caused by development, silvicultural practices, invasive plant species, disturbance by feral hogs, shading due to understory and canopy closure, altered hydrology, and ROW maintenance have impacted the range and abundance of white fringeless orchid. While the species is present in a number of sites on conservation lands, few conservation actions have been undertaken to address these threats to the species' habitat, and those that have been implemented, have been met with limited success (80 FR 55304 - 55321).

17.2. Environmental Baseline for White Fringeless Orchid

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the white fringeless orchid, its habitat, and ecosystem within the Action Area.

17.2.1. Action Area Numbers, Reproduction, and Distribution of White Fringeless Orchid

White fringeless orchid has been documented from TVA ROWs at five locations on the Cumberland Plateau near Spencer, Tennessee and at one location on Lookout Mountain near Fort Payne, Alabama. Population information is detailed in the BA and summarized below.

> Population 1: Population 1 was first observed by TVA botanists in 2009 as part of an environmental review for a minor TL infrastructure repair project. At that time, about 20 flowering plants were observed in a small ROW swale. Less than five plants occurred in

the adjacent forest. Counts of flowering stems from Population 1 are 20 (2009), 37 (2011), 369 (2013), 950 (2014), 1537 (2015), 761 (2016), and 991 (2017).

Population 2: Population 2 is located in a narrow strip of suitable habitat that straddles Simmons Creek, where it crosses the TVA ROW. There is no suitable habitat immediately adjacent to the ROW. In this area, the ROW bisects a loblolly pine (*Pinus taeda*) plantation. The site was only visited once by TVA botanists; nine flowering plants were seen in 2013.

Population 3: Population 3 was located by TVA botanists during a 2010 field survey for a new distribution line that was sited adjacent to an existing TVA TL. This small population grows in what could likely be considered marginal habitat. During all surveys of the site, white fringeless orchid was difficult to discern because of dense growth of competing vegetation. Counts of flowering stems from Population 3 are 7 (2010), 25 (2011), 0 (2014), 28 (2015), and 9 (2016).

Population 4: Population 4 covers more than 2.25 ac of ROW and was first observed in 1983. This relatively large occurrence persists as part of a diverse, herbaceous plant community within the ROW. The data available for the site suggests that the population is stable. Counts from Population 4 are about 40-50 plants (1984-1990), 487 (1997), 111 (2000), 7 (2008), 16 (2011), 205 (2014), 687 (2015), 883 (2016), and 920 (2017).

Population 5: Population 5 was discovered in August of 2018. About 50 flowering plants were observed within the TVA ROW, and no plants were seen outside of the ROW.

Population 6: Population 6 was discovered in 2013 and is the first occurrence of the species in DeKalb County, Alabama. This populations occurs near a sandstone complex with several other globally rare species, including sun-facing coneflower (*Rudbeckia heliopsidis*), woodland tickseed (*Coreopsis pulchra*), and longleaf sunflower (*Helianthus longifolius*). Plants were observed in July 2018, but no count was conducted.

It is likely additional undocumented populations of white fringeless orchid occur on TVA ROW, particularly on the Cumberland Plateau of Tennessee. About 11,500 ac of TVA ROW are situated in counties where white fringeless orchid is known to occur. While not all sections of these TVA ROWs are potential habitat for white fringeless orchid, TVA botanists have used the O-SAR process to designate about 8,300 and 500 ac of ROW as Plants Class 1 and Class 2, respectively. TVA botanists have field surveyed about 2,700 ac of ROW in the counties where white fringeless orchid is known to occur, and have found five of the populations listed above.

17.2.2. Action Area Conservation Needs of and Threats to White Fringeless Orchid

Consistent with the threats described in Section 17.1.4., disturbances to the white fringeless orchid have not been fully assessed in the Action Area, but observations during surveys indicate that invasive plant species, shading due to understory and canopy closure and ROW maintenance have resulted in declines to the species. However, TVA ROW maintenance is being tailored to minimize effects to the species at known locations. In addition, removal of invasive species and thinning of the canopy could improve habitat conditions at some locations.

17.3. Effects of Vegetation Management on White Fringeless Orchid

This section analyzes the direct and indirect effects of the Action on white fringeless orchid. An effects analysis summary of the effects of various methods of vegetation management on white fringeless orchid and the other 17 listed LAA plant species from the BA has been included in Appendix II.

17.3.1. Effects of Manual Vegetation Clearing on White Fringeless Orchid

All manual vegetation control methods utilized by TVA have the potential to adversely affect white fringeless orchid if they are carried out in habitat occupied by the species. The most likely effects would be from trampling or crushing individual plants from foot traffic or handling cut vegetation. While direct physical disturbances could result in adverse effects, the removal of overstory and resultant increases in light levels could benefit affected populations.

17.3.2. Effects of Mechanical Clearing on White Fringeless Orchid

All mechanical vegetation control methods utilized by TVA have the potential to adversely affect white fringeless orchid as a result of trampling or crushing from machinery traffic, in addition to foot traffic. Mechanical clearing could also result in increased light levels, benefitting future white fringeless orchid populations. In addition, given the propensity of white fringeless orchid to reproduce asexually from underground shoots, it is unlikely that mechanical vegetation control measures implemented by TVA would remove the species from a site.

17.3.3. Effects of Herbicide Use on White Fringeless Orchid

Vegetation control methods that utilize herbicides are likely to adversely affect white fringeless orchid; however, spot treatment with herbicide is highly targeted and unlikely to adversely affect white fringeless orchid at the population level, but could result in isolated, direct adverse effects on individual plants. Even though localized herbicide application typically targets woody species within the ROW floor, it is likely that white fringeless orchid plants that occur nearby would experience some level of herbicide related damage or death. Broadcast herbicide, from either the air or ground, could affect plants growing on and near the ROW edge if it were used in occupied habitat. However, most sections of TVA ROW, with naturalized vegetation and situated on the Cumberland Plateau, have either been field surveyed or are designated as Class 1 or 2 Plants in O-SAR, which prohibits the use of broadcast herbicide either from the air or ground making exposure unlikely.

17.3.4. Effects of Debris Management on White Fringeless Orchid

All debris management techniques used by TVA have a small potential to adversely affect white fringeless orchid. The debris removal phase most likely to affect the species is physical disturbance associated with manual or mechanized handling of material. This disturbance could result from dragging of debris over plants or the marginal soil disturbance that would be expected from use of machinery, but is not anticipated to result in the death of individual plants. If mulching/chipping occurs, the species could be directly affected by crushing from machinery and burial by mulch/chips. Pile burning could conceivably result in the loss of individual plants, but infrequent use, combined with the rarity of the species, makes the likelihood of this occurring small. TVA's facilitation of landowner use of wood materials in the ROW would have a similar potential for minor impacts as the other debris management methods.

17.4. Conclusion for White Fringeless Orchid

In this section, we interpret the findings of the previous sections for the white fringeless orchid (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to white fringeless orchid. Although some damage to plants is expected and individual plants could be adversely affected, we do not expect the extent of adverse effects to result in declines at the population level. Additionally, canopy thinning and removal of invasive species could benefit the white fringeless orchid in the future at some sites. Cumulative effects to white fringeless orchid that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the white fringeless orchid. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only a fraction of the known rangewide populations (six populations out of a total of 70 extant populations) occurs on ROW within the Action Area, and only a small percentage of the plants in the species range would be adversely affected by the Action. (4) Two of the six populations on TVA ROW have increased to nearly 1,000 plants per population, while the other, much smaller populations have fluctuated, but persisted, suggesting ROW vegetation management is not adversely affecting the species.

18. GREEN PITCHER PLANT

18.1. Status of Green Pitcher Plant

This section summarizes best available data about the biology and current condition of the green pitcher plant (*Sarracenia oreophila*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the green pitcher plant as endangered on September 21, 1979 (44 FR 54922-54923).

18.1.1. Description of Green Pitcher Plant

Green pitcher plant is a carnivorous, perennial herb in the pitcher plant family (Sarraceniaceae). Green pitcher plant grows from moderately branched rhizomes that are 1 to 1.5 cm (0.4- to 0.6 in) in diameter. The leaves are of two types. One type, the hollow leaves (the pitcher), appear in spring, are 20 to 75 cm (8 to 30 in) long, 6 to 10 cm (2.4 to 4 in) in circumference at the orifice (top opening), and gradually narrow toward the base. The pitchers are green to yellow-green with some being maroon suffused, maroon veined externally, or rarely with a purple blotch at the orifice. At the top of the pitcher, a similarly colored hood arches over the opening. Pitchers wither by mid- to late-summer, depending on soil moisture. The second type of leaves appear after flowering or when the plant is stressed, forming a rosette of flat leaves that are erect and then strongly curved downward and are approximately 5 to 18 cm (2 to 7 in) long. Flowers have five yellow petals, five yellow-green sepals, and an inverted, yellow-green, umbrella-shaped central disc. The flowers occur singly on a leafless flower stalk that is approximately 45 to 70 cm (18 to 28 in) long. The fruit is a tuberculate capsule 1.5 to 1.8 cm (0.6- to 0.7 in) wide. All of these descriptive features can be variable in this species. This description of green pitcher plant was summarized from a more thorough description found in Troup and McDaniel (1980); Catalani (2004); Chafin (2007); and Weakley (2015).

18.1.2. Life History of Green Pitcher Plant

The green pitcher plant is classified as an obligate wetland species, meaning that the species almost always occurs in wetlands (Lichvar *et al.* 2016). Green pitcher plant habitats can be generally grouped into two types: streambanks and upland bogs (Troup and McDaniel 1980; USFWS 1994b, 2014a; Sutter and Rudd 1997). These sites occur in a range of open to forested conditions and are thought to be underlain by semi-impervious clay layers that help maintain the relatively moist soil conditions (USFWS 2014a). Further characterizations of habitats by Carter *et al.* (2006) of several Alabama populations described habitats as poorly draining oak-pine flatwoods and red maple-blackgum swamps and seepage bogs with limited canopy cover. Control of competing vegetation through periodic scouring or fire may help maintain appropriate habitat conditions for green pitcher plant (USFWS 2014a). Plants found along streambanks may be more susceptible to extirpation caused by excessive scouring of the habitat during periodic extreme flood events (USFWS 2014a).

Green pitcher plant populations grow and spread by both sexual reproduction (production of seeds and recruitment of seedlings) and asexual, vegetative clones (via underground rhizomes) (Folkerts 1992; USFW 1994b). Sexual reproduction and genetic variability of populations of this species may be limited by the availability and movements of their pollinators. Queen bumblebees (*Bombus* spp.) are considered the primary pollinator of green pitcher plants (Folkerts 1992; Folkerts 1999). The movement distance for typical queen bumblebees is less than 1-mi (Folkerts 1992); therefore, pollen flow (and consequent gene flow) is restricted by the inability of pollinators to traverse this distance (Folkerts 1999). Dispersal of plants to new locations and recolonization of extirpated populations rely on the seed dispersal through insect or water movement (USFWS 2014a).

18.1.3. Numbers, Reproduction, and Distribution of Green Pitcher Plant

Green pitcher plant is found in the Cumberland Plateau and the Ridge and Valley provinces of Alabama, and the Blue Ridge physiographic province of Georgia and North Carolina. Within green pitcher plant's extant range, the species' distribution can be broadly divided into four geographic areas: Coosa Valley, Lake Chatuge, Lookout Mountain, and Sand Mountain (Dennis 1980; USFWS 1994b). Lake Chatuge green pitcher plant colonies are restricted to Georgia and North Carolina, whereas Coosa Valley, Lookout Mountain, and Sand Mountain green pitcher plant distribution is restricted to Alabama (USFWS 2014a).

Because of the limits of primary pollinators, populations of green pitcher plant are defined as plants that are separated from their nearest neighbors by at least 1-mi (USFWS 2014a). As of 2013, there were 15 known populations of green pitcher plant rangewide. The colonies in North Carolina and Georgia represent a single population, and the 28 colonies in Alabama represent an additional 14 populations (USFWS 2014a). Rangewide, ten green pitcher plant populations (20 colonies/sites) are protected. Three populations are protected by TNC in Alabama, Georgia, and North Carolina; two populations are protected by the State of Alabama; and five populations are protected by the NPS. Of the five populations protected by the NPS, the current status of three is currently unknown, but these populations are considered to have poor viability by the ANHP (USFWS 2014a). Populations occurring along streambanks have an unknown future, because flooding could scour and destroy those populations.

18.1.4. Conservation Needs of and Threats to Green Pitcher Plant

The primary threats identified in the Final Rule listing the green pitcher plant as endangered included a reduction in range from over-collecting, changes in land use (*e.g*., residential, agricultural, and silvicultural development), inundation from construction of reservoirs, mining, road construction, and succession of bog and wetland communities caused by removal of fire from the landscape (44 FR 54922-54923). Additional threats addressed in the latest 5-year review include cattle grazing, logging, and pollinator limitations (USFWS 2014a).

Although many populations of this species occur on protected lands, these plants are still vulnerable to poaching, changes to soil moisture from surrounding hydrologic alterations, and from succession of the landscape, which degrades the species' habitat (USFWS 2014a).

Research has identified that the small, isolated populations of this species are likely pollinator limited (Folkerts 1999). Any activities that reduce pollinator numbers or effectiveness may adversely affect the extant populations of green pitcher plant. This limitation has also likely resulted in low genetic diversity of existing populations and increased genetic isolation of populations (USFWS 2014a). Continued land use changes throughout the southeast coupled with pollinator declines will continue to threaten and isolate extant populations.

18.2. Environmental Baseline for Green Pitcher Plant

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the green pitcher plant, its habitat, and ecosystem within the Action Area.

18.2.1. Action Area Numbers, Reproduction, and Distribution of Green Pitcher Plant

In the Action Area, green pitcher plant is known to occur at one site on the TVA ROW at Little River Canyon National Preserve (LRCNP) in DeKalb County, Alabama. Green pitcher plants in this location were first observed in 1985 and extend off the ROW in many areas throughout this section of the park. TVA has deferred to the NPS on vegetation management on this section of ROW and has not used herbicide to manage vegetation on this TL for many years. The NPS uses mowing to control woody plant growth within the ROW and prescribed fire to maintain habitats, both within and outside of the ROW.

18.2.2. Action Area Conservation Needs of and Threats to Green Pitcher Plant

Few, if any, sizable, unsurveyed upland seepage bogs or streambank habitats that could host significant populations or colonies of green pitcher plant on TVA ROW remain in the Action Area. TVA botanists have used desktop reviews to identify areas that are likely to support green pitcher plant near Weiss Lake in the Coosa River valley, as well as on Lookout and Sand mountains. Since 2013, TVA botanists have field surveyed over 120 discrete sections of the Action Area in Alabama that were identified as having potential habitat, but no new populations of green pitcher plant were observed.

Threats to existing occurrences of green pitcher plant include loss, alteration, and/or degradation of habitat from residential, commercial, and/or industrial development, livestock grazing and trampling, encroachment of competing vegetation (including exotics), poaching, and ORV use. The population that occurs in the TVA ROW is threatened by woody vegetation encroachment and lack of fire, which promotes encroachment of shortleaf pine (*Pinus echinata)*, blackberry (*Rubus spp*.), and sparkleberry (*Vaccinium arboreum*) (Emanuel 1998).

Conservation measures could include managing or eradicating competing vegetation through prescribed fire, manual mowing and removal of woody vegetation, augmenting occurrences, support of safeguarding efforts, and the development of a management plan with the NPS for the population at LRCNP. The hydrology of this pitcher plant bog has already been impacted by activities associated with the power line ROW, as noted in Emanuel's 1998 management plan for the species at this location: "The hydrologic flow in this seepage bog has been interrupted by the woods road alongside the power line. Deep ruts have been created by vehicles driving across the seepage area. Three lanes of ruts have been created by avoidance of an existing rut that was muddy and impassable. The topographical gradient should be repaired to the original level and an alternative means of traversing the seepage area or avoiding it completely should be investigated. The interrupted hydrologic flow is detrimental to the southern portion of the seepage bog where other green pitcher plants exist." (Emanuel 1998).

18.3. Effects of Vegetation Management on Green Pitcher Plant

This section analyzes the direct and indirect effects of the Action on green pitcher plant. An effects analysis summary of the effects of various methods of vegetation management on green pitcher plant and the other 17 listed LAA plant species from the BA has been included in Appendix II.

18.3.1. Effects of Manual Vegetation Clearing on Green Pitcher Plant

Manual vegetation clearing has the potential to adversely affect green pitcher plant; however, provided such clearing does not excessively disturb the soil, it is unlikely to result in the death of individual plants. Green pitcher plant populations decline as succession of their habitats increases and clearing of woody vegetation will help maintain increased light levels and the appropriate hydrology the populations need. The plants are susceptible to physical damage caused by clearing activities, but the species could resprout if soils in the area are not excessively compacted by heavy equipment. The soil disturbance should be minimal because of BMPs designed for activities in wetlands.

Manually clearing trees on previously unmaintained ROW is a one-time event because these areas will subsequently be treated as ROW floor. Danger tree clearing occurs as needed and may not be needed in areas where green pitcher plant occur, because those populations are maintained as early successional habitats and have minimal overstory structure.

18.3.2. Effects of Mechanical Clearing on Green Pitcher Plant

All mechanical vegetation control methods used by TVA have the potential to adversely affect green pitcher plant. However, as long as the method does not excessively disturb the soil, it is unlikely to result in the death of individual plants. Mowers are generally set 10 to 12 inches off the ground and would likely miss much of the vegetative growth of this species; if damaged, however, this species would likely resprout. As previously stated, opening of the canopy through this type of clearing could benefit green pitcher plant populations.

18.3.3. Effects of Herbicide Use on Green Pitcher Plant

Vegetation control methods that use herbicides are likely to adversely affect green pitcher plant. Spot treatment with herbicides is highly targeted and unlikely to adversely affect green pitcher plant at the population level, but could result in isolated, direct adverse effects on individual plants. Cut stump and hack and squirt applications could be used when cutting larger woody material in and near the ROW to prevent resprouting and as an AMM to control smaller trees in occupied habitat within the ROW floor. Green pitcher plants occupy the ROW floor, and, therefore, are likely to be adversely affected by localized herbicide applications in those areas.

If individual green pitcher plants occur within a few feet of a tree treated with localized herbicide application, chances are high that the plant would experience some level of herbicide related damage. This damage may rise to the level of individual plant death especially if areas supporting the species were mowed for many years before application of herbicide, which would result in a proliferation of woody plant stems that would form a low tree canopy within the ROW. Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW edge if it were used in occupied habitat. Most, but not all, sections of TVA ROW with naturalized vegetation located near green pitcher plant occurrences have either been field surveyed or are designated as Plants Class 1 and 2 in O-SAR. This O-SAR restriction prohibits the use of broadcast herbicide from the air or ground.

According to TVA's BA, herbicide use is not to occur on NPS or USFS lands without the written permission of government officials; this should ensure herbicide use on the population of green pitcher plant at LRCNP has been reviewed and complies with the management plan for the LRCNP. Because TVA does not use herbicide to manage this population of green pitcher plant and the NPS uses mowing and prescribed fire to maintain this population, there should be no effect from herbicide use on the population.

18.3.4. Effects of Debris Management on Green Pitcher Plant

All debris management techniques (manual or mechanized handling of debris, mulching or chipping, and pile burning) used by TVA have some potential to adversely affect green pitcher plant. The characteristic of debris removal most likely to affect the species is physical disturbance associated with manual or mechanized handling of debris. This disturbance could result from dragging of debris over plants or soil disturbance that is expected from use of machinery. Wetland BMPs should minimize soil disturbance from these activities. Pile burning could result in loss of some plants if piles are located directly on top of or immediately adjacent to plants, but the infrequent use of the tool, the extreme rarity of the species, and the unlikely possibility of using a wetland habitat for burning make the likelihood of this technique adversely affecting green pitcher plant improbable. These effects can be avoided by marking known populations prior to these activities to ensure that piles are not located on the plants. TVA's facilitation of landowner use of vegetation debris (*e.g.*, fire wood) has similar potential for effects as manual debris management methods. Impacts from this activity can be reduced by ensuring wood placement and landowner access is not in an area with green pitcher plants.

18.4. Conclusion for Green Pitcher Plant

In this section, we interpret the findings of the previous sections for the green pitcher plant (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action will have localized adverse effects to green pitcher plant and result in no more than a few individual plants within the Action Area being adversely affected. Cumulative effects to green pitcher plant that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the green pitcher plant. We reached this determination based on the fact that the single population on TVA ROW is located on lands owned and managed by the NPS, which uses mowing and prescribed fire to maintain this population and prohibits herbicide use. Since TVA vegetation management activities likely will not be implemented at this site due to NPS management there, the Action could not affect plants at this site, and NPS's interrelated action to manage the ROW (i.e., in-lieu of TVA ROW management) does not appear to adversely affect the species.

If the NPS were to cease managing the population and if TVA began managing the ROW, it is also the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the green pitcher plant based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only a fraction of the known rangewide populations (one population out of a total of 15 extant populations) occurs on ROW within the Action Area; therefore, only a small percentage of the plants in the species range potentially would be adversely affected by the Action.

19. LARGE-FLOWERED SKULLCAP

19.1. Status of Large-Flowered Skullcap

This section summarizes best available data about the biology and current condition of large-flowered skullcap (*Scutellaria montana*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list large-flowered skullcap as endangered on June 20, 1986 (51 FR 22521-22524) and its decision to reclassify the species from endangered to threatened on January 14, 2002 (67 FR 1662-1668).

19.1.1. Description of Large-Flowered Skullcap

Large-flowered skullcap is a perennial herb with solitary, erect, square stems, usually from 30 to 50 cm (11.8 to19.7 in) tall. The leaves are lanceolate to ovate, on 1 to 2 cm (0.4- to 0.8-in) petioles, with blades 5 to 8 cm (2 to 3.2 in) long and 3 to 5 cm (1.2 to 2 in) wide, crenate to serrate margins, and hairy on both surfaces. The inflorescence is a terminal, leafy-bracted raceme, with or without paired lateral racemes at the base. The calyx is two-lobed (characteristic of the genus *Scutellaria*). The corolla is relatively large, 2.6 to 3.5 cm (1 to 1.4 in) long, blue and white, and lacking a fleshy ridge (annulus) within the corolla tube near the top of the calyx. Flowering occurs from mid-May to early June and fruits mature in June and early July (USFWS 1996d).

19.1.2. Life History of Large-Flowered Skullcap

Bridges (1984) described the habitat of large-flowered skullcap as rocky, submesic to xeric, well-drained, slightly acidic slope, ravine and stream bottom forests in the Ridge and Valley and Cumberland Plateau provinces of Northwestern Georgia, and adjacent southeastern Tennessee. TDEC (2008) reported that large-flowered skullcap can apparently live eight or more years.

Nutlets are released from mid-June to mid-July, overwinter, and apparently germinate in late March. Mature individuals that have perenneated as root stocks begin shoot growth in late March. By early April, plants are 5 to 10 cm (2 to 3.9 in) tall and are pushing through leaf litter. Anthesis typically begins during mid-May and continues through early June. Pollination is principally exclusively by Hymenoptera of the superfamily Apoideae (bees). The corolla shrivels somewhat and falls from the calyx one or two days after pollination, presumably within 24 hrs of fertilization. The calyx closes around the developing fruit immediately after corolla abscission. During the next two to four weeks, the calyx and the enclosed nutlets enlarge and mature. The calyx then dehisces by the loss of the upper lip and the nutlets are released (USFWS 1996d).

A different course is followed if fertilization does not occur. The corolla shrivels markedly and may or may not remain united to the calyx. The entire calyx, still open at the mouth, falls leaving the pedicel bare (USFWS 1996d).

Long distance seed dispersal appears to be limited for the large-flowered skullcap; dispersal distance is not known to exceed 2 mi (USFWS 1996d). Cruzan (2001) observed that large, gravity-dispersed seeds likely constrain the species' dispersal ability and cited unpublished data that indicated a persistent seed bank is likely in large-flowered skullcap because cold treatments failed to break seed dormancy in this species; whereas, the same treatments resulted in fairly high germination rates for closely related falseteeth skullcap (*Scutellaria pseudoserrata*).

19.1.3. Numbers, Reproduction, and Distribution of Large-Flowered Skullcap

The large-flowered skullcap has been found in Bledsoe, Hamilton, Marion, and Sequatchie counties in Tennessee; and Catoosa, Dade, Floyd, Gordon and Walker counties in Georgia (51 FR 22521-22524). According to TDEC (2014), there are currently 164 extant large-flowered skullcap EOs in Tennessee, distributed among 28 extant populations. Of the 28 extant populations in Tennessee, 22 have at least 100 plants and are located, in whole or part, on protected land (*i.e.*, they meet the criteria for viability) (USFWS 2015a). In Georgia, there are 52 extant EOs, but their distribution among populations has not been evaluated (USFWS 2015a).

In completing a status survey of large-flowered skullcap in Tennessee, TDEC (2014) applied the following criteria for delineating populations among the 164 extant occurrences:

1. Populations are defined as groups of EOs that are located in a major drainage within a HUC-12 watershed and have topographic continuity (*e.g.*, in some cases populations are delineated between groups of occurrences on top of the Cumberland Plateau and those on the escarpment within the same HUC-12).

2. Subpopulations are defined as groups of EOs within a population that occur in continuous habitat with no apparent physical barriers to gene flow.

Based on these criteria, there are 30 populations distributed among 16 HUC-12 watersheds in Tennessee, 28 of which are extant (*i.e.*, not F- or X-ranked as discussed below and reported in Table 19.1). Within eight of these populations, 22 subpopulations have been delineated because of significant discontinuity in habitat between some groups of occurrences included within those populations (TDEC 2014).

Using available data on large-flowered skullcap abundance and threats for each EO, TDEC (2014) assessed the viability of the 30 populations in Tennessee (Table 19.1). The viability ranks are based on criteria in the recovery plan that a population will be considered self-sustaining if monitoring data support the conclusion that it is reproducing successfully and is stable or increasing in size and if the minimum number of individuals is at least 100 (67 FR 1662-1668). The rank specifications that follow are based on the most recent information taking into account habitat quality, including invasive plant species and expert opinion:

A-rank (Excellent Viability): population of large-flowered skullcap contains greater than 1,000 plants with the number of plants in each occurrence that makes up a population. A smaller population with the number of plants in each occurrence having 500-1,000 plants with minimal habitat disturbance and no or few invasive exotic plant species.

B-rank (Good Viability): population of large-flowered skullcap with 500 -1,000 plants with the number of plants in each occurrence that makes up a population with some habitat disturbance, or smaller population with the number of plants in each occurrence having 100-500 plants in sites with minimal habitat disturbance and no or few invasive exotic plant species. Site may be restorable to an A rank.

C-rank (Fair Viability): population of large-flowered skullcap with 100 -500 plants with the number of plants in each occurrence that makes up a population with some habitat disturbance and some invasive exotic species.

D-rank (Poor Viability): population of large-flowered skullcap with less than 100 plants with the number of plants in each occurrence that makes up a population. Restoration of disturbed or degraded sites would be unlikely.

E-rank: Extant but no data available, habitat does exist at the site.

F-rank: Failed to find during survey period.

H-rank: Historic, not seen in 25 years.

X-rank: Extirpated.

Using these rank specifications and available data on minimum abundance recorded at each EO, TDEC (2014) determined that there are 22 viable populations (Table 19.1) in Tennessee. In many cases, recent counts of plants beyond those in permanent monitoring plots were not available, and the evaluation was based on plants in the plots alone. In other cases, no recent data were available. Of the 22 viable populations, 11 occur completely on protected lands and the other 11 are partially protected. In most cases, the majority of the EOs within the partially protected populations are located on protected lands (USFWS 2015a).

Table 19.1. Population ranks and protection status for *Scutellaria montana* in Tennessee (TDEC 2014).

	A-rank	B-rank	C-rank	D-rank	F-rank	X-rank
Total	8	2	12	6	1	1
Protected	5	1	5	3	1	0
Partially-protected	3	1	7	3	0	0

19.1.4. Conservation Needs of and Threats to Large-Flowered Skullcap

A recent status survey for large-flowered skullcap in Tennessee identified the following potential threats to the species and its habitat (USFWS 2015a):

- ORV traffic on undesignated trails
- Invasive exotic plants
- Trail construction and maintenance on public and conservation lands
- Power line maintenance including the use of herbicide, manual, and mechanical treatments for vegetation management
- Wildfire suppression involving construction of large fire lines
- Recreational impacts including unauthorized hiking, camping and picnicking on public and conservation lands
- Mineral mining and quarrying
- Removal of mature forest by logging or development on private lands.

While these threats to habitat remain on the landscape and potentially could affect large-flowered skullcap, the large number of populations and the protected status of many populations likely provides the redundancy and resilience needed for the species' conservation. Based on available data, no known threats to habitat are both widespread and severe enough to place the species at risk of extinction, nor are they likely to cause the species to become at risk of extinction in the foreseeable future given the fact that all viable populations are either partially or completely protected.

The proposed rule to reclassify large-flowered skullcap from endangered to threatened maintained that wildfire poses a threat to the species (65 FR 42976). However, a recent study demonstrated that large-flowered skullcap transplanted into a previously burned site had greater survival rates than a control plot and plots that had been either canopy-thinned or burned and canopy-thinned (Kile *et al*. 2013). This study did not examine effects of fire on individuals that were present at the time of the treatments. Anecdotal data from eight monitoring plots in the Tennessee River gorge, half of which burned in a 2007 wildfire, reveal no detectable difference in stage-specific or overall abundance of large-flowered skullcap between burned and unburned plots, and large-flowered skull cap abundance was greater in burned than unburned plots in preliminary results from a study in TNC's Marshall Forest Preserve in Georgia (S. Monteleone, Associate Professor of Biology, Shorter University, unpublished data). Based on the results of these studies, we no longer consider wildfire to be a threat to large-flowered skullcap. However, the potential exists for plants and habitat to be damaged during suppression operations that involve mechanical construction of fire lines (TDEC 2014).

Conservation needs for the species include continued monitoring across the species' range to infer general trends, collection of census data from populations for which recent data are lacking to evaluate viability ranks assigned by TDEC (2014) and to establish viability ranks for populations in Georgia, and development of management agreements for protected sites to ensure that conservation of the species would continue into the future if the species is delisted. The USFWS is working with partners via an informal recovery working group, coordinated by TVA, to develop a strategy for completing these actions within three to five years (USFWS 2015a).

19.2. Environmental Baseline for Large-Flowered Skullcap

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Large-Flowered Skullcap, its habitat, and ecosystem within the Action Area.

19.2.1. Action Area Numbers, Reproduction, and Distribution of Large-Flowered Skullcap

In the Action Area, large-flowered skullcap is known to occur on the only two TVA ROW crossing the Cumberland Plateau within the range of the species. Field surveys of these two TL, L6103-CH and L6068, were originally conducted by TVA botanists because both ROW crossed forest with multiple EO records for the species. In addition, one flowering plant was observed in 2002 along the open ROW of L6068. Large-flowered skullcap occurs primarily in forested habitats (USFWS 2015a), but the confirmed presence of the species within the open ROW suggested the possibility that plants might occur in larger numbers within the open ROW.

In May 2013, during the flowering period for the species, TVA botanists surveyed all potentially suitable ROW on L6068 east of the Sequatchie Valley and west of the Ridge and Valley. Along this 12+ mi of ROW within potentially suitable habitat, 16 patches with 313 total plants were recorded from on or adjacent to the ROW. No attempt was made to survey areas off the ROW. Some plants were observed on the open ROW floor, but most favored the edge of the ROW where the individuals received relatively more sunlight than the adjacent closed-canopy forest. Many plants occurring on the ROW edge were situated in a thin band along the ROW margin that had been recently cleared of trees, so it is possible that these individuals established in a closed-canopy forest even though they were observed in more open conditions.

On the L6103-CH TL ROW, about half of the 9 mi of potentially suitable habitat on the Cumberland Plateau were surveyed in July of 2013. Only two flowering and two vegetative large-flowered skullcap plants were observed at a single location during this survey.

Large-flowered skullcap plants have not been observed on open TL ROW within the Ridge and Valley physiographic province. TVA botanists have not visited all ROW within Georgia and Tennessee that bisect forest that may support the species.

TVA ROW on the Cumberland Plateau regularly contain relatively intact herbaceous plant communities; this is uncommon on ROW situated in the Ridge and Valley near Chattanooga, Tennessee. Large-flowered skullcap could occur on TVA ROW in the Ridge and Valley in this small section of Georgia and Tennessee, but the individuals on the ROW would likely be few and comprise only a small part of the population in the surrounding forest.

19.2.2. Action Area Conservation Needs of and Threats to Large-Flowered Skullcap

The potential exists for habitat encroachment from invasive exotic plants and vegetation management (herbicide applications and manual, and mechanical treatments) to threaten large-flowered skullcap in the Action Area. Reducing these threats is best addressed by continued coordination with TVA regarding maintenance of ROW.

19.3. Effects of Vegetation Management on Large-Flowered Skullcap

This section analyzes the direct and indirect effects of the Action on large-flowered skullcap. An effects analysis summary of the effects of various methods of vegetation management on large-flowered skullcap and the other 17 listed LAA plant species from the BA has been included in Appendix II.

19.3.1. Effects of Manual Vegetation Clearing on Large-Flowered Skullcap

Large-flowered skullcap can occupy ecotones between the forest and ROW. Manual clearing in these habitats would most likely affect individuals growing along the edge of the ROW. Manual removal of single danger trees may have a positive effect on the species by providing a boost in light levels that could increase productivity and reproduction without fundamentally changing the vegetation structure and light regime in the immediate vicinity of the plant. Manual removal of swaths of previously unmaintained trees along a ROW margin may have beneficial or adverse effects depending on the situation. Large-flowered skullcap seems to favor ecotones as evidenced by the surveys of L6068 in 2013, but many of these plants likely established in shadier conditions and may not survive in the long-term. However, plants observed in higher light conditions were generally more vigorous than plants in the adjacent, shaded forest, so there may be some advantage to individuals that occur in habitats situated along the edge of the closed canopy forest.

Manual clearing would have the potential to directly affect individual plants by trampling, cutting, and crushing, but it is unlikely this disturbance would result in the death of individual plants.

In summary, all methods of manual vegetation clearing would likely adversely affect the species to varying degrees, but not always result in permanent loss of plants. Beneficial effects could result from manual clearing in instances where light levels were increased.

19.3.2. Effects of Mechanical Clearing on Large-Flowered Skullcap

If mechanical vegetation control methods utilized by the TVA ROW program intersect habitat occupied by large-flowered skullcap, the species could be adversely affected. As described above under Section 2.3.1., as with manual clearing, mechanical clearing also has the potential to provide beneficial or adverse effects via removal of swaths of previously unmaintained trees along a ROW margin, depending on the situation, and to directly affect individual plants individual plants by trampling, cutting, and crushing, but likely would not result in the death of individual plants.

Side wall trimming may have some minor direct or indirect effect on large-flowered skullcap plants if that tool were used, but the physical disturbance or change in light levels would be unlikely to result in the loss of plants from a given area.

In summary, all methods of mechanical clearing would likely adversely affect the species to varying degrees, but not always result in permanent loss of plants. Beneficial effects could result from mechanical clearing in instances where light levels were increased.

19.3.3. Effects of Herbicide Use on Large-Flowered Skullcap

Vegetation control methods that utilize herbicides are likely to adversely affect large-flowered skullcap if used in occupied habitat, although the tool would likely only effect relatively small parts of populations that occur on ROW. Plants occurring off the ROW would not be affected. Spot treatment of herbicide is highly targeted and unlikely to adversely affect large-flowered skullcap at the population level, but could result in isolated, direct adverse effects on individual plants. Cut stump and hack and squirt applications could be used when cutting trees to prevent resprouting or as an AMM to control smaller trees in occupied habitat. Localized herbicide application has the potential to adversely affect plants occurring on the open ROW floor where that tool is used. Individual plants would likely be killed if located adjacent to woody species targeted for removal. This process of targeting woody species for removal would also favor herbaceous species over woody species, which could result in more habitat for large-flowered skullcap in the long-term.

Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW edge. This tool is non-selective and would injure or kill large-flowered skullcap if used in occupied habitat, but all ROW along the Cumberland Plateau within the known range of the species has either been field surveyed or is designated as Class 1 or 2 Plants in the O-SAR database. This designation prohibits the use of broadcast herbicide.

In summary, all methods of herbicide use would likely adversely affect the species.

19.3.4. Effects of Debris Management on Large-Flowered Skullcap

Debris management techniques used by TVA have potential to adversely affect large-flowered skullcap. Any physical disturbance associated with manual or mechanized handling of debris occurring on the open ROW edge could directly affect plants. Leaving debris in place typically has little direct effect on vegetation, but the subsequent vegetation control efforts can be hindered by larger debris piles. Specifically, low-volume foliar herbicide applications can be less targeted around piles because applicators have a difficult time moving amongst the downed branches. This problem has been observed on the L6068 ROW. Large-flowered skullcap was observed growing through piles of cut trees along with other small tree seedlings along the recently re-cleared ROW margin. TVA did not apply herbicide directly adjacent to plants, because the location was known. However, localized herbicide application would be more likely to produce off-target damage to surrounding vegetation amongst slash piles, which could affect undocumented rare plant occurrences that occur on ROW across the system. This potential negative effect would diminish over time as the woody material decomposes.

Mulching and chipping in occupied habitat could result in burial of individual plants. This could result in death of some plants occurring in the work area; however, during the 2013 survey of L6068 ROW, vigorous large-flowered skullcap plants were observed growing through mulch along the ROW edge. The limited evidence available suggests that it is unlikely that mulching or chipping in occupied habitat would result in the loss of all plants present. Mulching or chipping debris could also result in crushing from machinery.

Burning would occur in the open ROW and would not affect large-flowered skullcap, but debris handling by machinery could adversely affect individual plants on the ROW edge. TVA's facilitation of landowner use of wood has similar potential for small impacts as manual debris management methods.

In summary, all methods of debris management (manual, mechanical, burning, and landowner use) would likely adversely affect the species.

19.4. Conclusion for Large-flowered Skullcap

In this section, we interpret the findings of the previous sections for the large-flowered skullcap (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to large-flowered skullcap and result in only a few individual plants within the Action Area being adversely affected. Manual and mechanical clearing may provide some beneficial effects to the species because plants observed in higher light conditions were generally more vigorous than plants in the adjacent forest. Therefore, those individuals in habitats situated along the edge of closed canopy forest could benefit from the Action. Cumulative effects to large-flowered skullcap that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the large-flowered skullcap. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only a fraction of the known rangewide populations (two populations, comprised of over 300 plants, out of a total of 80 extant populations, comprised of several thousand plants) occurs on TVA ROW in the Action Area; therefore, only a small percentage of plants in the species range would be affected by the Action.

20. TENNESSEE YELLOW-EYED GRASS

20.1. Status of Tennessee Yellow-Eyed Grass

This section summarizes best available data about the biology and current condition of Tennessee yellow-eyed grass (*Xyris tennesseensis*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list Tennessee yellow-eyed grass as endangered on July 26, 1991 (56 FR 34151 34154).

20.1.1. Description of Tennessee Yellow-Eyed Grass

Tennessee yellow-eyed grass is a rare perennial monocot that is an obligate wetland plant that prefers relatively high pH seeps and streambanks. The plant ranges from 7 to 10 dm (2.3 to 3.3 ft) in height. Plants typically occur in clumps where they arise from fleshy bulbous bases. Leaves are basal, the outermost scale-like, the larger one linear, twisted, deep green and 14 to 45 cm (5.5 to 17.7 in) in length. The inflorescence consists of brown conelike spikes, 1 to 1.5 cm (0.4- to 0.6 in) in length, which occur singly at the tips of long slender stalks from 30 to 70 cm (12 to 28 in) long. The flowers, which are pale yellow in color and 4.5 mm (0.2 in) long, unfold in the late morning and wither by mid-afternoon. Fruits are thin-walled capsules containing numerous seeds 0.5 to 0.6 mm (0.02-in) in length. Flowering occurs from August through September.

20.1.2. Life History of Tennessee Yellow-Eyed Grass

Tennessee yellow-eyed grass is restricted to calcareous seeps, fens, and spring runs in Alabama, Georgia, and Tennessee. The species is not only at risk as a wetland plant, but is also extremely rare due to its unusual habitat requirement among North American xyrids for circumneutral pH soils overlying calcareous substrates. In addition, it has been shown to be a poor competitor and quickly succumbs to ecological succession without periodic disturbance.

20.1.3. Numbers, Reproduction, and Distribution of Tennessee Yellow-Eyed Grass

The known current and historic distribution of Tennessee yellow-eyed grass is restricted to the states of Alabama, Georgia, and Tennessee almost exclusively within the Interior Plateau and Ridge and Valley ecoregions. Tennessee yellow-eyed grass was known from only seven sites, five in Tennessee, one in Georgia, and one in Alabama, at the time of listing in 1991 (56 FR 34151-34154). However, surveys since its listing have resulted in the location of 16 additional populations. Currently, a total of 22 populations are known to be extant including three in Bibb County, four in Calhoun County, and one each in Shelby and Franklin Counties, Alabama; four in Bartow County, one in Floyd County, and one in Whitfield County, Georgia; and seven in Lewis County, Tennessee. Status surveys conducted in 1998-1999 listed 17 sites with plants (Moffett 2008). A resurvey of several of these sites in the summer and fall of 2008 revealed a decline in populations following several years of drought (Boyd and Moffett 2010). A population survey conducted in the summer and fall of 2009 by Auburn University concluded that the known population size has been relatively stable during the past decade. The 2009 study (Boyd and Moffett 2010) found known occurrences from 23 sites, an increase from the 17 known sites from the 1998-1999 surveys. A population survey conducted across the species three-state range in the summer and fall of 2009 by Auburn University found occurrences at 23 sites. Three of the sites in the 2009 surveys were new occurrences, all discovered in Georgia.

Seedlings appear to need relatively moist soils with significant sun exposure to become established and grow to maturity. Further, this species tends to be disturbance dependent and needs active management to maintain populations for long-term survival (Boyd and Moffett 2010). Current research on Tennessee yellow-eyed grass indicates that flower production and (perhaps) seedling recruitment are most extensive in locations that are relatively sunny and lack an overstory of shrub or tree canopies. The species does best in relatively open moist sites. According to Moffett (2008), woody competition that shades out the species and herbaceous competition that shades and competes with the species can suppress its growth and reproduction. This management strategy reveals that conservation of the species requires a more hands-on management approach than some endangered plant species.

20.1.4. Conservation Needs of and Threats to Tennessee Yellow-Eyed Grass

Because this species depends on open, sunny sites for establishment, modification of habitat through natural succession or lack of disturbance is considered a major threat to the success of Tennessee yellow-eyed grass. Due to the level of destruction and degradation of habitat associated with human population growth in the southeastern U.S., active conservation and management for this species are critical to its continued existence. In situ efforts focus on habitat protection, acquisition, and/or restoration and management of CH for rare taxa. This species continues to be threatened by habitat destruction, including stream impoundment, habitat conversion for agriculture and residential development, and poor management practices of the few remaining populations (Johnson *et al*. 2012).

20.2. Environmental Baseline for Tennessee Yellow-Eyed Grass

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of Tennessee yellow-eyed grass, its habitat, and ecosystem within the Action Area.

20.2.1. Action Area Numbers, Reproduction, and Distribution of Tennessee Yellow-Eyed Grass

Tennessee yellow-eyed grass has not been documented on TVA ROW, but the species may be found in unsurveyed ROW. The species prefers open, moist conditions, which are not necessarily mutually exclusive with a TL ROW (UFWS 2014b). However, for the species to be present, a ROW would have to intersect a calcareous seep or other similar feature, which are rare on the landscape. Known populations from Alabama, Georgia, and Tennessee all occur with 1.5 mi of one or more TVA TL. Portions of these and other nearby TVA TL segments with naturalized vegetation and wetland features have been designated as Class 1 Plants in O-SAR, but the rarity of the species reduces the likelihood that it occurs within TVA ROW.

20.2.2. Action Area Conservation Needs of and Threats to Tennessee Yellow-Eyed Grass

Tennessee yellow-eyed grass prefers higher light levels than those found in closed canopy forest. The species can thrive in canopy gaps within forested situations and can occur in open habitats, such as the "roadside ditch" in Franklin County, Alabama, that is referenced in the BA. Disturbance associated with TVA ROW vegetation management could adversely affect individual plants, but since the program is focused on removing woody vegetation, there would be a disproportionally larger impact on woody species. This focus on woody species removal on ROW can favor light-loving herbaceous species such as Tennessee yellow-eyed grass and result in beneficial effects to entire populations, even if individual plants are adversely affected. In addition, methods such as broadcast herbicide that can produce entire, ROW-wide changes to vegetation composition would not be used in areas near known populations of the species because of restrictions in the O-SAR database.

20.3. Effects of Vegetation Management on Tennessee Yellow-Eyed Grass

This section analyzes the direct and indirect effects of the Action on Tennessee yellow-eyed grass. An effects analysis summary of the effects of various methods of vegetation management on Tennessee yellow-eyed grass and the other 17 listed LAA plant species from the BA has been included in Appendix II.

20.3.1. Effects of Manual Vegetation Clearing on Tennessee Yellow-Eyed Grass

Tennessee yellow-eyed grass could occur within the open ROW floor or along the ROW edge if the TL intersects appropriate habitat. Since Tennessee yellow-eyed grass would occur in a wetland or SMZ, manual vegetation control techniques would be used to remove trees. This could result in direct adverse effects resulting from physical disturbance, but could also increase light levels on-site that could benefit the population.

In summary, manual vegetation clearing would likely adversely affect the species. Beneficial effects could also potentially be realized by manual clearing in instances where light levels were increased to plants.

20.3.2. Effects of Mechanical Clearing on Tennessee Yellow-Eyed Grass

If mechanical vegetation control methods utilized by the TVA ROW program intersect habitat occupied by Tennessee yellow-eyed grass, there is the potential the species could be adversely affected. Extensive rutting throughout a seep could also result in local changes to hydrology that may affect the long-term viability of the population, if present. Side-wall trimming may result in a very small amount disturbance that could adversely affect Tennessee yellow-eyed grass, but the resulting increase in light reaching the forest floor may be beneficial to the species if that tool were used in occupied habitat.

In summary, all methods of mechanical clearing have the potential to adversely affect the species (if present) in varying degrees, but not always resulting in permanent loss of plants. Beneficial effects could also potentially be realized by mechanical clearing in instances where light levels were increased to the plants.

20.3.3. Effects of Herbicide Use on Tennessee Yellow-Eyed Grass

Vegetation control methods that utilize herbicides are likely to adversely affect Tennessee yellow-eyed grass if used in occupied habitat. Spot treatment of herbicide is highly targeted and unlikely to adversely affect Tennessee yellow-eyed grass at the population level, but could result in isolated, direct adverse effects on individual plants. Cut stump and hack and squirt applications could be used when cutting trees to prevent resprouting. These methods could also be used as an AMM to control smaller trees in occupied habitat. Even though localized herbicide application targets woody species within the ROW floor, the use of that tool would have some level of effects on the species. If individual Tennessee yellow-eyed grass plants occur within a few feet of a tree seeding treated with localized herbicide application, chances are high that the plant would experience some level of herbicide related damage. This damage may rise to the level of individual plant death. However, removal of competing woody species may benefit populations of Tennessee yellow-eyed grass over the long-term.

Broadcast herbicide, either from the air or ground, could adversely affect plants growing on and near the ROW. However, all ROW situated near populations of Tennessee yellow-eyed grass have been reviewed using the O-SAR process, and areas with naturalized vegetation and wetlands features have been designated as Class 1 Plants. This O-SAR restriction prohibits the use of broadcast herbicide either from the air or ground.

In summary, all methods of herbicide use would likely adversely affect the species.

20.3.4. Effects of Debris Management on Tennessee Yellow-Eyed Grass

Debris management techniques used by TVA have a small potential to adversely affect Tennessee yellow-eyed grass. Any physical disturbance associated with manual or mechanized handling of debris occurring on the open ROW edge could directly affect plants. These effects would include physical damage resulting from cutting or dragging trees and would not likely result in death of individuals. If mulching/chipping did occur, the species could be directly affected by crushing from machinery and burial by mulch/chips. Pile burning could conceivably result in the loss of individual plants, but the infrequent use of the tool combined with the extreme rarity of the species make the likelihood of this occurring discountable. TVA's facilitation of landowner use of wood has similar potential for small impacts as manual debris management methods.

In summary, all methods of debris management (manual, mechanical, burning, and landowner use) would likely adversely affect the species if present.

20.4. Conclusion for Tennessee Yellow-Eyed Grass

In this section, we interpret the findings of the previous sections for Tennessee yellow-eyed grass (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to Tennessee yellow-eyed grass, resulting in only a small percentage of undocumented, individual plants within the Action Area being affected, if any; no populations would be extirpated by TVA ROW vegetation management activities. Cumulative effects to Tennessee yellow-eyed grass that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of Tennessee yellow-eyed grass. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Of the 22 extant populations that are known rangewide, none of those populations currently occur within the Action Area. (4) For the species to occur on a ROW, it would have to intersect a calcareous seep or other similar feature, which are inherently rare habitats on the landscape.

21. REPORTING REQUIREMENTS

This section provides the specific instructions for reporting. As necessary and appropriate to fulfill this responsibility, the TVA must require any permittee, contractor, or grantee to accomplish the reporting through enforceable terms that are added to the permit, contract, or grant document.

1. Annual Reporting. Each year from 2020–2041, TVA will file a report not later than December 31 covering the preceding fiscal year ending September 30. The report will:

    a. Summarize system-wide vegetation management activities that complied with ESA §7(a)(2) by relying on the programmatic consultation;
    b. Identify total acreage of floor work and tree work, including a summary of the use of each vegetation control method considered in the consultation during the reporting period; enumerate known sites of federally listed plants that were intersected by the TVA vegetation management program during the reporting period and identify the vegetation control and debris and debris management methods used on those sites;
    c. Provide the results of any surveys for known and newly discovered populations of federally listed plants associated with TVA ROW vegetation management projects during the survey period;
    d. Identify the number of listed plants adversely affected to the extent practicable, if any, and, when possible, the number of listed plants beneficially affected;
    e. Summarize the outcome of any coordination with USFWS Field Offices; and
    f. Be provided to the U.S. Fish and Wildlife Service, Tennessee Field Office, 446 Neal Street, Cookeville, Tennessee 38501.

2. Annual Coordination. After the receipt of the final report, TVA and the USFWS Tennessee Field Office will determine if a follow-up meeting is necessary to discuss the annual report, review the progress of the Action, or review any new information relevant to the Action and its effects on the plant species considered in this consultation. If one or both parties determines a meeting is needed, TVA and the USFWS will meet on a mutually agreeable date between February 1 and May 1.

22. CONSERVATION RECOMMENDATIONS

ESA §7(a)(1) directs Federal agencies to use their authorities to further the purposes of the ESA by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to avoid or minimize the adverse effects of a proposed action, implement recovery plans, or develop information that is useful for the conservation of listed species. The USFWS offers the following recommendations that are relevant to the listed species addressed in this BO and that we believe are consistent with the authorities of the TVA. In general, our recommendations are to continue and expand the various programs that TVA already undertakes to contribute to rare plant conservation.

1. Protect listed plants from clearing, development, and use of herbicides.
2. Avoid mowing during the growing season on sites where listed plants may be present.
3. Use hand-clearing or prescribed fire to control competing woody plants and to create sunny openings for listed plant species that prefer increased sunlight exposure.
4. Eradicate invasive exotic plant species from TVA ROWs, especially areas in close proximity to known locations of listed plants.
5. Promote (fund and allow) research on these listed plant species within the TVA PSA.

23. REINITIATION NOTICE

Formal consultation for the Action considered in this BO is concluded. Reinitiating consultation is required if the TVA retains discretionary involvement or control over the Action (or is authorized by law) when:

a. new information reveals that the Action may affect listed species or designated CH in a manner or to an extent not considered in this opinion;
b. the Action is modified in a manner that causes effects to listed species or designated CH not considered in this opinion; or
c. a new species is listed or CH designated that the Action may affect.

24. LITERATURE CITED

Alabama Army National Guard. 2011. Updated Integrated Natural Resources Management Plan and Record of Environmental Consideration. Fort McClellan Army National Guard Training Center, Pelham Range and the Main Enclave, Calhoun County, Alabama. Alabama Army National Guard, Environmental Branch, Anniston, AL. 151 pp. and appendices.

Alabama Herbarium Consortium. 2019. Alabama plant atlas. http://www.floraofalabama.org/Plant.aspx?ID=867, accessed March 2019.

Alabama Natural Heritage Program. 2014. Status assessment of *Apios priceana* (Fabaceae), Price's potato-bean, in Alabama and Mississippi. Unpublished report to U.S. Fish and Wildlife Service, Jackson, Mississippi.

Alabama Natural Heritage Program. 2018. Element occurrence records for *Clematis morefieldii*. Accessed March 29, 2018.

Bailey, C. 2005. Survey for Morefield's leather-flower (*Clematis morefieldii*) in southeastern Tennessee. Unpublished section 6 report by the Tennessee Department of Environment and Conservation to U.S. Fish and Wildlife Service.

Bailey, C. and A. Shea. 2000. New population survey, site protection survey, and monitoring protocol for *Arenaria cumberlandensis*. Unpublished report from TDEC to USFWS, Cookeville, Tennessee. December 2000. 9 pp. plus one appendix.

Barbers, S.L. and G.S. Wilhelm. 2005. Third-year restoration monitoring report for Dellwood Park West, Lockport, Illinois. Unpublished report to Corporation for Open Lands, Chicago, Illinois. 15 pp. plus appendices.

Barger, T.W., B.D. Holt, L. Derry, and J. Matthews. 2014. The vascular flora of the Old Cahawba Forever Wild Tract, Dallas County, Alabama. Southeastern Naturalist 13:288–316.

Barneby, R.C. 1977. *Daleae imagines;* an illustrated revision *of Errazuriza* Philippi, *Psorothamnus* Rydberg, *Mariana* Leibmann, and *Dalea* Lucanus emend. Barneby, including all species of Leguminosae tribe Amorpheae Borissova ever referred to *Dalea.* Memoirs New York Bot. Gard. 27:viii + 891 pp.

Barneby, R.C., and E.L. Bridges. 1987. A new species of *Astragalus* (Fabaceae) from Tennessee's Central Basin. Brittonia 39(3): 358-363.

Barrett, S.C.H,. and J.R. Kohn. 1991. Genetic and evolutionary consequences of small population size in plants: implications for conservation. *In* D.A. Falk and K.E. Holsinger (eds.), Genetics and Conservation of Rare Plants. Oxford University Press, New York, NY.

Baskin, C.C., and J.M. Baskin. 2000. Seed germination ecology of *Lesquerella lyrata Rollins* (Brassicaeae), a federally threatened winter annual. Natural Areas Journal 20: 159-165.

Baskin, J.M., and C.C. Baskin. 1972. Influence of germination date on survival and seed production in a natural population of *Leavenworthia stylosa*. American Midland Naturalist, Vol. 88, No. 2, pp. 318-323.

Baskin, J.M., and C.C. Baskin. 1973. The past and present geographical distribution of *Petalostemon foliosus* and notes on its ecology. Rhodora 75:132-140.

Baskin, J.M., and C.C. Baskin. 1989. Cedar glade endemics in Tennessee and a review of their autecology. J. Tenn. Acad. Sci. 64(3):63-74.

Baskin, J.M., and C.C. Baskin. 1998. Studies on seed dormancy and germination in *Lesquerella lyrata* (Brassicaceae), Montgomery, Alabama. 23 pp.

Bateman, A.J. 1955. Self-incompatibility systems in angiosperms. III. Cruciferae. Heredity 9:53-68.

Bhattacharya, M., R.B. Primack, and J. Gerwein. 2003. Are roads and railroads barriers to bumblebee movement in a temperate suburban conservation area? Biological Conservation 109:37–45.

Boyd, R.S. 2014. Reproductive biology of the federally threatened Price's potato-bean (*Apios priceana*). Unpublished report to U.S. Department of the Army, Redstone Arsenal, Alabama.

Boyd, R.S. 2015. Alabama leather flower. Encyclopedia of Alabama. http://www.encyclopediaofalabama.org/article/h-3662?printable=true, accessed March 2019.

Boyd, R.S, and J.M. Moffett. 2010. Population Survey of the Federally Endangered Tennessee Yellow-Eyed Grass (*Xyris tennesseensis*). Auburn University, Alabama. 12pp.

Boyd, R.S., and K. Paris. 2013. Report on reproductive attrition, insect herbivory manipulation, and a survey of Alabama and Tennessee populations of Morefield's leather flower (*Clematis morefieldii*). Unpublished report for the U.S. Fish and Wildlife Service.

Bridges, E. 1984. Element Stewardship Abstract for *Scutellaria montana.* Tennessee Natural Heritage Program files.

Bruneau, A., and G. J. Anderson. 1988. Reproductive biology of diploid and triploid *Apios americana* (Leguminosae). American Journal of Botany 75:1876–1883.

Carter, R., T. Boyer, H. McCoy, and A. Londo. 2006. Classification of green pitcher plant (*Sarracenia oreophila* (Kearney) Wherry) communities in the Little River Canyon National Preserve, Alabama. Natural Areas Journal 26:84-93.

Catalani, M. 2004. A field study of *Sarracenia oreophila*. Carnivorous Plant Newsletter 33:6-12.

Chafin, L.G. 2007. Field Guide to the Rare Plants of Georgia. State Botanical Garden of Georgia, Athens, Georgia.

Chafin, L.G. 2008. Field guide to the rare plants of Georgia. State Botanical Garden of Georgia. Athens, GA.

Chester, E.W., and S.E. Holt. 1990. An update on Price's potato bean. Kentucky Native Plant Society Newsletter. 5:7–8.

Claerbout, A.E., J.M. Coons, H.R. Owen, and K.R. Robertson. 2007. *Castanea*, Vol. 72, No. 3 (Sep., 2007), pp. 130-137.

Cook, T.L. 2018. Phytogeographic analysis of *Clematis morefieldii* in the Southern Cumberland Plateau. M.S. Thesis. Alabama A&M University, Normal, Alabama.

Crabtree, T. 2011. Monitoring of *Clematis morefieldii* Kral in Tennessee. Unpublished report for the U.S. Fish and Wildlife Service.

Crabtree, T. 2014. 2013 Monitoring of *Clematis morefieldii* Kral in Tennessee. Unpublished report for the U.S. Fish and Wildlife Service.

Cruzan, M.B. 2001. Population size and fragmentation thresholds for the maintenance of genetic diversity in the herbaceous endemic *Scutellaria montana* (Lamiaceae). Evolution 55: 1569-1580.

Currah, R.S., L.W. Zettler, and T.M. McInnis. 1997. *Epulorhiza inquiline sp*. nov. from *Platanthera* (Orchidaceae) and a key to *Epulorhiza* species. Mycotaxon. January – March 1997. Volume LXI, pp.335-342.

Davenport, L.J. 2007. Climate change and its potential effects on Alabama's plant life. Department of Biological and Environmental Sciences, Samford University, Birmingham, AL. 75 pp. https://www.samford.edu/images/Davenport_CLIMATECHANGE2007.pdf, accessed March 2019.

Dennis, W.M. 1980. *Sarracenia oreophila* (Kearney) Wherry in the Blue Ridge Province of northeast Georgia. Castanea 45(2):101-102.

Ebinger, J.E., L.R. Phillippe, M.J.C. Murphy, G.C. Tucker, and P. Marcum. 2010. Vascular plant species extirpated or not vouchered as occurring in Illinois. Erigenia 23:3–23.

Edens-Meier R., M. Arduser, E. Westhus, P. Bernhardt. 2011. Pollination ecology of *Cypripedium reginae* Walter (Orchidaceae): size matters. Telopea 13: 327–340.

Ellis, J.R. 2008. Conservation genetics of the endangered sunflower *Helianthus verticillatus*. Doctoral dissertation, Vanderbilt University.

Ellis, J.R., and D.E. McCauley. 2009. Phenotypic differentiation in fitness related traits between populations of an extremely rare sunflower: conservation management of isolated populations. Biological Conservation 142:1836–1843.

Ellis, J.R., C.H. Pashley, J.M. Burke, and D.E. McCauley. 2006. High genetic diversity in a rare and endangered sunflower as compared to a common congener. Molecular Ecology 15:2345–2355.

Ellstrand, N.C., and D.R. Elam. 1993. Population genetic consequences of small population size: implications for plant conservation. Annual Review of Ecology and Systematics 24, pp. 217-242.

Emanuel, C. 2000. Monitoring report for Morefield's leather flower, *Clematis morefieldii*. Unpublished report for the U.S. Fish and Wildlife Service, Jackson, Mississippi.

Emanuel, C.M. 1998. Vegetation management plan for *Sarracenia oreophila*, green pitcher plant. Prepared for Little River Canyon National Preserve, Ft. Payne, Alabama. 57 pp. + appendices.

Fenneman, N.M. 1938. Physiography of eastern United States. McGraw-Hill Book Co., New York.

Fernald, M.L. 1950. Gray's manual of botany. 8th ed. American Book Co., New York.

Fitch, E. A., J. L. Walck, and S. N. Hidayati. 2007. Agroecosystem management for rare species of *Paysonia* (Brassicaceae): integrating their seed ecology and life cycle with cropping regimens in a changing climate. American Journal of Botany 94:102-110.

Folkerts, G.W. 1992. Identification and measurement of damage caused by flower and seed predators associated with *Sarracenia oreophila* and recommended management/control measures deemed appropriate. Unpublished report to U.S. Fish and Wildlife Service, Jackson, Mississippi. 52 pp.

Folkerts. D. 1999. Pitcher plant wetlands of the southeastern United States. Arthropod associates. In: D.P. Batzer, R.B. Rader, and S.A. Wissinger, eds. Invertebrates in freshwater wetlands of North America: ecology and management. John Wiley and Sons, New York, pp. 247-275.

Georgia Department of Natural Resources. 2018. Element occurrence records for *Clematis morefieldii*. Accessed April 16, 2018.

Gleason, H.A., and A. Cronquist. 1963. Manual of the vascular plants of Northeastern United States and adjacent Canada. Second edition. New York Botanical Garden, Bronx, New York.

Goertzen, L.R., and R.S. Boyd. 2007. Genetic diversity and clonality in the federally endangered plant *Clematis socialis* Kral (Ranunculaceae). Journal of the Torrey Botanical Society 134:433-440.

Goertzen, L.R., J.L. Trusty, and R.S. Boyd. 2011. Clonal diversity and genetic structure in the endangered Alabama leather-flower *Clematis socialis* Kral (Ranunculaceae). Journal of the Torrey Botanical Society 138:41-51.

Hagen, M., M. Wikelski, and W.D. Kissling. 2011. Space use of bumblebees (*Bombus* spp.) revealed by radio-tracking. PLoS One 6:e19997. doi:10.1371/journal.pone.0019997.

Hatch, S.L., and D.A. Kruse. 2008. The vascular flora of the Natchez Trace Parkway (Franklin, Tennessee to Natchez, Mississippi). Results of a floristic inventory, August 2004 – August 2006. Unpublished report submitted to Gulf Coast Inventory and Monitoring Network, Lafayette, Louisiana.

Hawkins, B., S. Sharrock, and K. Havens. 2008. Plants and climate change: which future? Botanic Gardens Conservation International, Richmond, UK. 96 pp.

Hilton, J.L. 1996. North Alabama Glade Study. Unpublished report to U.S. Fish and Wildlife Service, Jackson, Mississippi. 88pp. and appendices.

Hilton, J.L. 1997. North Alabama Glade Study. Unpublished report to U.S. Fish and Wildlife Service. Jackson, MS. 96 pp.

Illinois Department of Natural Resources. 2008. Illinois Natural Heritage Database. Springfield, Illinois. Data released to U.S. Fish and Wildlife Service, Cookeville, Tennessee, on August 18, 2008.

Isotria Workshop. 2016. Sponsered by the Smithsonian Environmental Research Center, Charles McC. Mathias Laboratory on the campus of the Smithsonian Environmental Research Center in Edgewater, Md., November 17 – 18, 2016.

Johnson, T., J.M. Cruse-Sanders, and G.S. Pullman. 2012. In Vitro Cellular & Developmental Biology 48: 369-376.

Kentucky State Nature Preserves Commission. 2015. Kentucky Natural Heritage Program Database. Unpublished data provided to U.S. Fish and Wildlife Service, Cookeville, Tennessee, 27 March 2015.

Key, R. 2004. Status and population trends of the federal endangered leafy prairie clover, Lockport Prairie Nature Preserve. Presentation at the 31st Natural Areas Conference, Chicago, Illinois.

Kile, H.M., J. Shaw, and J.N. Boyd. 2013. Response of Federally threatened *Scutellaria montana* (large-flowered skullcap) to pre-transplantation burning and canopy thinning. Southeastern Naturalist 12:99-120.

Klank, C., J. Ghazoul, and A.R.Pluess. 2012. Genetic variation and plant performance in fragmented populations of globeflowers (*Trollius europaeus*) within agricultural landscapes. Conserv Genet. 13: 873–884.

Knight, M.E., A.P. Martin, S. Bishop, J.L. Osborne, R.J. Hale, R.A. Sanderson, and D. Goulson. 2005. An interspecific comparison of foraging range and nest density of four bumblebee (*Bombus*) species. Molecular Ecology 14:1811–1820.

Koelling, V.A., J.L. Hamrick, and R. Mauricio. 2011. Genetic diversity and structure in two species of *Leavenworthia* with self-incompatible and self-compatible populations. Heredity 106: 310–318.

Koelling, V.A., and R. Mauricio. 2010. Genetic factors associated with mating system cause a partial reproductive barrier between two parapatric species of *Leavenworthia* (Brassicaceae). American Journal of Botany 97(3): 412–422.

Kral, R. 1983. A Report of Some Rare, Threatened, and Endangered Forest Related Vascular Plants of the South. USDA Forest Service, Southern Region, Technical Publication R8-TP 2. Volume 1:522-524.

Kral, R. 1987. A new "Viorna" *Clematis* from northern Alabama. Annals of the Missouri Botanical Garden 74:665–669.

Lichvar, R.W., D.L. Banks, W.N. Kirchner, and N.C. Melvin. 2016. The National Wetland Plant List: 2016 wetland ratings. Phytoneuron 2016-30:1-17.

Lloyd, D.G. 1965. Evolution of self-compatability and racial differentiation in *Leavenworthia* (Cruciferae). Contr. Gray Herb. 195: 1-134.

Mandel, J.R. 2010. Clonal diversity, spatial dynamics, and small genetic population size in the rare sunflower, *Helianthus verticillatus*. Conservation Genetics 11:2055–2059.

Matthews, J.F., J.R. Allison, R.T. Ware, Sr., and C. Nordman. 2002. *Helianthus verticillatus* small (Asteraceae) rediscovered and redescribed. Castanea 67:13–24.

McDaniel, S., and E. Lyons. 1987. Final status report on *Leavenworthia crassa*. Submitted to the U.S. Fish and Wildlife Service, Endangered Species Office, Jackson, MS (unpublished).

McDaniel, S.T. 1987. Final Status Report on *Lesquerella lyrata Rollins*. Unpublished report to U.S. Fish and Wildlife Service, Jackson, Mississippi. 15 pp.

Medley, M.E. 1980. Status report on *Apios priceana*. Unpublished report for U.S. Fish and Wildlife Service contract #14-16-0004-79-105.

Memmott, J., P.G. Craze, N.M. Waser, and M.V. Price. 2007. Global warming and the disruption of plant-pollinator interactions. Ecology Letters 10, pp. 710-717.

Moffett, J.M. Jr. 2008. *Xyris tennesseensis*: Status survey, habitat restoration/management concerns, and relation to a new xyrid, *Xyris spathifolia*. Ph.D. dissertation, Auburn University, 196 pp.

Molano-Flores, B. 2004. Reproductive success of the federally endangered leafy prairie clover, *Dalea foliosa* (A. Gray) Barneby (Fabaceae) in Illinois: a third year of data. Castanea 69:9-14.

Molano-Flores, B., and Bell, T.J. 2012. Projected population dynamics for a federally endangered plant under different climate change emission scenarios. Biological Conservation 145:130-138.

Morris, A.B., R.S. Baucom, and M.B. Cruzan. 2002. Stratified analysis of the soil seed bank in the cedar glade endemic, *Astragalus bibullatus*: Evidence for historical changes in genetic structure. American Journal of Botany 89:29-36.

NatureServe Explorer. 2018a. *Isotria medeoloides* - (Pursh) Raf. Updated March 2018. Available: http://explorer.natureserve.org/servlet/NatureServe?searchName=Isotria+medeoloides (Accessed March 28, 2019).

NatureServe Explorer. 2018b. *Lesquerella globosa*. Updated March 2018. Available: http://explorer.natureserve.org/servlet/NatureServe?searchName=Lesquerella+globosa) (Accessed November 14, 2018).

Osborne, J.L., A.P. Martin, N.L. Carreck, J.L. Swain, M.E. Knight, D. Goulson, R.J. Hale, and R.A. Sanderson. 2008. Bumblebee flight distances in relation to the forage landscape. Journal of Animal Ecology 77:406–415.

Paris, K.J. 2013. Population status and reproductive biology of *Clematis morefieldii*, a federally endangered plant. M.S. Thesis, Auburn University, Alabama.

Paris, K.J., K. Burgess, A.N. Wright, and R.S. Boyd. 2015. Impact of insecticide treatment on herbivory and reproductive success of the federally endangered plant *Clematis morefieldii* Kral. Castanea 80:229–242.

Paris, K.J., K. Burgess, A.N. Wright, and R.S. Boyd. 2016. Reproductive biology of the federally endangered *Clematis morefieldii* Kral (Ranunculaceae). Castanea 81:175–187.

Patrick, T.S., J.R. Allison, and G.A. Krakow. 1995. Protected plants of Georgia. Georgia Department of Natural Resources, Wildlife Resources Division.

Pearson, P.B. 1967. Germination and Dormancy in Five Species of *Lesquerella*. A thesis presented to the Graduate Faculty of Vanderbilt University, Nashville, Tennessee.

Phillips, N.M.M. 2006. Vascular flora and gradient analysis of the Natchez Trace Parkway. M.S. Thesis. Texas A&M University.

Primack, R.B. 1998. *Essentials of Conservation Biology*. Sinauer Associates, Sunderland, Massachusetts. 660 pp.

Pyne, M., M. Gay, and A. Shea. 1995. Guide to rare plants - Tennessee Division of Forestry District 5. Tennessee Dept. Agriculture, Division of Forestry, Nashville.

Rasmussen. H.N., and D.F. Whigham. 1993. American Journal of Botany, Vol. 80, No. 12 (Dec. 1993), pp. 1374-1378.

Redmer, M., and K. Lah. 2008. A Dolomite-Paved Road to Recovery for the Endangered Leafy Prairie Clover. U.S. Fish & Wildlife Service Field Notes, Region 3, July 21, 2008. 2pp.

Robinson, B. L. 1898. A new species of *Apios* from Kentucky. Botanical Gazette 25:450–453.

Rollins, R.C. 1955. The articulate-leaved species of *Lesquerella* (Cruciferae). Rhodora 57:241-264.

Rollins, R.C. 1963. The evolution and systematics of *Leavenworthia* (Cruciferae). Contrib. Gray Herb. No. 192: 3-98.

Schotz, A.R. 2001. Status survey report on *Helianthus verticillatus* in Alabama. Alabama Natural Heritage Program, Huntingdon College, Montgomery, Alabama. Unpublished report for U.S. Fish and Wildlife Service, Jackson, Mississippi.

Schotz, A. 2008. E-mail to Cary Norquist, Alabama Natural Heritage Program, Auburn, Alabama. July 31, 2008.

Schotz, A. 2011. Status assessment of *Dalea foliosa* (Gray) Barneby, the leafy prairie clover, in Alabama. Unpublished report from Alabama Natural Heritage Program to U.S. Fish and Wildlife Service, Cookeville, Tennessee. December 31, 2011. 21 pp.

Schotz, A. 2014. Range-wide status update on *Marshallia mohrii* Beadle (Asteraceae, Mohr's Barbara's-buttons). Unpublished report for U.S. Fish and Wildlife Service, Jackson, MS. 102 pp. and appendices.

Seabrook, J.A.E., and L.A. Dionne. 1976. Studies on the genus *Apios*. I. Chromosome number and distribution of *Apios americana* and *A. priceana*. Canadian Journal of Botany 54:2567–2572.

Shea, M.M. 1992. Status Survey Report on *Plantanthera integrilabia*. Kentucky Endangered Plant Species Program, United States Fish and Wildlife Service Cooperative Agreement No. 14-126-0004-89-956, Work Order No. 90-2, Frankfort, Kentucky. March 1992. 45 pp and appendices.

Shea, M.M. 1993. Status Survey Report on *Lesquerella globosa* (Desv.) Wats. Unpublished Report. Kentucky State Nature Preserves Commission. 122 pp.

Silva, N.F., and D.R. Goring. 2001. Mechanisms of self-incompatibility in flowering plants. Cellular and Molecular Life Sciences 58:1988–2007.

Somers, P. and S.C. Gunn. 1990. Status report, *Astragalus bibullatus*. Unpublished report to the Southeast Region, U.S. Fish and Wildlife Service. 33 pp.

Sutter, R., and N. Rudd. 1997. Monitoring protocols for *Sarracenia oreophila* (Green pitcher plant). Unpublished report for The Nature Conservancy, Southeast Conservation Science Department, Southeast Regional Office, Chapel Hill, NC. 20 pp. + appendices.

Taft, J.B., Z. Kron, A. Dombrowski. 2010. 2010 monitoring results for the threatened and endangered plant species in the Interstate 355 South Extension Crossing of the Des Plaines River Valley. Unpublished report to Illinois State Toll Highway Authority from Illinois Natural History Survey, Champaign, Illinois. December 15, 2010. 17 pp.

Takayama, S., and A. Isogai. 2005. Self-incompatibility in plants. Annu Rev Plant Biol 56:467-489.

Tennessee Department of Environment and Conservation. 2004a. *Dalea foliosa* Recovery: Survey for new populations, assessment of known sites, and prioritization of known sites. Unpublished report to U.S. Fish and Wildlife Service, Cookeville, Tennessee. 12 pp + Appendices.

Tennessee Department of Environment and Conservation. 2004b. Monitoring leafy prairie clover (*Dalea* foliosa) on the former Tennessee Valley Authority Columbia Dam Project Lands (Yanahli Wildlife Management Area/Duck River Complex State Natural Area). Unpublished report to U.S. Fish and Widlife Service, Atlanta, Georgia. 13 pp.

Tennessee Department of Environment and Conservation. 2005. *Astragalus bibullatus, Dalea foliosa,* and *Echinacea tennesseensis* Population Monitoring. Unpublished report to the U.S. Fish and Wildlife Service. 29 pp.

Tennessee Department of Environment and Conservation. 2008. Large-flowered skullcap (*Scutellaria montana*) population monitoring for 2007. Unpublished report prepared by Tennessee Department of Environment and Conservation, Division of Natural Areas, for U.S. Fish and Wildlife Service, Cookeville, Tennessee. January 2008. 17 pp.

Tennessee Department of Environment and Conservation. 2011a. Tennessee Natural Heritage Inventory Database. Nashville, Tennessee. Data exported to U.S. Fish and Wildlife Service November 2011.

Tennessee Department of Environment and Conservation. 2011b. Status report for *Arenaria cumberlandensis* Wofford & Kral (*Minuartia cumberlandensis* (Wofford & Kral) McNeill), Cumberland sandwort. Prepared for U.S. Fish and Wildlife Service, Cookeville, Tennessee, March 2011. 51 pp.

Tennessee Department of Environment and Conservation. 2012. 2010-2011 population monitoring of *Apios priceana*, Price's potato-bean. Unpublished report to U.S. Fish and Wildlife Service, Atlanta, Georgia. December 2012.

Tennessee Department of Environment and Conservation. 2014. 2009 Status survey for *Scutellaria montana* Chapman (large-flowered skullcap) in Tennessee. Unpublished report prepared by Tennessee Department of Environment and Conservation, Natural Heritage Program, for U.S. Fish and Wildlife Service, Cookeville, Tennessee. January 2014. 104 pp.

Tennessee Department of Environment and Conservation. 2015. Tennessee Natural Heritage Inventory Database. Nashville, Tennessee.

Tennessee Department of Environment and Conservation. 2018. Tennessee Natural Heritage Inventory Database. May 2018.

Tennessee Division of Natural Areas. 2008a. Survey for new populations of *Helianthus verticillatus*, whorled sunflower. Unpublished report to U.S. Fish and Wildlife Service.

Tennessee Division of Natural Areas. 2008b. Report on 2007-2008 population monitoring for *Lesquerella perforata* (Rollins), Spring Creek bladderpod. Unpublished report to U.S. Fish and Wildlife Service, Atlanta, Georgia. 8 pp.

Tennessee Natural Heritage Program. 2018. Element occurrence records for *Clematis morefieldii*. Accessed July 11, 2018.

Tennessee Valley Authority. 2014. Tennessee Valley Authority Natural Heritage Project. Unpublished data provided to U.S. Fish and Wildlife Service, Cookeville, Tennessee. March 24, 2009.

Tennessee Valley Authority. 2015a. Guideline for Vegetation Maintenance, Site Specific Environmental Reviews & Permitting. Revision 5.

Tennessee Valley Authority. 2015b. *Marshallia mohrii* element occurrence records. Tennessee Valley Authority Regional Natural Heritage Project, Knoxville, TN. Accessed February 10, 2015.

Tennessee Valley Authority. 2017a. A guide for environmental protection and best management practices for Tennessee Valley Authority construction and maintenance activities, revision 3. Edited by G. Behel, S. Benefield, R. Brannon, C. Buttram, G. Dalton, C. Ellis, C. Henley, T. Korth, T. Giles, A. Masters, J. Melton, R. Smith, J. Turk, T. White, and R. Wilson. Chattanooga, TN. Retrieved from https://www.tva.com/file_source/TVA/Site%20Content/Energy/Transmission/Transmission-Projects/pdf/BMP%20Manual%20Revision%203.0_FINAL_8-4-17.pdf (accessed January 2018).

Tennessee Valley Authority. 2017b. Transmission Environmental Protection Procedures, Right-Of-Way Vegetation Management Guidelines, Revision 8, April 2017.

Tennessee Valley Authority. 2018. TVA Regional Natural Heritage Database.

Tepedino, V.J., W.R. Bowlin, and T.L. Griswold. 2012. Pollinators complication conservation of an endemic plant: *Physaria obcordata* (Cruciferae) in the Piceance Basin, Colorado. Natural Areas Journal 32:140-148.

Troup, R.L., and S. McDaniel. 980. Current status report on *Sarracenia oreophila*. Unpublished report for the U.S. Fish and Wildlife Service. 62 pp.

U. S. Dept. of Agriculture/Soil Conservation Service. 1977. Soil Survey of Rutherford County. United States Department of Agriculture, Soil Conservation Service, in cooperation with the University of Tennessee Agricultural Experiment Station. 95 pp.

U.S. Fish and Wildlife Service. 1990. Endangered and threatened wildlife and plants; determination of threatened status for the plant *Lesquerella lyrata* (lyrate bldderpod). 55 FR 39869.

U.S. Fish and Wildlife Service. 1992. Small whorled pogonia (*Isotria medeoloides*) recovery plan, first revision. Northeast Regional Office, Newton Corner, MA. 62 pp and appendices.

U.S. Fish and Wildlife Service. 1993. Recovery Plan for *Apios priceana*. Jackson, Mississippi.

U.S. Fish and Wildlife Service. 1994a. Recovery plan for Morefield's leather flower (*Clematis morefieldii*). U.S. Fish and Wildlife Service, Southeast Region, Atlanta, Georgia.

U.S. Fish and Wildlife Service. 1994b. Green pitcher plant recovery plan. U.S. Fish and Wildlife Service, Jackson, Mississippi. 24 pp.

U.S. Fish and Wildlife Service. 1996a. Recovery Plan for the Leafy Prairie-clover (*Dalea Foliosa*). Southeast Region, Atlanta, Georgia. 74 pp.

U.S. Fish and Wildlife Service. 1996b. Recovery plan for the lyrate bladderpod (*Lesquerella lyrata Rollins*). Atlanta, Georgia. 27 pp.

U.S. Fish and Wildlife Service. 1996c. Recovery Plan for Cumberland Sandwort (*Arenaria cumberlandensis*). Southeast Region, Atlanta, Georgia. 28 pp.

U.S. Fish and Wildlife Service. 1996d. Recovery Plan for Large-flowered Skullcap (*Scutellaria montana*). Southeast Region, Atlanta, Georgia. 30 pp and appendix.

U. S. Fish and Wildlife Service. 1997. Recovery Plan for Arabis perstellata Braun (Braun's Rockcress), Atlanta, Georgia, 21 pp.

U.S. Fish and Wildlife Service. 2006. Recovery Plan for the *Lesquerella perforate* (Spring Creek bladderpod). Southeast Region, Atlanta, Georgia. 24 pp.

U.S. Fish and Wildlife Service. 2008. Small whorled pogonia (*Isotria medeoloides*) 5-year review: summary and evaluation. New England Field Office, Concord, NH. 18 pp and appendices.

U.S. Fish and Wildlife Service. 2010. Morefield's leather flower (*Clematis morefieldii*) 5-year review: summary and evaluation. U.S. Fish and Wildlife Service, Southeast Region, Jackson, Mississippi. 11 pp and appendix.

U.S. Fish and Wildlife Service. 2011a. Recovery Plan for *Astragalus bibullatus* (Pyne's ground-plum). Tennessee Ecolological Services Field Office, Cookeville, Tennessee. 42 pp and appendix.

U.S. Fish and Wildlife Service. 2011b. Pyne's ground-plum (*Astragalus bibullatus*) 5-Year Review: Summary and Evaluation. Southeast Region, Cookeville Ecological Services Field Office, Cookeville, Tennessee. 29 pp and appendix.

U.S. Fish and Wildlife Service. 2011c. Spring Creek bladderpod (*Lesquerella perforata*) 5-Year Review: Summary and Evaluation. Southeast Region, Cookeville Ecological Services Field Office, Cookeville, Tennessee. 13 pp and appendix.

U.S. Fish and Wildlife Service. 2013. Cumberland Sandwort (*Arenaria cumberlandensis* Wofford and Kral) (=*Minuartia cumberlandensis* (Wofford and Kral) McNeill) 5-Year Review: Summary and Evaluation. Southeast Region, Tennessee Ecological Services Field Office, Cookeville, Tennessee. 22 pp.

U.S. Fish and Wildlife Service. 2014a. Green pitcher plant (*Sarracenia oreophila*) 5-year review: summary and evaluation. U.S. Fish and Wildlife Service, Jackson, Mississippi. 34 pp.

U.S. Fish and Wildlife Service. 2014b. Tennessee yellow-eyed grass (*Xyris tennesseensis* Kral) 5-Year Review: Summary and Evaluation. Southeast Region, Alabama Ecological Services Field Office, Daphne, Alabama. 12 pp and appendix.

U.S. Fish and Wildlife Service. 2015a. Large-flowered Skullcap (*Scutellaria montana*) 5-Year Review: Summary and Evaluation. Southeast Region, Tennessee Ecological Services Field Office, Cookeville, Tennessee. 22 pp and appendices.

U.S. Fish and Wildlife Service. 2015b. Leafy prairie-clover *(Dalea foliosa)* 5-Year Review: Summary and Evaluation. Southeast Region, Tennessee Ecological Services Field Office, Cookeville, Tennessee. 28 pp.

U.S. Fish and Wildlife Service. 2016a. Price's potato-bean (*Apios priceana*) 5-year review: summary and evaluation. U.S. Fish and Wildlife Service, Cookeville, Tennessee.

U.S. Fish and Wildlife Service. 2016b. Mohr's Barbara's buttons (*Marshallia mohriis*) 5-year review: summary and evaluation. Southeast Region, Mississippi Field Office, Jackson.

U.S. Fish and Wildlife Service. 2017. Alabama leather-flower (*Clematis socialis*) 5-year review: summary and evaluation. Southeast Region, Mississippi Field Office, Jackson.

U.S. Fish and Wildlife Service. 2018a. Amendment to 2010 Braun's Rockcress (*Arabis perstellata*) 5-Year Review: Summary and Evaluation. Southeast Region, Kentucky Ecological Services Field Office, Frankfort, Kentucky. 13 pp and appendices.

U.S. Fish and Wildlife Service. 2018b. Morefield's leather flower (*Clematis morefieldii*) 5-year review: summary and evaluation. U.S. Fish and Wildlife Service, Southeast Region, Jackson, Mississippi. 11pp, and appendix and addendum.

U.S. Fish and Wildlife Service. 2018c. Short's bladderpod (*Physaria globosa*), Status: Endangered. Midwest Region. Available: https://www.fws.gov/midwest/endangered/plants/shortsbladderpod/index.html (Accessed online November 9, 2018).

U.S. Forest Service. 2009. Monitoring and evaluation report: Land Between the Lakes National Recreation Area, fiscal year 2009.

U.S. Forest Service. 2018. Recovery of Leafy Prairie-clover in Illinois, Contributing to the Recovery of Leafy Prairie-Clover in Northeastern Illinois by Growing Plants from Seed and Planting in Restored Dolomite Prairie Habitat, 2 pp. Available: https://www.fs.fed.us/wildflowers/Rare_Plants/conservation/success/dalea_foliosa_recovery.shtml (Accessed online October 30, 2018).

U.S. Forest Service. no date. Monitoring and evaluation report, fiscal years 2010 and 2011, Midewin National Tallgrass Prairie. Unpublished report by U.S. Department of Agriculture, Forest Service. 41 pp. Available: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3810663.pdf (Accessed online March 13, 2015).

Walter, W.M., E.M. Croom Jr., G.L. Catignant, and W.C. Thresher. 1986. Compositional study of *Apios priceana* tubers. Journal of Agricultural and Food Chemistry 34:39–41.

Weakley, A.S. 2008. Flora of the Carolinas, Virginia, Georgia, Northern Florida, and Surrounding Areas. University of North Carolina, Chapel Hill, NC. Working draft of April 7, 2008. 924 pp.

Weakley, A.S. 2015. Flora of the Southern and Mid-Atlantic States. Working Draft of 21 May 2015. University of North Carolina Herbarium, Chapel Hill.

Webb, D.H., and R. Kral. 1986. Recent collections and status of *Lesquerella lyrata Rollins* (Cruciferae). Sida 11 (3): 347-351.

Weber, S.F. 1991. Status report on *Clematis morefieldii*. Unpublished report to U.S. Fish and Wildlife Service, Southeast Region, Jackson, Mississippi.

Weber, S. F. 1994. Status report on *Clematis morefieldii*. Unpublished report to the U.S. Fish and Wildlife Service, Jackson, Mississippi.

Wemple, D.K. 1970. Revision of the genus *Petalostemum* (Leguminosae). Iowa St. J. Sci. 45(1 1):1-102.

Winder, C. T. 2004. Levels and patterns of genetic diversity in the rare and endangered Cumberland stitchwort, *Minuartia cumberlandensis* (Caryophyllaceae). Unpublished M.S. thesis, University of Tennessee, Knoxville. December 2004. 73 pp.

Wofford, E. 2011. E-mail. Geoff Call, Recovery Coordinator, Tennessee Ecological Services Field Office. RE: inquiry about A. bibullatus specimen. Research Associate Professor, University of Tennessee, March 23, 2011.

Woods, M. 1988. A revision of *Apios* and *Cochlianthus* (Leguminosae). Doctoral dissertation. Southern Illinois University, Carbondale, Illinois.

Wurdack, K. 2011. E-mail. Geoff Call, Recovery Coordinator, Tennessee Ecological Services Field Office. RE: inquiry about specimens of *Astragalus bibullatus*. Research Scientist and Associate Curator, Botany Department, Smithsonian Institution, March 24, 2011.

Yoder. J.A., S.M. Imfeld, D.J. Heydinger, C.E. Hart, M.H. Collier, K.M. Gribbins, and L.W. Zettler. 2010. Comparative water balance profiles of Orchidaceae seeds for epiphytic and terrestrial taxa endemic to North America. Plant Ecology (2010) 211, pp. 7–17.

Yoder, J.A., L.W. Zettler, and S.L. Stewart. 2000. Water requirements of terrestrial and epiphytic orchid seeds and seedlings, and evidence for water uptake by means of mycotrophy. Plant Science 156 (2000), pp. 145-150.

Zettler, L.W., N.S. Ahuja, and T.M. McInnis, Jr. 1996. *Castanea*, Vol. 61, No. 1 (Mar., 1996), pp. 14-24.

Zettler, L.W., and J.E. Fairey, III. 1990. The Status of *Platanthera integrilabia*. An Endangered Terrestrial Orchid. Lindleyana Vol. 5, No. 4, pp. 212-217.

Zettler, L.W., and T.M. McInnis, Jr. 1992. Propagation of *Platanthera integrilabia* (Correll) Luer, An Endangered Terrestrial Orchid, Through Symbiotic Seed germination. Lindleyana 7(3), pp. 154-161.

Tennessee Department of Environment and Conservation. 2018. Tennessee Natural Heritage Inventory Database. May 2018.

25. APPENDIX I - NOT LIKELY TO ADVERSELY AFFECT SPECIES

Listed species (LE=listed as endangered; LT=listed as threatened) and designated critical habitats (CH) that TVA has determined the proposed Action is not likely to adversely affect (NLAA).

Scientific Name	Common Name	Federal Status	CH (Y=Yes)	TVA Species Determination	TVA CH Determination
Mammals					
Glaucomys sabrinus coloratus	Carolina Northern Flying Squirrel	LE	-	NLAA	-
Birds					
Charadrius melodus	Piping Plover	LT	-	NLAA	-
Grus americana	Whooping Crane	LE	-	NLAA	-
Mycteria americana	Wood Stork	LT	-	NLAA	-
Picoides borealis	Red-cockaded Woodpecker	LE	-	NLAA	-
Sterna antillarum athalassos	Interior Least Tern	LE	-	NLAA	-
Reptiles					
Graptemys oculifera	Ringed Map Turtle	LT	-	NLAA	-
Sternotherus depressus	Flattened Musk Turtle	LT	-	NLAA	-
Amphibians					
Gyrinophilus gulolineatus	Berry Cave Salamander	C	-	NLAA	-
Necturus alabamensis	Black Warrior Waterdog	LE	Y	NLAA	NLAA
Fishes					
Acipenser oxyrinchus desotoi	Gulf Sturgeon	LT	-	NLAA	-
Chrosomus saylori	Laurel Dace	LE	Y	NLAA	NLAA
Cottus paulus (pygmaeus)	Pygmy Sculpin	LT	Proposed	NLAA	NE*
Crystallaria cincotta	Diamond Darter	LE	Y	NLAA	NLAA
Cyprinella caerulea	Blue Shiner	LT	-	NLAA	-
Elassoma alabamae	Spring Pygmy Sunfish	LT	Proposed	NLAA	NLAA
Erimonax monachus	Spotfin Chub	LT	Y	NLAA	NLAA
Erimystax cahni	Slender Chub	LT	Y	NLAA	NLAA
Etheostoma akatulo	Bluemask Darter	LE	-	NLAA	-
Etheostoma boschungi	Slackwater Darter	LT	Y	NLAA	NLAA
Etheostoma chermocki	Vermilion Darter	LE	Y	NLAA	NE*
Etheostoma chienense	Relict Darter	LE	-	NLAA	-

Scientific Name	Common Name	Federal Status	CH (Y=Yes)	TVA Species Determination	TVA CH Determination
Etheostoma nuchale	Watercress darter	LE	-	NLAA	-
Etheostoma percnurum	Duskytail Darter	LE	-	NLAA	-
Etheostoma phytophilum	Rush Darter	LE	Y	NLAA	NE*
Etheostoma rubrum	Bayou Darter	LT	-	NLAA	-
Etheostoma spilotum	Kentucky Arrow Darter	LT	-	NLAA	-
Etheostoma susanae	Cumberland Darter	LE	Y	NLAA	NLAA
Etheostoma trisella	Trispot Darter	PT	-	NLAA	-
Etheostoma wapiti	Boulder Darter	LE	-	NLAA	-
Moxostoma sp. 2	Sicklefin Redhorse	Under Review	-	NLAA	-
Notropis albizonatus	Palezone Shiner	LE	-	NLAA	-
Notropis cahabae	Cahaba Shiner	LE	Proposed	NLAA	NE*
Noturus baileyi	Smoky Madtom	LE	Y	NLAA	NE*
Noturus crypticus	Chucky Madtom	LE	Y	NLAA	NE*
Noturus flavipinnis	Yellowfin Madtom	LT	Y	NLAA	NE*
Noturus stanauli	Pygmy Madtom	LE	-	NLAA	-
Percina antesella	Amber Darter	LE	Y	NLAA	NLAA
Percina aurolineata	Goldline Darter	LT	Proposed	NLAA	NE*
Percina aurora	Pearl Darter	LT	-	NLAA	-
Percina jenkinsi	Conasauga Logperch	LE	Y	NLAA	NLAA
Percina tanasi	Snail Darter	LT	-	NLAA	-
Phoxinus cumberlandensis	Blackside Dace	LT	-	NLAA	-
Scaphirhynchus albus	Pallid Sturgeon	LE	-	NLAA	NLAA
Scaphirhynchus suttkusi	Alabama Sturgeon	LE	-	NLAA	-
Speoplatyrhinus poulsoni	Alabama Cavefish	LE	Y	NLAA	NE*
Freshwater mussels					
Alasmidonta atropurpurea	Cumberland Elktoe	LE	Y	NLAA	NLAA
Alasmidonta raveneliana	Appalachian Elktoe	LE	Y	NLAA	NE*
Cumberlandia monodonta	Spectaclecase	LE	-	NLAA	-
Cyprogenia stegaria	Fanshell	LE	-	NLAA	-

Scientific Name	Common Name	Federal Status	CH (Y=Yes)	TVA Species Determination	TVA CH Determination
Dromus dromas	Dromedary Pearlymussel	LE	-	NLAA	-
Epioblasma brevidens	Cumberlandian Combshell	LE	Y	NLAA	NLAA
Epioblasma capsaeformis	Oyster Mussel	LE	Y	NLAA	NLAA
Epioblasma florentina florentina	Yellow-blossom Pearlymussel	LE	-	NLAA	-
Epioblasma florentina walkeri	Tan Riffleshell	LE	-	NLAA	-
Epioblasma metastriata	Upland Combshell	LE	Y	NLAA	NLAA
Epioblasma obliquata obliquata	Purple Catspaw	LE	-	NLAA	-
Epioblasma othcaloogensis	Southern Acornshell	LE	Y	NLAA	NLAA
Epioblasma penita	Southern Combshell	LE	-	NLAA	-
Epioblasma torulosa gubernaculum	Green Blossom Pearlymussel	LE	-	NLAA	-
Epioblasma torulosa rangiana	Northern Riffleshell	LE	-	NLAA	-
Epioblasma torulosa torulosa	Tuberculed Blossom Pearlymussel	LE	-	NLAA	-
Epioblasma triquetra	Snuffbox	LE	-	NLAA	-
Epioblasma turgidula	Turgid Blossom Pearlymussel	LE	-	NLAA	-
Fusconaia cor	Shiny Pigtoe Pearlymussel	LE	-	NLAA	-
Fusconaia cuneolus	Fine-rayed Pigtoe	LE	-	NLAA	-
Hemistena lata	Cracking Pearlymussel	LE	-	NLAA	-
Lampsilis abrupta	Pink Mucket	LE	-	NLAA	-
Lampsilis altilis	Fine-lined Pocketbook	LT	Y	NLAA	NLAA
Lampsilis perovalis	Orange-nacre Mucket	LT	Y	NLAA	NLAA
Lampsilis virescens	Alabama Lampmussel	LE	-	NLAA	-
Lemiox rimosus	Birdwing Pearlymussel	LE	-	NLAA	-
Leptodea leptodon	Scaleshell	LE	-	NLAA	-
Medionidus acutissimus	Alabama Moccasinshell	LT	Y	NLAA	NLAA
Medionidus parvulus	Coosa Moccasinshell	LE	Y	NLAA	NLAA
Obovaria retusa	Ring Pink	LE	-	NLAA	-
Pegias fabula	Little-wing Pearlymussel	LE	-	NLAA	-
Plethobasus cicatricosus	White Wartyback	LE	-	NLAA	-

Scientific Name	Common Name	Federal Status	CH (Y=Yes)	TVA Species Determination	TVA CH Determination
Plethobasus cooperianus	Orange-foot Pimpleback	LE	-	NLAA	-
Plethobasus cyphyus	Sheepnose	LE	-	NLAA	-
Pleurobema clava	Clubshell	LE	-	NLAA	-
Pleurobema curtum	Black Clubshell	LE	-	NLAA	-
Pleurobema decisum	Southern Clubshell	LE	Y	NLAA	NLAA
Pleurobema furvum	Dark Pigtoe	LE	Y	NLAA	NLAA
Pleurobema georgianum	Southern Pigtoe	LE	-	NLAA	-
Pleurobema gibberum	Cumberland Pigtoe	LE	-	NLAA	-
Pleurobema hanleyianum	Georgia Pigtoe	LE	-	NLAA	-
Pleurobema marshalli	Flat Pigtoe	LE	-	NLAA	-
Pleurobema perovatum	Ovate Clubshell	LE	Y	NLAA	NLAA
Pleurobema plenum	Rough Pigtoe	LE	-	NLAA	-
Pleurobema taitianum	Heavy Pigtoe	LE	-	NLAA	-
Pleuronaia dolabelloides	Slabside Pearlymussel	LE	Y	NLAA	NLAA
Potamilus capax	Fat Pocketbook	LE	-	NLAA	-
Potamilus inflatus	Alamabama (inflated) Heelsplitter	LT	-	NLAA	-
Ptychobranchus greenii	Triangular Kidneyshell	LE	Y	NLAA	NLAA
Ptychobranchus subtentum	Fluted Kidneyshell	LE	Y	NLAA	NLAA
Quadrula cylindrica	Rabbitsfoot	LT	Y	NLAA	NLAA
Quadrula cylindrica strigillata	Rough Rabbitsfoot	LE	Y	NLAA	NLAA
Quadrula fragosa	Winged Mapleleaf	LE	-	NLAA	-
Quadrula intermedia	Cumberland Monkeyface	LE	-	NLAA	-
Quadrula sparsa	Appalachian Monkeyface	LE	-	NLAA	-
Quadrula stapes	Stirrupshell	LE	-	NLAA	-
Toxolasma cylindrellus	Pale Lilliput	LE	-	NLAA	-
Villosa fabalis	Rayed Bean	LE	-	NLAA	-
Villosa perpurpurea	Purple Bean	LE	Y	NLAA	NLAA
Villosa trabalis	Cumberland Bean	LE	-	NLAA	-
Snails					

Scientific Name	Common Name	Federal Status	CH (Y=Yes)	TVA Species Determination	TVA CH Determination
Anguispira picta	Painted Snake Coiled Forest Snail	LT	-	NLAA	-
Athearnia anthonyi	Anthony's River Snail	LE	-	NLAA	-
Campeloma decampi	Slender Campeloma	LE	-	NLAA	-
Leptoxis ampla	Round Rocksnail	LT	-	NLAA	-
Leptoxis foremani	Interrupted Rocksnail	LE	Y	NLAA	NLAA
Leptoxis plicata	Plicate Rocksnail	LE	-	NLAA	-
Leptoxis taeniata	Painted Rocksnail	LT	-	NLAA	-
Lioplax cyclostomaformis	Cylindrical Lioplax	LE	-	NLAA	-
Pleurocera foremani	Rough Hornsnail	LE	-	NLAA	-
Pyrgulopsis ogmorhaphe	Royal Marstonia	LE	-	NLAA	-
Pyrgulopsis pachyta	Armored Marstonia	LE	-	NLAA	-
Insects					
Neonympha mitchellii	Mitchell's Satyr	LE	-	NLAA	-
Crustaceans					
Orconectes shoupi	Nashville Crayfish	LE	-	NLAA	-
Flowering Plants					
Arabis georgiana	Georgia Rock-cress	LT	Y	NLAA	NE*
Conradina verticillata	Cumberland Rosemary	LT	-	NLAA	-
Liatris helleri	Heller's Blazing Star	LT	-	NLAA	-
Lindera melissifolia	Pondberry	LE	-	NLAA	-
Ptilimnium nodosum	Harperella	LE	-	NLAA	-
Sagittaria secundifolia	Kral's Water-plantain	LT	-	NLAA	-
Spigelia gentianoides	Gentian Pinkroot	LE	-	NLAA	-
Spiraea virginiana	Virginia Spiraea	LT	-	NLAA	-

*NE = No Effect

26. APPENDIX II - SUMMARY OF EFFECTS ANALYSIS FOR LIKELY TO ADVERSELY AFFECT PLANT SPECIES

(source: BA Table 6-1)

Summary of Effects Analysis for all LAA Plant Species

Category	METHODS[1]	EXPLANATION	EXPOSURE[2]	STRESSOR AND RESPONSE[2]	AVOIDANCE MEASURES[3]	EFFECT[4]
Vegetation Control	Manual	Cutting or pulling using hand tools or chainsaws	Most likely to occur on ROW edges while clearing danger trees, in other unmaintained parts of ROW, or in areas where herbicide is not permitted	Physical damage up to death; Change to vegetation structure on-site resulting in positive or negative response of listed species	Known sites recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = LAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA
Vegetation Control	Mechanical - Clearing	Clearing of trees and shrubs where previous vegetation maintenance has been infrequent and woody plants have encroached into ROW or removal of vegetation in areas where trees were never cleared. Can also be used to safely remove off-ROW danger trees	Most likely to occur on ROW edges while clearing danger trees or in other unmaintained parts of ROW; One-time event on ROW as cleared areas will be subsequently treated as ROW floor; Exposure to chips/mulch is on-going	Physical damage up to death; Change to vegetation structure on-site resulting in positive or negative response of listed species; mulch/chips could impede the growth of listed species or competing vegetation	Known sites recorded in O-SAR as Class 2 Plants Bulldozer use requires site specific review	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = LAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA

Category	METHODS[1]	EXPLANATION	EXPOSURE[2]	STRESSOR AND RESPONSE[2]	AVOIDANCE MEASURES[3]	EFFECT[4]
Vegetation Control	Mechanical - Mowing	Mowing of herbaceous plants and seedlings to maintain vegetation within the floor area of the ROW	Periodic, once every three years maximum on open ROW	Physical damage up to death; Change to vegetation structure on-site resulting in positive or negative response of listed species	Known site recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = NLAA ASBI = LAA CLMO = NLAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = NLAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = NLAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA
Vegetation Control	Mechanical – Side-Wall Trimming	Tree trimming, from ground or air, on ROW edge	Periodic as needed depending on tree growth. Temporary change in light conditions	Change to vegetation structure on-site resulting in positive or negative response of listed species	Known site recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = LAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA

Category	METHODS[1]	EXPLANATION	EXPOSURE[2]	STRESSOR AND RESPONSE[2]	AVOIDANCE MEASURES[3]	EFFECT[4]
Vegetation Control	Herbicide - Spot	Highly targeted herbicide application like stump treatment or hack and squirt	Direct contact with herbicide, which is unlikely given targeted nature. Every three years on the ROW floor, as trees are cut if used to treat stumps after tree clearing	Physical damage up to death; Change to vegetation structure on-site resulting in positive or negative response	Known site recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = LAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA
Vegetation Control	Herbicide - Localized	Low volume foliar most common. Basal treatment, localized granular application, and bareground treatments also included	Direct contact with herbicide. Every three years on the ROW floor.	Physical damage up to death; Change to vegetation structure on-site resulting in positive or negative response	Known site recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = LAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA

Category	METHODS[1]	EXPLANATION	EXPOSURE[2]	STRESSOR AND RESPONSE[2]	AVOIDANCE MEASURES[3]	EFFECT[4]
Vegetation Control	Herbicide – Broadcast (ground)	Non-selective herbicide application made from the ground	Direct contact with herbicide	Physical damage up to death; Change to vegetation structure on-site resulting in positive or negative response	Known site recorded in O-SAR as Class 2 Plants Undocumented sites would be protected by O-SAR Class 1 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = NLAA CLSO = NLAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = NLAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA
Vegetation Control	Herbicide – Broadcast (aerial)	Non-selective herbicide application made from the ground	Direct contact with herbicide	Physical damage up to death; Change to vegetation structure on-site resulting in positive or negative response	Known site recorded in O-SAR as Class 2 Plants Undocumented sites would be protected by O-SAR Class 1 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = NLAA CLSO = NLAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = NLAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA

Category	METHODS[1]	EXPLANATION	EXPOSURE[2]	STRESSOR AND RESPONSE[2]	AVOIDANCE MEASURES[3]	EFFECT[4]
Debris Management	Manual	Cut and leave trees. Material may be cut into smaller pieces to facilitate decomposition	Physical disturbance during cutting of debris; Subsequent vegetation control efforts may be less precise due to large dead trees left on ROW edge	Physical damage from debris management; indirect negative effects up to death of individual if debris left in place hinders future herbicide applications	Known site recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = NLAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA
Debris Management	Mechanical	Chipping, mulching, and off-site hauling of debris	Physical disturbance during debris handing; Exposure to chips/mulch is on-going	Physical damage up to death; mulch/chips could impede the growth of listed species or competing vegetation	Known site recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = NLAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA

Category	METHODS[1]	EXPLANATION	EXPOSURE[2]	STRESSOR AND RESPONSE[2]	AVOIDANCE MEASURES[3]	EFFECT[4]
Debris Management	Burning	Burning in piles or containers	Physical disturbance during debris or container handling; heat from burning	Physical damage up to death resulting from crushing or effects of fire	Known site recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = NLAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA
Debris Management	Landowner Use	Debris can be provided to the landowner in the form of firewood or mulch	Physical disturbance during debris handling	Physical damage up to death resulting from crushing	Known site recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = NLAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA

[1] Methods are described in detail in Chapter 3 Description of Proposed Actions.

[2] *Stressor* resulting from the activity; *exposure* (*e.g.*, life stage, activity intensity, duration) of species to potential stressors resulting from actions; *response* (*e.g.*, growth, flowering incidence, death) by the species that results from exposure.
[3] Conservation measures are discussed in Chapter 4 Right-of-Way Processes and Procedures
[4] Effects: NE = No effect, NLAA = Not likely to adversely affect, LAA = Likely to adversely affect
Species: APPR =*Apios priceana*, ARPE = *Arabis perstellata*, ASBI = *Astragalus bibullatus*, CLMO = *Clematis morefieldii*, CLSO = *Clematis socialis*, DAFO = *Dalea foliosa*, HEVE = *Helianthus verticillatus*, ISME = *Isotria medeoloides*, LECR = *Lesquerella crassa*, LELY = *Leavenworthia lyrata*, LEPE = *Lesquerella perforata*, MAMO = *Marshallia mohrii*, MICU = *Minuartia cumberlandensis*, PHGL = *Physaria globosa*, PLIN = *Platanthera integrilabia*, SAOR = *Sarracenia oreophila*, SCMO = *Scutellaria montana*; XYTE = *Xyris tennesseensis*

Appendix E – National Historic Preservation Act Programmatic Agreement on TVA Operation and Management Activities

PROGRAMMATIC AGREEMENT
AMONG
THE TENNESSEE VALLEY AUTHORITY, THE ADVISORY COUNCIL ON HISTORIC PRESERVATION, AND THE STATE HISTORIC PRESERVATION OFFICERS OF ALABAMA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, TENNESSEE, AND VIRGINIA, AND FEDERALLY RECOGNIZED INDIAN TRIBES, REGARDING UNDERTAKINGS SUBJECT TO SECTION 106 OF THE NATIONAL HISTORIC PRESERVATION ACT OF 1966

WHEREAS, the Tennessee Valley Authority (TVA) is a federal agency and instrumentality of the United States, created by and existing pursuant to the TVA Act (1933) to foster the social and economic welfare of the people in the Tennessee River Valley, promote stewardship of the region's natural resources, provide low cost energy, and improve flood control and navigation of the Tennessee River and its tributaries; and,

WHEREAS, TVA operates and maintains the nation's largest public power system, including hydropower, coal, gas, nuclear, solar and wind generation facilities, auxiliary structures, and electrical distribution lines and facilities; and,

WHEREAS, TVA is charged with managing approximately 293,000 acres of public lands, 38,000 acres of power and commercial lands, 30 million square feet of buildings and structures, 470,000 acres of inundated land, 11,000 miles of shoreline, 11,700 archeological sites; and with maintaining approximately 237,000 acres of transmission line rights-of-way (ROW) easements, collectively more than 16,200 circuit miles-; and,

WHEREAS, TVA's approval is required in the form of a permit under Section (§)26a of the TVA Act, 16 *United States Code* [U.S.C.] §831y-1, before the construction, operation, and maintenance of any dam, appurtenant works, or other obstruction affecting navigation, flood control, public lands, or reservations across, along, or in the Tennessee River or its tributaries; and,

WHEREAS, TVA provides economic development and renewable energy programs to qualifying eligible companies or communities; and,

WHEREAS, TVA has obligations under the TVA Act, the National Environmental Policy Act (NEPA), the National Historic Preservation Act of 1966 (NHPA) as amended, the Archaeological Resources Protection Act (ARPA), the Native American Graves Protection and Repatriation Act (NAGPRA), the Historic Sites Act of 1935, the Antiquities Act, the American Indian Religious Freedom Act, the Religious Freedom Restoration Act, Executive Order (EO) 13007 ("Indian Sacred Sites"), EO 13287 ("Preserve America"), EO 13175 ("Consultation and Coordination with Indian Tribal Governments"), and related authorities; and,

WHEREAS, TVA has determined that the operation and maintenance of its power systems, certain land management activities, projects requiring the issuance of 26a permits, and projects funded through grants and funds to third parties, are subject to review under Section 106 of the

NHPA and the regulations implementing Section 106 (36 *Code of Federal Regulations* [C.F.R.] Part 800). Each of these functional groups has numerous associated activities that may affect historic properties; and,

WHEREAS, TVA's undertakings include a large number of activities that have little or no potential to affect historic properties (Appendix A) or have the potential to affect historic properties (as defined under 36 C.F.R. §800.16(l)(1)), but that are similar or repetitive in nature or constitute routine management activities (Appendix B); and,

WHEREAS, 36 C.F.R. §800.14(b)(2) allows federal agencies to develop a Programmatic Agreement (PA) as a program alternative to govern the implementation of an agency's particular program or undertakings; and,

WHEREAS, TVA will use this PA to fulfill its Section 106 responsibilities, as may other federal agencies that designate TVA as the lead federal agency pursuant to 36 C.F.R. §800.2(a)(2) for the activities described in this PA; and,

WHEREAS, the Advisory Council on Historic Preservation (ACHP) has agreed to participate in the development and execution of this PA in accordance with 36 C.F.R. §800.14(b); and,

WHEREAS, TVA has consulted with the state historic preservation officers (SHPOs) of Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee, and Virginia in developing the terms of this PA; and,

WHEREAS, TVA recognizes the unique legal relationship of the federal government with sovereign federally-recognized Indian tribes as set forth in the Constitution of the United States, treaties, statutes, and court decisions; and that consultation with tribes must, therefore, recognize the government-to-government relationship between the federal government and tribes; and,

WHEREAS, TVA acknowledges that federally recognized Indian tribes possess special expertise in assessing the eligibility of historic properties that may possess religious and cultural significance to them, as provided in 36 C.F.R. §800.4(c)(1); and,

WHEREAS, TVA has consulted with those federally recognized Indian tribes that have expressed an interest in TVA's power service area (PSA), viz. Absentee Shawnee Tribe of Indians of Oklahoma, Alabama-Coushatta Tribe of Texas, Alabama-Quassarte Tribal Town, Cherokee Nation, The Chickasaw Nation, The Choctaw Nation of Oklahoma, Coushatta Tribe of Louisiana, Delaware Nation, Eastern Band of Cherokee Indians, Eastern Shawnee Tribe of Oklahoma, Jena Band of Choctaw Indians, Kialegee Tribal Town, Mississippi Band of Choctaw Indians, The Muscogee (Creek) Nation, Osage Nation, Poarch Band of Creek Indians, The Quapaw Tribe of Indians, The Seminole Nation of Oklahoma, Shawnee Tribe, Thlopthlocco Tribal Town, and United Keetoowah Band of Cherokee Indians in Oklahoma; and, WHEREAS, the tribes agreed to participate in the development of this PA and have been invited to be signatories (hereinafter referred to as “Tribal Signatories”); and,

WHEREAS, this PA will not apply to proposed TVA undertakings located on or affecting historic properties on tribal lands as defined by 36 C.F.R. §800.16(x); and,

WHEREAS, TVA, ACHP, the SHPOs, and Tribal Signatories (collectively “the Signatories”) 36 C.F.R. §800.6(c)(2) determined that, pursuant to 36 C.F.R. §§ 800.14(b)(1) and 800.14(b)(2), the requirements of Section 106 can be more effectively and efficiently fulfilled under a PA for activities that are similar and repetitive in nature by stipulating roles and responsibilities and establishing protocols for consultation facilitating the identification and evaluation of historic properties and determination of effects; and,

WHEREAS, TVA solicited comments from various stakeholders, affected local governments, and the public by posting the draft PA on its public website for a period of at least 30 days, with affirmative advance notice to individuals and organizations with known or anticipated interest in undertakings within TVA’s PSA; and,

WHEREAS, TVA is developing, in consultation, a *Cultural Resources Management Plan* and an inventory of TVA’s architectural resources that will further facilitate and support the processes laid out in this PA; and,

NOW, THEREFORE, the Signatories mutually agree that TVA will meet its responsibilities under Section 106 of the NHPA through implementation of this PA, rather than by following the procedure set forth in 36 C.F.R. §§800.3 through 800.7.

STIPULATIONS

TVA will ensure that the following measures are carried out:

I. Purpose and Need

A. As TVA's undertakings encompass a diverse set of projects across seven states, this PA identifies procedures that TVA will use to meet its responsibilities under Section 106 for undertakings in TVA's PSA (Appendix C), and to establish an internal review process for such undertakings.

B. This PA addresses Section 106 NHPA compliance only, and does not address TVA's compliance with Section 110 of NHPA, or with ARPA or NAGPRA.

C. To increase efficiency, the PA:

1. Identifies categories of activities that are unlikely to affect historic properties if present, and excludes these activities from further review under Section 106. A list of these activities is in Appendix A.

2. Identifies repetitive activities with foreseeable effects to historic properties that require further review by TVA cultural resources staff (CRS). A list of repetitive undertakings requiring further review is in Appendix B.

II. Roles and Responsibilities

A. <u>TVA</u>: Pursuant to federal responsibilities set out in the NHPA and ACHP regulations at 36 C.F.R. Part 800, TVA shall:

1. Ensure that CRS assessing TVA undertakings under Section 106, including the applicability of the exemptions noted in Appendix B, meet the Secretary of Interior's *Standards and Guidelines for Archaeology and Historic Preservation, Professional Qualifications for Archeologists and/or Historians* (48 FR 44738-44739; SOI Standards). TVA shall meet or exceed these standards in a manner commensurate with: 1) the nature and complexity of the activity, property, or resource being investigated or treated, and 2) the knowledge and expertise needed to complete the work. CRS will ensure that external contractors conducting cultural resource surveys meet SOI standards.

2. Determine the Area of Potential Effects (APE).

3. Make a reasonable and good faith effort to identify historic properties pursuant to 36 C.F.R. §800.4(b). The identification effort will take into account the nature and scale of the undertaking, the degree of federal involvement, the nature and extent of potential effects on historic properties within the APE, and applicable state and tribal

guidance. TVA shall ensure that all documentation resulting from undertakings reviewed pursuant to this PA is consistent with the standards in 36 C.F.R. §800.11.

4. Assess the eligibility of historic properties within an undertaking's APE for listing on the National Register of Historic Places (NRHP), and seek concurrence on eligibility determinations with the appropriate SHPO(s) and tribes.

5. Seek to avoid adverse effects to historic properties, realizing that given TVA's operational requirements, some adverse effect may be unavoidable. If adverse effects cannot be avoided, TVA would develop appropriate minimization or mitigation measures in consultation with the appropriate SHPO(s) and tribes.

6. Provide the Signatories with an annual report, as outlined in Stipulation IV.

7. Not grant a loan, loan guarantee, permit, license, or other assistance to an applicant who has intentionally, significantly, and adversely affected a historic property, pursuant to 36 C.F.R. §800.9(c)(1), to which the grant would relate; or having legal power to prevent it, has allowed a significant adverse effect to occur. However, if after consultation with the SHPO(s), tribes, and ACHP, TVA determines that extraordinary circumstances justify granting such assistance despite the adverse effect created by the applicant, TVA shall complete consultation for the undertaking pursuant to the terms of this PA and Section 106 of the NHPA.

8. Identify additional consulting parties, including any communities, organizations, or individuals that may have an interest in a specific undertaking and its effects on historic properties as outlined under Stipulation XI.

9. Plan and lead annual effectiveness reviews of this PA (Stipulation IV).

10. Provide updated site file information to the states following state guidelines.

11. Design and administer training and subsequent guidance to appropriate TVA staff and contractors. The training will address, at a minimum, the procedures to be used for meeting TVA's obligations under Section 106 and other preservation laws for activities covered in this PA. TVA will consult with the Signatories on this training. Updates on the training will be provided in the annual report under Stipulation IV.

12. Consult with all tribes with an interest in the TVA PSA on a government-to-government basis.

13. Comply with Section 304 of NHPA (54 U.S.C. §307103) and Section 9 of ARPA (16 U.S.C. §470hh).

14. Integrate the PA in a manner that meets its historic preservation responsibilities as fully as possible along with its other responsibilities under the TVA Act, TVA's *Natural Resource Plan* (NRP), other executed PAs, NEPA, and other statutory authorities, executive orders, and federal policies.

B. SHPOs: Pursuant to responsibilities set out in NHPA and ACHP regulations at 36 C.F.R. Part 800, the appropriate SHPO(s) shall:

1. Review TVA's determination of APE, identification level efforts, National Register eligibility determinations, and effect findings for undertakings subject to the "Standard Review Process" outlined under Stipulation III.D, and provide comments within the periods prescribed in the 36 C.F.R. Part 800 regulations.

2. Participate in reviews of the effectiveness of this PA.

3. Coordinate with and assist TVA in identifying consulting parties, including any communities, organizations, or individuals that may have an interest in a specific undertaking and its effects on historic properties for undertakings subject to the "Standard Review Process" outlined under Stipulation III.D.

4. Each state may designate a lead to act on their behalf for TVA undertakings involving multiple states (36 C.F.R. §800.3(c) (2)).

C. ACHP: Pursuant to responsibilities set out in the NHPA and 36 C.F.R. Part 800, ACHP shall:

1. Provide technical guidance, and participate in dispute resolution and reviews of the effectiveness of this PA.

2. Participate as a consulting party in reviewing select undertakings that meet one or more of the *Criteria for Council Involvement in Reviewing Individual Section 106 Cases* (36 C.F.R. Part 800 Appendix A) for undertaking outlined in Stipulation III.D.

3. Inform TVA of emerging issues, policies, training, working groups, or guidelines applicable to Section 106 of the NHPA and the stipulations of this PA.

D. Tribal Signatories:

1. Review TVA's determination of APE, National Register eligibility determinations, and effect findings for undertakings subject to the "Standard Review Process," provide comments within the periods required prescribed in the 36 C.F.R Part 800 regulations and identify concerns about historic properties of traditional religious and cultural significance.

2. Provide comments on TVA's findings in accordance with the PA.

3. Participate in reviews of the effectiveness of this PA.

III. Section 106 Review Process

A. Categories of Undertakings for Purposes of This PA:

1. Appendix A: Activities determined, in consultation between TVA and the Signatories, to be unlikely to affect historic properties, and therefore excluded from further Section 106 review.

    a) No further review or consultation is required so long as activities fall within the parameters described in Appendix A and are not a component of a larger project.

    b) Activities carried out by TVA that fall in Appendix A will be listed in the annual report under Stipulation IV.

2. Appendix B: Activities that will be reviewed by TVA CRS, but will not require consultation with the Signatories as long as they fall within the parameters described in Appendix B.

    a) For activities determined by TVA CRS to fall under Appendix B, TVA will follow the review process described in Stipulations III.B and III.C.

    b) If an activity under Appendix B cannot be implemented in accordance with the requirements described in Stipulation III.C, or constitutes only a component or multiple activities as part of a larger project, TVA will follow the "Standard Review Process" outlined under Stipulation III.D.

    c) Undertakings carried out by TVA that fall under the activities listed in Appendix B will be listed in the annual report under Stipulation IV.

3. All activities that are not listed under Appendix A or B will proceed under Stipulation III.D.

B. Determine APE

1. For undertakings under Appendix B, TVA CRS will make APE determinations without consultation with the SHPO(s) or Tribal Signatories. The documentation for APE determination will be included in the annual report under Stipulation IV. For undertakings subject to Stipulation III.D. TVA will consult with SHPO(s) and Tribal Signatories regarding the APE determination.

2. If an activity falls under an Appendix B category, TVA will determine the APE, consistent with 36 CFR § 800.16(d), to include all geographic areas within which the undertaking may directly, indirectly, or cumulatively alter the character or use of historic properties.

3. The APE can include lands held in fee by the U.S. government, lands in which the U.S. government holds a real property interest other than fee title, as well as private or public lands over which the U.S. government currently holds no property interest or access rights.

4. The APE shall include the area of potential physical ground disturbance and any property, structure, or portion thereof that will be physically altered, destroyed, or changed in use by the undertaking.

5. The APE shall be delineated to include visual, audible, and atmospheric effects where the undertaking has potential to introduce visual, audible, or atmospheric elements that diminish or alter characteristics an eligible or listed historic property including the setting and landscape that represent a contributing quality to an eligible or listed that property.

6. When assessing the effects of an undertaking, TVA shall take consider effects that will occur immediately and directly, as well as those that are reasonably foreseeable and may occur later in time or be farther removed in distance, or be cumulative.

7. Unless otherwise established through consultation with the SHPO(s) and Tribal Signatories, the presumed APE for visual effects for construction of new facilities 200 feet or less in overall height would be a half-mile-radius within the visual line of sight from the proposed activity.

C. Identification, Evaluation, and Consultation Process for Appendix B Activities

1. Background Review Process:

   CRS will conduct background research consistent with 36 C.F.R. §§800.4(a)(2–4) to determine the likelihood that historic properties are within the APE.

   a) Background research can include, but is not limited to, survey records of past identification efforts and other information on previously identified resources in the area, topographic maps, satellite/aerial images, historic maps, tax records, state site- and architectural-files, soil maps, TVA land-acquisition maps, local informants, oral histories, the potential for an area to be historically significant as a “Traditional Cultural Property” (TCP) based on information provided by federally recognized Indian tribes or other descendant communities, photographs and documentation depicting past and current land conditions, and other relevant resources.

b) CRS will find that no historic properties would be affected, if background research indicates that:

i. For undertakings that could potentially affect archaeological or sites that could be of religious and cultural significance to Indian tribes, one of the following conditions are met:

a. Adequate archaeological surveys meeting current archaeological standards were previously performed within the APE, and no archaeological sites have been identified in the APE with the exception of previously determined (in consultation) NRHP-ineligible sites. If previously identified archaeological sites are located within the APE and not previously determined in consultation to be ineligible, the undertaking would be reviewed under the “Standard Review Process” in accordance with Stipulation III.D.

b. The land within the APE has been subject to significant ground disturbance, such as strip mining, extensive grading, trenching, major construction, or severe erosion within the vertical APE.

c. The review of the environmental context of the APE suggests little potential for intact archaeological deposits or TCPs. For example, the APE lacks stable land surfaces, buried Holocene deposits, caves, rock shelters, and other conditions that could allow a prehistoric or historic occupation, Indian removal routes, stone features, or other resources that could be of religious and cultural significance to federally recognized Indian tribes to be present.

ii. For undertakings that have the potential to directly or indirectly affect historic structures or districts:

a. Adequate architectural surveys were performed previously in the APE within the past five years by individuals meeting the Secretary of the Interior “Qualification Standards” for historic preservation, and no eligible or listed historic structures were identified, in concurrence with the SHPO(s).

b. Comparison of maps, tax records, and aerial imagery (aerial photographs or satellite images) with clear unobstructed views to the resource location and current project location photos, indicate a lack of extant structures older than 50 years in the APE, and not within, or within the viewshed, of a historic district.

iii. The basis of TVA’s “no historic properties affected” finding will be included in the annual report in accordance with Stipulation IV.A–B.

2. Field Reconnaissance Process:

   If, after conducting background research, TVA determines none of the above conditions are met, then CRS will conduct a field reconnaissance survey for Appendix B activities in accordance with the *Secretary of Interior's Standards for Archaeology and Historic Preservation* and relevant state-recommended minimum guidelines and standards. If TVA conducts a reconnaissance, it will be completed by CRS or TVA-approved contractors. The results of the reconnaissance will be evaluated as follows:

   a) If the field reconnaissance does not identify any cultural resources that would indicate the presence of archaeological sites, historic structures, or potential Indian removal routes, stone features, caves, or other properties that may be of religious and cultural significance, TVA will make a finding of "no effect to historic properties."

   b) If the field reconnaissance identifies one or more archaeological sites or historic structures, and/or identifies a potential for the presence of buried archaeological sites in the APE, TVA shall complete one of the following steps:

      i. Modify the project such that the undertaking meets requirements for an Appendix A activity.

      ii. Consult on the eligibility of the identified resource and the undertaking's effects to historic properties using the "Standard Review Process" (Stipulation III.D).

   c) CRS will provide updated site file information to the SHPO(s) following CRS review.

   d) TVA will consult with Indian tribes regarding properties that are potentially of religious and cultural significance to the tribes, and update TVA's database to ensure that the locations of identified resources are maintained.

3. The basis of TVA's finding of "no historic properties affected" for Appendix B activities will be documented in TVA's 800.11(d) "Documentation Form" (Appendix D), and will be provided to the Signatories in the annual report under Stipulation IV.

D. Standard Review Process for Undertakings Not Covered by Appendix A or B.

   1. If an activity does not fall within Appendix A or B, or falls within Appendix B, and newly identified archaeological sites, artifacts, or above-ground resources (including properties potentially of religious and cultural significance to the tribes) are identified, and the undertaking cannot be modified such that the undertaking meets requirements

for an Appendix A activity, TVA will follow the review process set out in 36 C.F.R. §§800.3-800.7. These steps will include delineation of the APE, identification of historic properties, determination of effects, and avoidance/minimization of adverse effects where possible, or resolution of adverse effects through consultation with the appropriate SHPO(s) and tribes.

2. TVA, at its discretion, may use a consolidated consultation process pursuant to 36 C.F.R. §800.3(g) for non-controversial projects, and provide the SHPO(s) and tribes with documentation and a request for concurrence with findings and recommendations that address multiple steps in 36 C.F.R. §§800.3–800.6. When using consolidated consultation, TVA will provide documentation in accordance with C.F.R. §800.11 and applicable SHPO standards.

3. Where the undertaking under consideration involves corridors (such as for transmission lines) or large land areas, TVA may, at its discretion, use a phased process to identify and evaluate effects to historic properties, as provided for in 36 C.F.R. §§800.4(b)(2) and 800.5(a)(3). Under a phased approach, TVA may proceed with the implementation of certain phases of the project for which the Section 106 process has been completed, provided that proceeding with one phase of a project does not preclude the possibility of avoidance of known and as-yet-unidentified or -evaluated historic properties within the APE during additional phases of the project. TVA will provide the SHPO(s) and tribes written notification that TVA is proceeding under this approach.

IV. Reports

TVA shall provide the Signatories an annual report by January 30 for each fiscal year (October 1–September 30) that this PA remains in effect.

A. The annual report will include a table with an entry for each activity listed in Appendix A and reviewed pursuant to Stipulation III.A.1. The table will include:

1. name/title of the undertaking

2. applicable activity listed in Appendix A

3. state and county location

4. geographic coordinates

B. The report will summarize each activity undertaken during the fiscal year for which TVA relied on the Appendix B categories for fulfilling its Section 106 obligations. The report will contain digital optical-character-recognition PDF and spatial data for each activity. The report will incorporate other TVA cultural resource stewardship activities. The report will also include updates on training, staff changes, and procedures that are developed because of the PA. The annual report will include an entry for each activity listed in Appendix B and reviewed pursuant to Stipulation III.C during the fiscal year, including:

1. project name, site and description and size

2. APE depicted on a United States Geological Survey (USGS) map with coordinates and ArcGIS shapefiles

3. reference to any previous surveys

4. environmental and topographical description

5. photo documentation

6. current land use and previous disturbance

7. environmental and historical context information sources

8. known archaeological sites, historic structures, or significant landscapes near the location

9. methodology of field reconnaissance

10. location of any shovel tests

11. survey results

12. basis of “no historic properties affected” finding

13. whether, after an initial background research and reconnaissance survey, the undertaking was elevated to the “Standard Review Process”

C. Signatories will have forty-five (45) calendar days to submit comments on the annual report. TVA will respond to comments within forty-five (45) calendar days.

D. TVA and the signatories to this PA shall consult within six months upon execution of the PA and annually thereafter to review implementation of the terms of this PA. TVA will also develop and provide to the Signatories a questionnaire to help evaluate the effectiveness of the PA.

V. Lead Federal Agency

A. TVA may use this PA to fulfill its Section 106 responsibilities and those of other federal agencies that have designated TVA as the lead federal agency pursuant to 36 C.F.R. §800.2(a)(2) for the undertakings described in this PA. Identification of the lead federal agency shall be provided to the appropriate SHPO(s) and tribes via e-mail.

B. If another federal agency has concluded its Section 106 review during the previous three years, TVA has no further obligation under Section 106 to review a TVA undertaking of its own that would be subject to this PA, if TVA confirms that the scope and effect (defined by TVA per 36 C.F.R. §800.16[i]) are the same as that of the undertaking reviewed by the previous agency; that the passage of time does not require any new or additional identification of historic properties; and if the previous agency's consultation and concurrence is documented consistent with 800.11(d) or 800.11(e). TVA shall provide documentation of these occurrences in the annual report accordance with TVA's 800.11(d) or 800.11(e) "Documentation Form" (Appendix D) of these occurrences in the annual report. Should TVA determine that the previous Section 106 review was insufficient, or involved interagency disagreements about eligibility, effect, and/or treatment measures, or does not follow TVA's procedure for delineating APE, then TVA shall conduct additional Section 106 consultation for its undertaking in accordance with the terms of this PA.

VI. Curation

A. TVA shall ensure that any archaeological material and associated records recovered from TVA land will be permanently curated in one of its primary repositories, and in accordance with the requirements in 36 C.F.R. Part 79.

B. If archaeological materials are recovered from private lands as a result of a TVA undertaking, TVA shall encourage the curation of those archaeological materials collected from private lands (with the exception of NAGPRA human remains and NAGPRA cultural items, which are addressed in Stipulation IX) at a repository that meets the requirements in 36 C.F.R. Part 79.

C. For data recovery projects under Stipulation III.D, specific curation facilities will be determined during development of a memorandum of agreement for that specific undertaking in consultation with the appropriate SHPO(s) and tribes.

VII. Coordination with TVA's *Cultural Resource Management Plan*

To the extent practicable, TVA will incorporate the provisions of this PA and those of other TVA agreements relative to the NHPA, ARPA, and NAGPRA into TVA's internal guidance documents to be developed as part of TVA's *Cultural Resource Management Plan* and will include these activities in the annual report (Stipulation IV).

VIII. Emergency Procedures

During emergencies at TVA, TVA actions necessary to protect human health or property are not subject to Section 106 requirements. However, TVA will notify the appropriate SHPO(s) and tribes of emergency management activities, and staff will work with emergency responders to, whenever reasonable, minimize the overall effect of such activities to historic properties. TVA will evaluate the effects of emergency-related activities. TVA CRS will assess any effects to historic properties and allow consulting parties seven business days to comment, if circumstances permit. TVA will provide to the consulting parties a report of actions taken after they have been completed, and will include these activities in the annual report (Stipulation IV).

IX. Treatment of Human Remains and NAGPRA Cultural Items

A. Federal Lands

TVA shall ensure that any human remains and NAGPRA cultural items discovered on federal lands during implementation of the terms of this PA are treated respectfully and in accordance with NAGPRA.

B. Non-Federal Lands

If verified human remains are identified within the APE on non-federal or non-tribal lands as a consequence of a TVA undertaking, TVA shall:

1. Ensure that the treatment of any human remains discovered within the APE complies with applicable state laws and is respectful of tribal or other descendent communities.

2. Ensure the cessation of ground-disturbing activities within a 328-ft-radius of human remains or NAGPRA cultural items, and protection of the site with temporary fencing or other natural barricades, until the appropriate state and local officials can be consulted.

C. TVA will develop a guidance document on the treatment of human remains, in consultation with the SHPOs and Tribal Signatories as part of the implementation of this PA

X. Post-Review Discoveries

TVA shall ensure that unidentified historic properties or unanticipated effects to historic properties discovered during the implementation of an undertaking are subject to the following measures:

A. TVA will consult with the ACHP and relevant SHPOs and tribes in accordance with 36 C.F.R. §800.13(b).

B. All ground-disturbing work within a 328-foot-radius of the discovery, or work within a historic structure, will be immediately stopped and the discovery location secured against further disturbance, pending completion of the consultation.

C. If the post-review discovery includes human remains, then TVA will follow Stipulation IX.

D. TVA will develop a guidance document for post review discoveries, in consultation with the SHPOs and Tribal Signatories as part of the implementation of this PA.

XI. Public Outreach and Consulting Parties Involvement

A. In fulfilling its obligations for undertakings subject to the “Standard Review Process,” (Stipulation III.D), TVA shall seek the views of the public in a manner that reflects the nature, complexity, and effect(s) of the undertaking, likely public interest, and any confidentiality concerns of tribes, private individuals, or businesses. Public participation must be undertaken by TVA in a manner consistent with the confidentiality provisions of 36 C.F.R. §800.11(c). TVA may use the agency’s procedures developed pursuant to NEPA to solicit and respond to public comments obtained either via public involvement or through announcement of the availability of TVA’s environmental reviews on TVA’s public website, and thereby satisfy NHPA public involvement requirements. TVA shall consider comments provided by the public regarding the effect of the undertaking on historic properties.

B. Certain individuals, organizations, or descendent groups with a demonstrated interest in an undertaking may also be invited to participate as consulting parties, due to their legal or economic relation to the undertaking or the affected historic properties. TVA shall, except where appropriate to protect confidentiality under 36 C.F.R. §800.11(c), provide consulting parties with information regarding the undertaking and its effects on historic properties.

XII. Administrative Conditions

A. Duration

This PA will be in effect for ten (10) years from the date the PA becomes effective, unless terminated in accordance with Stipulation XII.E. One year before the expiration of the PA, TVA will consult with all parties to seek to renew or revise the PA as needed. The duration of the PA may be extended for an additional ten (10) years upon obtaining signatures of the parties. Extensions shall be established through the amendment process outlined in Stipulation XII.C.

B. Dispute Resolution

1. Should a dispute arise, the signatories to this PA shall attempt in good faith to resolve the dispute relating to this PA by negotiating amongst themselves. If the dispute cannot

be resolved, TVA shall forward all relevant documentation and the views of all parties relating to the dispute to the ACHP, along with TVA's proposed resolution.

2. Within thirty (30) calendar days after receipt of all pertinent documentation of the dispute from TVA, the ACHP shall exercise one of the following options:

    a) Advise TVA that the ACHP concurs with TVA's proposed resolution; in this case, TVA may proceed with implementing its proposed resolution; or,

    b) Provide TVA with recommendations, which TVA shall take into account in reaching a final resolution to the dispute.

3. Should the ACHP not exercise one of the above options within thirty (30) calendar days after receipt of all pertinent documentation, TVA may move forward with its proposed resolution of the dispute.

4. TVA shall take into account any ACHP recommendation provided (in accordance with Stipulation XII.B) when making its final determination to resolve the dispute, and TVA shall communicate this determination in writing to all signatories. TVA's responsibility to carry out all actions under this PA that are not subject to the dispute shall remain unchanged.

C. Amendments

The signatories may request that this PA, including appendices, be amended or modified as needed. The signatories will consult to consider such amendments or modifications.

1. An amendment to this PA, exclusive of Appendices A and B, shall be effective upon the date a copy of the amended PA signed by the signatories is filed with the ACHP.

2. If a modification to Appendices A and B is requested:

    a) TVA shall consult with the signatories regarding the proposed modifications.

    b) If no signatory objects within thirty (30) calendar days to the proposed modifications, TVA shall provide a revised copy of the PA to the signatories.

    c) If a signatory objects to the proposed modification, TVA shall follow the dispute resolution process in Stipulation XII.B.

D. Withdrawal from Participation

Any SHPO or Tribal Signatory may withdraw from this PA after providing TVA written notice ninety (90) calendar days prior to its withdrawal. TVA shall consult with the withdrawing party to identify any mutually acceptable measures that would avoid the party's withdrawal. If mutually acceptable measures are identified that would require amendment to the PA, TVA will go through the amendment procedures outlined in Stipulation XII.C. In the case of SHPO withdrawal, the PA would no longer apply within that SHPO's state and TVA would comply with 36 CFR Part 800 for all undertakings previously subject to this PA in that state. In the case of a Tribal Signatory withdrawing from the PA, TVA would consult with that Tribe pursuant to 36 CFR Part 800 for all undertakings previously subject to this PA that would have the potential to affect historic properties of religious and cultural significance to the Tribe. This PA would remain in effect in all other jurisdictions and for all other parties.

E. Termination

If any signatory to this PA determines that its terms cannot be carried out, that party shall immediately consult with the other signatories to attempt to develop an amendment per Stipulation XII.C. If an amendment cannot be reached within ninety (90) days (or another period agreed upon by the signatories), TVA or the ACHP may terminate this entire PA. Once the PA has been terminated, and before continuing work on any undertaking subject to its terms, TVA must either (a) execute a new PA pursuant to 36 C.F.R. 800.14, or (b) follow 36 C.F.R. Part 800 for each individual undertaking. TVA shall notify the signatories as to the course of action it will pursue.

Execution of the PA by the TVA, the SHPOs of Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee, and Virginia, and the ACHP, and implementation of its terms is evidence that TVA has taken into account the effects of these undertakings on historic properties and afforded the ACHP an opportunity to comment.

TENNESSEE VALLEY AUTHORITY

By: ______________________________ Date: 10-18-19

Rebecca Tolene
Vice President, Environmental

ADVISORY COUNCIL ON HISTORIC PRESERVATION

By: Aimee Jorjani Date: 11/27/19

Chairman Aimee Jorjani
Advisory Council on Historic Preservation

ALABAMA STATE HISTORIC PRESERVATION OFFICER

By: Lisa D. Jones Date: 11·5·2019
Lisa D. Jones
Executive Director, State Historic Preservation Officer

Title: State Historic Preservation Officer

GEORGIA STATE HISTORIC PRESERVATION OFFICER

By: Dr. Dave Crass Date: 15 NOV 2019

David Crass
Division Director and Deputy State Historic Preservation Officer

KENTUCKY STATE HISTORIC PRESERVATION OFFICER

By: ______________________ Date: 12-19-19

Craig Potts, Executive Director and State Historic Preservation Officer,
Kentucky Heritage Council

Approved as to form and legality:

By: Wm H. Adams II Date: Dec. 2, 2019

William H. Adams II, Legal Counsel to the State Historic Preservation Officer
Tourism, Arts, and Heritage Cabinet

MISSISSIPPI STATE HISTORIC PRESERVATION OFFICER

By: ______________________ Date: 11-18-19

FOR:

Katherine Blount

State Historic Preservation Officer

NORTH CAROLINA STATE HISTORIC PRESERVATION OFFICER

By: Kevin Cherry Date: 11-14-2019

Kevin Cherry
Deputy Secretary of Department of Cultural Resources and State Historic Preservation Officer

TENNESSEE STATE HISTORIC PRESERVATION OFFICER

By: E. Patrick McIntyre Jr Date: 10/31/19

E. Patrick McIntyre, Jr
Executive Director and State Historic Preservation Officer

VIRGINIA STATE HISTORIC PRESERVATION OFFICER

By: Julie V Langan Date: 11-7-19

Julie Langan
DHR Director and State Historic Preservation Officer

ABSENTEE SHAWNEE TRIBE OF OKLAHOMA

By: ___________________________________ Date: _____________

Name:

Title:

ALABAMA-COUSHATTA TRIBE OF TEXAS

By: ______________________ Date: 01/07/2020

Title: Alabama-Coushatta Tribe of Texas
Tribal Council Chairperson

ALABAMA-QUASSARTE TRIBAL TOWN

By: ___________________________________ Date: _____________

Name:

Title:

CHEROKEE NATION

By: ___________________________________ Date: _____________

Chuck Hoskin Jr.
Principal Chief

THE CHICKASAW NATION

By: Bill Anoatubby Date: DEC 16 2019

Bill Anoatubby
Governor

Nothing construed in this Agreement shall be construed to waive the sovereign rights of the Chickasaw Nation, its officers, employees or agents.

THE CHOCTAW NATION OF OKLAHOMA

By: ____________________________________ Date: ______________

Gary Baton
Chief

COUSHATTA TRIBE OF LOUISIANA

By: ______________________________ Date: 11-20-19

Title: Tribal Chairman

Name: David Sickey

DELAWARE NATION

By: Debbie Dotson Date: 12/06/2019

Deborah Dotson
President

EASTERN BAND OF CHEROKEE INDIANS

By: ______________________ Date: 1/30/2020

Richard Sneed
Principal Chief

EASTERN SHAWNEE TRIBE OF OKLAHOMA

By: Glenna J. Wallace Date: 12-10-2019

Glenna Wallace
Chief

JENA BAND OF CHOCTAW INDIANS

By: ___________________________________ Date: ______________

Cheryl Smith

Chief

KIALEGEE TRIBAL TOWN

By: ___________________________________ Date: _____________

Tiger Hobia
Mekko

MISSISSIPPI BAND OF CHOCTAW INDIANS

By: ___________________________________ Date: _____________

Cyrus Ben

Chief

THE MUSCOGEE (CREEK) NATION

By: David W. Hill Date: 2/14/2020

David W. Hill

Principal Chief

THE OSAGE NATION

By: ___________________________________ Date: _____________

Geoffrey M. Standing Bear
Principal Chief

POARCH BAND OF CREEK INDIANS

By: Larry D. Haikey Date: 1-30-2020

Larry Haikey
Tribal Historic Preservation Officer

THE QUAPAW NATION

By: ___________________________________ Date: _____________

John Berrey

Chairman

THE SEMINOLE NATION OF OKLAHOMA

By: Greg Chilcoat Date: 11/20/19

Greg Chilcoat
Chief

SHAWNEE TRIBE

By: ________________________ Date: 1-16-2020

Ben Barnes

Chief

THLOPTHLOCCO TRIBAL TOWN

By: ______________________________ Date: 11/25/19

Ryan Morrow
Mekko

UNITED KEETOOWAH BAND OF CHEROKEE INDIANS IN OKLAHOMA

By: ____________________________________ Date: ______________

Joe Bunch
Chief

Appendix A - Activities Unlikely to Affect Historic Properties

Activities within Appendix A, in consultation between TVA and the signatories, have been determined as unlikely to affect historic properties, if present, and are therefore excluded from further review. Work associated with Appendix A activities would be done by hand or involve lightweight vehicles (e.g., all-terrain vehicles [ATVs], light-duty and standard trucks) or low ground-pressure equipment (e.g., using rubberized tracks or weight-dispersing tires). Matting could be used to prevent ground disturbance when using heavy-duty equipment, as warranted. Visual inspections of soil and hydraulic conditions will be used to determine work times, adhering to working in dry conditions when practicable. All work on historic structures would be performed in accordance with Secretary of the Interior's Standards. If these conditions cannot be met, these activities would be included under Appendix B. Should any of these activities have unanticipated effects on historic properties, work shall stop and the procedures in Stipulation X shall be followed. CRS will be contacted if work is proposed in areas previously delineated as highly sensitive archaeological sites (e.g., previously identified sites with known human remains and Trail of Tears/removal routes).

A. Land Management and Improvements

1. in-kind repair of existing concrete or asphalt curbs, or gutters where no new ground disturbance is proposed
2. installing curb cuts in accordance with the American Disabilities Act
3. activities establishing and maintaining vegetation, limited to broadcast or no-till seeding, with minimal seedbed preparation; grass plugs, aeration, spreading mulch, fertilization, mowing, bush hogging, chain sawing, applying herbicides, removing vegetation by hand using a weed wrench, and hand pruning, with the exception of activities occurring within cemeteries or other previously delineated highly sensitive archaeological sites maintenance and in-kind, in-place repair of existing fencing and installation of a post or fencing
4. installing gates within existing fences, or repairing and replacing gates on access roads or along corridors within the zone of initial disturbance
5. mitigating hazard trees or removing individual trees, cutting at the base of the trunk, or trimming branches
6. installing new single-post signs (channel, T-post, or Carsonite posts) four inches in diameter or less
7. installing, replacing, or maintaining floating buoys
8. maintaining an existing trail that does not result in additional ground disturbance beyond the established trail
9. maintenance or replacement of park or playground equipment involving no new ground disturbance
10. road maintenance (surface water control, soil erosion control, regrading, resurfacing, and maintenance of ditches, guardrails, culverts, bank/cut slopes) that does not result in additional ground disturbance beyond that incurred when the road and associated appurtenant works were established

11. using existing gravel pits, including further materials-extraction and stockpiling within the pit, where no horizontal expansion of the pit area will occur
12. in-kind repair and replacement of exterior lighting less than 50 years old and not eligible under Criteria Consideration G
13. in-kind repairs and replacement of walks, steps, and retaining walls, that are less than 50 years old and not eligible under Criteria Consideration G
14. removing and restoring littered, trash, and dump sites with no new ground disturbance, provided dump sites can be reasonably demonstrated to be recent occurrences
15. temporary actions not involving modification of an existing structure nor ground disturbance (e.g., placement of traffic cones, racing events, obstacle courses)
16. plugging and abandoning boreholes and groundwater monitoring wells
17. establishing and using a temporary material-laydown yard on paved, graveled, compacted, or fill-covered surfaces
18. removing silt and debris from catch basins, drainage systems, and sumps
19. acquiring commercial fill (less than 25 cubic yards) from approved sites holding valid permits that does not lead to horizontal expansion of the site
20. applying low-intensity controlled fire in previously burned locations and which CRS has previously determined contain no above-ground resources

B. Building Maintenance and Rehabilitation (all work would be confined within existing facilities)

1. except for construction of new additions, all renovation, maintenance, or internal changes to an existing facility less than 50 years old and not meeting Criteria Consideration G, or properties greater than 50 years old and which have been previously determined (in consultation within the last 10 years) to be ineligible for the National Register or non-contributing buildings within a district or property listed in or eligible for the National Register
2. demolition, removal, and/or disposal of temporary buildings (e.g., trailers, mobile units, or similar structures) involving no ground disturbance, and where removal would be completed with minimal ground disturbance
3. maintaining, installing, relocating, removing, and repairing equipment (including motors, valves, shredders, compressors, pumps, castors, power supplies, lathes, saws, shears, presses, welding equipment, dust collectors, dry boxes and vent systems) not requiring the removal of historic walls and floor coverings, and (except for within public spaces) the modification or addition of permanent or temporary ladders
4. repair or in-kind replacement of non-historic, existing, safety-required signs that meet OSHA and other safety requirements
5. replacing or installing caulking and weather stripping around windows, doors, walls, and roofs (*NOTE:* Replacing caulking applied to masonry joints instead of properly repointing deteriorated joints would not be considered routine maintenance.)
6. removing exterior or interior paint by non-destructive means, limited to hand scraping, low-pressure water-wash (<200 pounds per square inch [psi]), use of a needle gun (on metal surfaces only), or paint-removal chemicals (provided that careful testing was previously

done under CRS supervision), to assure that the method selected will not affect the building materials, and that the removal follows *National Preservation Brief No. 6*

7. installing, replacing, or repairing existing plumbing, electrical wiring, and fire-protection systems, provided no alterations are made to character-defining features, spaces, or historic fabrics
8. maintaining, repairing, removing, modifying, upgrading, or replacing plant and building electrical systems (e.g. arc-flash testing, building conduit, wiring, lighting fixtures, etc.), provided no alterations are made to character-defining features or historic fabric
9. siting, installing, maintaining, repairing, removing, or replacing communications and computer systems (including facsimile systems, internal microwave and radio systems, fiber-optic cables, and phone systems), where no ground disturbance would occur and the activity would not affect the historic fabric of the structure or character-defining features and spaces
10. repairing underground utilities in the documented area of disturbance
11. except within public spaces, routine installation, upgrades, replacements, and/or modifications to the interior of safety structures, including fire dampers, exit lights, fire-protection systems, sprinkler systems, anti-freezing devices in existing sprinkler systems, corridors, stairways, fire-alarm systems, smoke detectors, motion detectors, security devices, fire hydrants and associated piping, and emergency generators
12. in-kind repair or replacement of non-character-defining hydroelectric equipment (character-defining equipment including but not limited to turbines, generators, intake valves, surge tanks, pumps, spillway gates, sluice and radial gates, trash removal equipment [rakes, racks, and hoists], jib and gantry cranes, and control panels) found both in the interior and on the exterior of hydroelectric facilities
13. installation or modification of personnel safety systems and devices, including safety showers, eye washes, fume hoods, radiation monitoring devices, sprinkler systems, emergency exit-lighting systems; surveillance systems; protective additions to electrical equipment; personnel accountability/assembly systems and stations; improvement to non-historic walking and working surfaces or areas; anchoring floor mats, fabrication and temporary ladders or platforms installed for a particular project, shields and guards, and non-historic stairway modifications
14. adding new dam-safety instruments within private spaces not visible externally
15. adding communication hardware to existing dam-safety instruments not requiring conduit within private spaces that are not visible externally
16. testing existing instrumentation using water, where no ground disturbance is required
17. cutting a slot (see “slot cut” in Appendix G, “Glossary”) in a concrete dam that is exhibiting concrete growth, in cases where a slot had previously been installed
18. construction or installation of underground features within a documented area of disturbance, or entirely within fill, including trenching, test pits, or borings
19. in-kind underwater repairs to concrete structures at an elevation below normal operating lake elevations
20. in-kind replacement of dam-safety instrumentation, or a component of an instrument
21. except in public spaces, welding steel features where repairs are needed to restore equipment to its original loading capacity.

22. grouting in a concrete dam to repair small leaks
23. installation of temporary floating-caissons or trash booms for the duration of a particular project
24. installation of rock bolts in a rock slope at a dam

C. Permitting

1. above-ground fiber-optic cable and broadband on existing transmission or communication structures
2. renewal or transfer of permit ownership, where TVA's Section 106 compliance requirements have been previously met, and where the vertical and aerial footprint of the project and associated actions has not changed
3. issuance of new or renewed easements and leases that do not authorize any new activities outside of Appendix A, and where TVA's Section 106 compliance requirements have previously been met

D. Operation and Maintenance of Substations and Switchyards

1. maintenance, testing, removal, relocation, conveyance, exchange (within an existing substation), and replacement of substation equipment including (but not limited to) propane tanks, transformers, arresters, fuses, relays, transducers, regulators, converters, isolators, piping, wave traps, batteries, breakers, bushings, valves, switches, wiring, or capacitor banks at a substation or switching station, provided this work is within the confines of the documented area of previous disturbance, is less than 50 years old, and any new structure does not exceed the current maximum height
2. placement of temporary transformers or mobile substations within an existing substation
3. excavation in documented, previously disturbed areas of substations and switchyards

E. Operation and Maintenance of Transmission Lines

1. inspections and maintenance of hardware on transmission line (TL) structures
2. replacement of in-kind (or functionally similar for wood pole structures only) transmission line assets such as cross arms, insulators, lightning arrestors, lighting systems, spacers, vibration dampers, markings, structural knee-braces, or miscellaneous bent, damaged, or worn steel-tower members
3. installation of wildlife avoidance/shielding systems, reflectors, aerial marker-balls, navigation, or aircraft warning systems on existing structures (excluding strobes)
4. use of herbicides (except for aerial applications), bush hog, mulcher, mower, and other light-duty equipment to control vegetation and establish or maintain ROW width that involve no new ground disturbance, with the exception of activities occurring within cemeteries or other previously flagged sensitive archaeological sites
5. repair or replacement of above-ground conductors, ground wire, or fiber-optic cable using bucket trucks and truck-mounted spools; placement of fill or rocks around existing towers, structures, or culverts when the fill/rock comes from a commercial source or a previously

reviewed and approved location, provided the work does not expand the original project footprint

6. application of paint, coatings, or preservatives to transmission structures less than 50 years old
7. removal or replacement of wood poles that do not require additional horizontal ground disturbance and/or additional height greater than seven to 10 feet
8. removal or replacement of TL structures that are less than 50 years old that do not require additional horizontal ground-disturbance or increased height
9. line modifications, including conductor slides, cuts, and floating dead-ends, to modify ground clearance
10. pull points for line re-conductoring on existing, previously paved, graveled, compacted, or fill-covered surfaces
11. reinforcement of wood transmission structures with steel bracing-assemblies (e.g., PoleEnforcer brand)
12. co-locate small wire telecommunication, electric distribution, or related hardware on existing transmission line structures where no ground disturbance is necessary
13. maintenance, repair, or in-kind or functionally similar replacement of equipment or devices such as footings, grillage, and anchors inside the footprint on an existing TL structure

F. New Construction

1. construction of methane gas or electric generating-systems using commercially available technology installed within an existing landfill that has no potential to cause a visual effect an historic property
2. construction or installation of water intakes within a documented area of disturbance that does not cause additional ground disturbance
3. installation of temporary construction-related structures that would be in place for the duration of a project, including scaffolding, sediment-capture devices, barriers, screening, fences, protective walkways, signs, office trailers, or restroom facilities, which would cause no ground disturbance, and would not damage historic buildings/structures

G. Administrative Actions and Grants

1. property-protection activities that do not physically alter facilities or grounds
2. administrative actions that do not involve, or result in, physical work on the part of TVA or any other party
3. nondestructive and/or non-altering site characterization, data collection, study, inventory, and monitoring
4. financial and technical assistance to promote energy efficiency or water conservation, including assistance in installing or replacing energy efficient appliances, insulation, HVAC systems, plumbing fixtures, and water heating systems, that does not alter the building exterior or historic fabric of the structure or interior character-defining spaces, and does not disturb the ground

5. financial assistance, including approving and administering grants, loans, and rebates that are strictly financial in nature to state, local, and private organizations and entities that are strictly financial in nature
6. financial assistance to purchase or replace equipment, so long as installation or use of the equipment would not affect historic properties and is not a part of a larger undertaking
7. agreements for the sale, purchase, or interchange of electricity not resulting in the construction and operation of new generating facilities, or modifications to existing generating facilities and associated electrical transmission infrastructure
8. the purchasing or leasing, and subsequent operation, of existing combustion turbine or combined-cycle plants located in or near a TVA transmission system for which existing adequate transmission and interconnection to the power service area are available, provided that planned TVA operation of such facilities is within existing TVA environmental permit limits
9. conducting or funding minor research and development projects or programs that do not result in ground disturbance.

Appendix B - Activities that Require Additional TVA Internal Review

Activities described in Appendix B will be reviewed by TVA CRS, but will not initially require consultation with the Signatories. If CRS identifies a cultural resource and finds that conditions of Appendix B cannot be met as outlined in Stipulation III.C, TVA will proceed under Stipulation III.D. (“Standard Review Process”). All work on historic properties would be performed in accordance with SOI Standards. Any activities in Appendix B would not be within a known or identified National Register eligible, potentially eligible or undetermined archaeological resource or constitutes multiple activities as part of a larger project.

A. Land Management and Improvements

1. placing less than 500 linear feet of bank stabilization materials (e.g., gravel, riprap, etc.), where either no bank-shaping or bank-shaping less than or equal to a slope of 2:1 is required
2. demolition of permanent building, equipment, structures, and recreational facilities, less than 50 years old that have not achieved exceptional historic significance during this period, or that have been previously determined (in consultation within the past 10 years) not to contribute to the significance of historic properties, and do not fall within a listed or eligible historic district, and where removal would be completed with minimal ground disturbance
3. installation of new fencing and gate supports when the size of the pole is four inches or less in diameter
4. prescribed burns in areas where the activity is contained entirely in open fields that do not have exposed cultural features
5. planting bare rootstock in stands smaller than two acres
6. trenching less than 12-inches-wide and 200-feet-long using a Ditch Witch® or similar equipment, where the trench depth does not exceed two feet
7. preliminary on-site engineering and environmental studies, including (but not limited to) geotechnical borings and monitoring stations and groundwater test wells entailing a footprint of fewer than seven such locations clustered within two acres
8. new culvert installation and berm construction of less than 20 feet in diameter industrially-modified areas, using on-site or commercially available soil, but excluding large, poured, box culverts
9. installation of guardrails and exterior lighting using supports four inches or less in diameter within the existing right of way
10. installation of habitat enhancement features, such as wildlife nesting or roosting boxes, that require ground disturbance
11. activities to restore and enhance wetlands and riparian (i.e., aquatic) habitats, including minor revegetation and removal of debris and sediment following a natural or human-caused disturbance affecting less than two acres
12. fill placement, excavation, or dredging (less than 25 cubic yards) in areas with no known, previously identified inundated sites
13. ash-pond drain installations

14. trail maintenance (including re-benching and trenching to restrict access) involving previously unreviewed areas that would require disturbance of less than two acres, and which are not part of a larger expansion or improvement to the recreational area
15. removal and disposal of temporary buildings (such as trailers, command centers, and mobile units) where removal will be completed with minimal ground disturbance

B. Building Maintenance and Rehabilitation on Buildings ≥50 Years Old, or Those That Have Been Identified As Achieving Exceptional Significance within The Past 50 Years

1. lead-paint abatement conducted in accordance with Chapter 18 of HUD guidelines for evaluating and controlling lead-based-paint hazards ("Lead Hazard Control and Historic Preservation," and carried out in accordance with *National Park Service (NPS) Preservation Brief No. 37, "*Appropriate Methods for Reducing Lead Paint Hazards in Historic Housing")
2. in-kind repair or replacement of roof cladding and sheeting, flashing, gutters, soffits, and downspouts on historic buildings or structures involving no change in roof pitch or configuration
3. in-kind repair or replacement of siding or trim
4. repair or repointing of chimneys or other masonry features on historic buildings or structures with the design, size, shape, mortar materials, and joint profiles matching the original in color, texture, hardness, composition and tooling; and, for historic properties, the approaches recommended in *NPS Preservation Brief No. 2,* "Repointing Mortar Joints in Historic Brick Buildings"
5. securing or mothballing a historic property following *NPS Preservation Brief No. 31*, "Mothballing Historic Buildings"
6. modifications necessary to comply with earthquake and hurricane codes following *NPS Preservation Brief No. 41,* "The Seismic Retrofit of Historic Buildings: Keeping Preservation in the Forefront"
7. general clean-up, encapsulation, and removal or disposal of asbestos-containing materials from buildings and structures, provided no historic fabric is involved
9. installation of new hydroelectric equipment including but not limited to turbines, generators, intake valves, surge tanks, pumps, spillway gates, sluice and radial gates, trash removal equipment (rakes, racks, and hoists), jib and gantry cranes, and control panels found both in the interior and on the exterior of hydroelectric facilities
10. application of exterior paint to previously painted surfaces, when no historic decorative paint schemes or colors (e.g., graining, stenciling, marbling) will be covered by paint
11. in-kind patching and resurfacing of exterior surfaces, such as stucco and concrete, to match existing materials with regard to material composition, consistency, texture, and color
12. automating existing instrumentation anywhere on a dam where new conduit is needed
13. cutting a new slot in a dam exhibiting concrete growth
14. adding new interior or exterior safety and directional signs
15. installing new post-tensioned anchors in a dam
16. adding survey monuments and control points in a dam

17. drilling a hole to install a seal in a concrete dam
18. adding new dam-safety monitoring-instruments within public spaces of a dam, powerhouse, or facility
19. installing platforms or ladders within public spaces within a facility
20. routine installation, upgrades, replacements and/or modifications to structures in public spaces, including fire dampers, exit lights, and fire-protection, -alarm, and sprinkler systems; anti-freezing devices in existing sprinkler systems; corridors, stairways, smoke and motion detectors, security cameras, fire hydrants and associated piping, and emergency generators
21. in-kind replacement of non-historic windows with new replacement windows
22. renovations to restrooms and interior, non-public spaces (i.e., offices, break rooms, etc.) that have been previously renovated and which lack historic fabric
23. in-kind repairs and replacement of walks, steps, and retaining walls at historic properties.
24. installation, replacement, or repair of HVAC systems, provided no alterations are made to character-defining features, spaces, or historic fabrics

C. Permitting

1. easements, ROW, licenses, land use permits, and leases authorizing new individual activities listed in Appendix B
2. approvals for minor structures located along the shoreline, such as single- or double-slip boat docks, boathouses, single ramps, and facilities such as steps, benches, and closed-loop heat exchangers, to be used by a single residence (excluding requests for water-use facilities associated with a new subdivision or other residential-complex development)

D. Transmission Line and Associated Infrastructure Operation and Maintenance

1. replacement of footings, grillage, and anchors outside the existing footprint of an existing TL structure
2. tower extensions and replacement of existing structures, when the size of the increase is no more than 20 percent of the height of the existing structure
3. installation of pull points for line re-conductoring, where the 100-foot-radius surrounding the pole needs improvement beyond adding gravel or ground covering for stabilization
4. demolition of abandoned transmission-line assets on structures less than 50 years old
5. replacement of wood transmission-line structures of any age that would require additional ground disturbance
6. modifications and improvements to informal corridors (such as farm and logging roads) to establish access corridors, excluding paving

E. Administrative Actions

1. modifications to land use plans to rectify administrative errors, or to incorporate new information consistent with previously approved decisions included in the plan, or minor changes to land use allocations to a more restrictive or protective allocation, provided it is

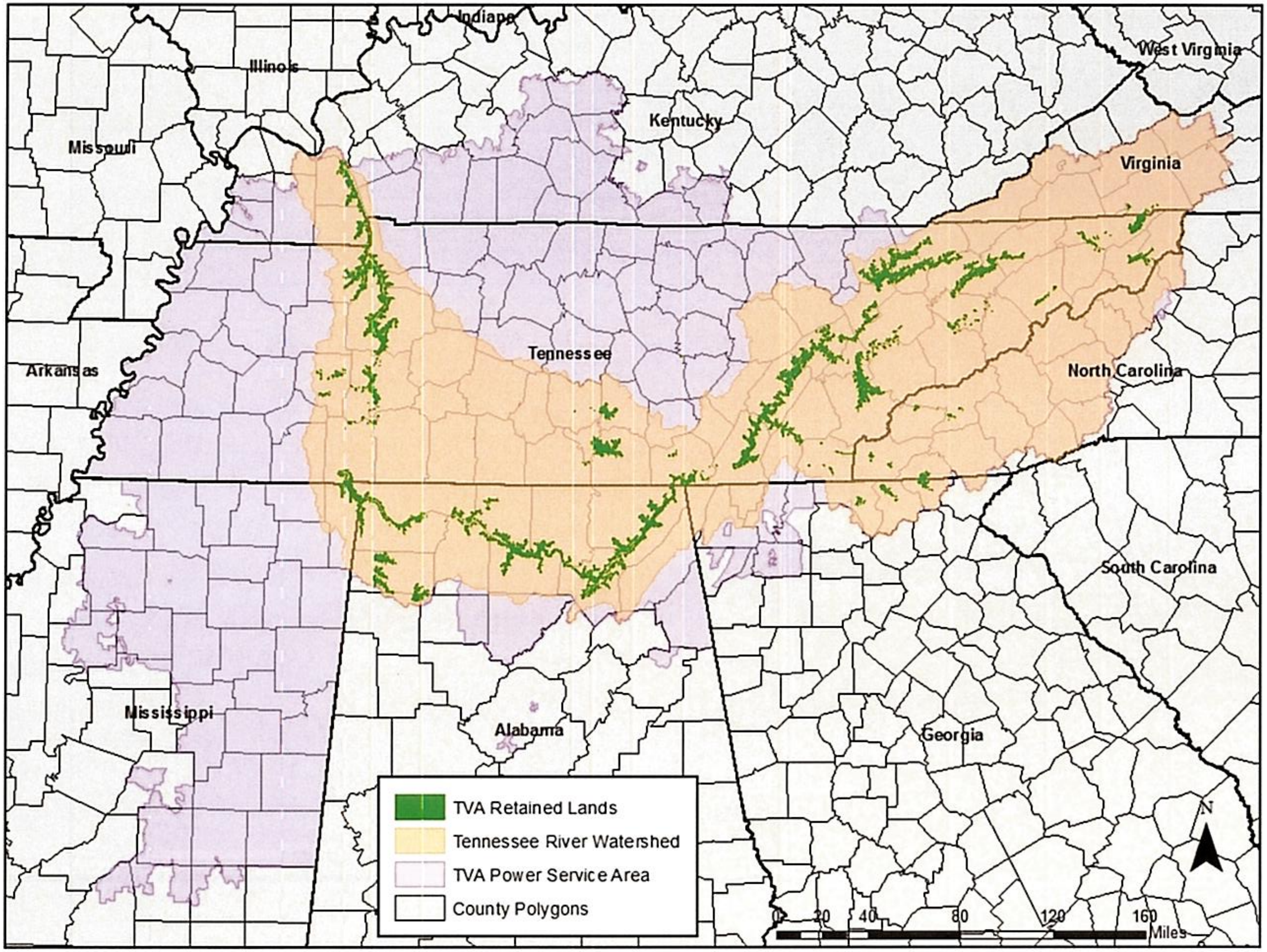
consistent with other TVA plans and policies; or amendments to land use allocations to implement TVA shoreline-management or land-use policies, and provided no restrictions were previously placed during Section 106 consultation

2. transfer of ownership or control of equipment or land rights involving less than two acres

F. New Construction

1. installation of minor structures along the shoreline, such as single- or double-slip boat docks, single ramps, and facilities such as steps and benches
2. installation of fish attractors in areas where no previously identified, inundated, archaeological resources have been identified

Appendix C
TVA Power Service Area Map, with Lands and Generation Facilities


Indiana
Illinois
West Virginia
Kentucky
Missouri
Virginia
Arkansas
Tennessee
North Carolina
South Carolina
Mississippi
Alabama
Georgia
TVA Retained Lands
Tennessee River Watershed
TVA Power Service Area
County Polygons
0 20 40 80 120 160
Miles
N

Appendix D
TVA 800.11(d) or 800.11(e), "Documentation Form"

Tennessee Valley Authority

Finding of No Historic Properties Affected Documentation Pursuant to 36 CFR 800.11(d)

REPORT TITLE

REPORT DATE

Tennessee Valley Authority
400 West Summit Hill Drive
West Tower 11D
Knoxville, Tennessee 37902

Finding of No Historic Properties Affected Documentation Pursuant to 36 CFR 800.11(d)

Description of The Undertaking

Project Information

TVA CID

Project Lead

Project Reviewer

Related Project Record(s)

Project Type	Project Number
Project Number	

State

County

TVA Property

Latitude

Longitude

Description of the Undertaking

Short Description

Long Description

Federal Involvement

I

Area of Potential Effects (APE)

See Map of Geographic Scope Below

Steps Taken to Identify Historic Properties

Consultation

Consultation

Consulting Parties

Oral History Interviews

Oral History Interviews

Background Research

Environmental Context

Topographic Situation

Soil Series and Minimum Slope

Previous Disturbance(s)

Current Land Use(s)

Modern Vegetation

Archaeological Potential

Previous Archaeological Surveys within APE

Previous Archaeological Survey References

Survey Coverage within APE

Presence of Archaeological Sites

Nature and Location of Known Archaeological Site(s)

Archaeological Potential if Survey Coverage is Partial, Unknown, or None

Likely Nature and Location of Archaeological Sites if High Potential

Survey Recommendation

Historic Structures/Landscapes Potential

Known or potential historic structures/landscapes with an unobstructed view of the project:

Existence of substantial modern visual intrusions exist within the viewshed:

If "Yes", list modern visual intrusions:

Field Survey Recommendation (Appendix B, if survey required)

Basis for Finding No Historic Properties Present or Affected

Effect Finding for the Undertaking

Map of Geographic Scope

TVA Archaeological Reconnaissance Form

Administrative Information

Field Reviewer

Fieldwork Dates

Document Date

Field Conditions

Percent Disturbed

Surface Visibility

Archaeological Field Methodology

Level of Effort

Archaeological Field Methodology

Survey Coverage

Photographs

Geographic Focus

Results

Findings

Calculated Total Acres Surveyed

Reported Total Acres Surveyed

Reported Total Shoreline Miles Surveyed

Summary

Recommendation

No further archaeological work

External Archaeological Reconnaissance Form

Administrative Information

Surveyor

Field Work Dates

Document Date

Archaeological Field Methodology

Level of Effort

Archaeological Field Methodology

Survey Coverage

Geographic Focus

Results

Calculated Total Acres Surveyed

Reported Total Acres Surveyed

Reported Total Shoreline Miles Surveyed

Summary

Appendix E
Glossary

aeration: Using devices (typically pulled behind a riding mower) to break up thatch and compacted soil in lawns in commercial settings.

aircraft warning devices: Devices such as lights, signs, and marker balls. Signs and lights are placed on top of transmission-line structures. Marker balls are brightly colored balls placed around overhead ground wires to make them more visible to aircraft and birds.

ash pond drainage: Ditches excavated within the footprint of an ash pond to allow water to accumulate and drain from the surrounding ash. Excavated material is placed in windrows within the pond footprint so that it can drain and dry to reduce moisture.

character-defining: Elements including the overall shape of a building, its materials, artisanship, decorative details, interior spaces and features, as well as various aspects of its site and environment that contribute to its significance.

construction matting: Mats deployed to negate ground pressure exerted by heavy equipment. Mats will be in good condition to ensure proper installation, use, and removal. Mats will be placed one at a time such that vehicle treads do not disturb the ground surface within environmentally sensitive areas. In most cases, mats will be placed along the travel area so that the individual boards are resting perpendicular to the direction of traffic. No gaps will exist between mats. Mats will be placed far enough on either side of the resource area to rest on firm ground. Matting will be removed by "backing" out of the site, removing mats one at a time from behind the equipment as it moves along the exit path, placing each mat in the truck bed as it is removed. This ensures that the ground surface within the site is not disturbed by the vehicle tracks. The mats to be used will be selected in accordance with the weight of the construction equipment to be used in each area, such that no rutting will occur.

Criteria Consideration G: Properties that have achieved exceptional significance in the last 50 years (e.g., Tellico Dam).

cultural resources: A general phrase describing a wide variety of resources, including, but not limited to, archaeological sites, features, landscapes, historical sites, historic structures, natural feature of religious and cultural significance, traditional cultural properties, etc.

cultural resources staff: Archaeologists and architectural historians employed by TVA or staff-augmented archaeological or architectural historian contractors under the direct supervision of TVA staff responsible for making determinations regarding the applicability of this PA, and for certifying that all undertakings comply with applicable PA stipulations.

curb cut: A solid ramp graded down from the top surface of a sidewalk to the surface of an adjoining street, designed for pedestrian use.

dam-safety monitoring instruments: Instruments to manage dam safety, including, but not limited to, water-level gages, piezometers, seepage and leakage gauges, level and alignment surveys, and crack and joint measuring devices.

Equipment:

Heavy-duty equipment: Motorized construction and demolition machines. Examples include cranes, trucks with more than two axles, and tracked equipment. The term “heavy-duty equipment” is synonymous with “heavy machine,” “heavy truck,” and “heavy vehicle,” as these terms are commonly used interchangeably. Examples of heavy-duty equipment commonly used in TVA actions include triple-axle trucks, crawler-dozers, crawler-loaders, four-wheel-drive loaders, cranes, power excavators (whether wheeled or tracked, except mini-excavators), and dump trucks.

Light-duty equipment: Motorized vehicles such as pickup trucks, two-axle bucket trucks, mulchers, feller-bunchers, mowers, bush hogs, skid steers, compact track-loaders, and tracked mini-excavators.

Low-pressure equipment: Motorized machines, tracked or wheeled, designed to minimize ground pressure.

Transmission-line components: Hardware that is part of a transmission line, including structures (poles or towers), insulators, conductor, lightning arrestors, and ground and guy wires.

emergency situations: A disaster or emergency declared by the president or governor of a state or other immediate threats of damage to property or loss of human life, as designated by a TVA official.

functionally similar: Components of a transmission structure that are similar in design and function but, because of modern safety requirements, may be made of different materials.

grillage: A type of foundation used to support transmission structures with below-grade steel, connecting, tower legs designed to resist uplift and thrust forces by transferring loads to the ground. Related to **grillage surcharge**, which is gravel applied over grillage to provide additional weight and stabilization.

ground disturbance: Any activity that moves, alters, compacts, or penetrates the ground surface of previously undisturbed soils and sediments. Undisturbed soils possess intact and distinct natural soil horizons. Previously undisturbed soils and archaeological resources may occur below the depth of disturbed soils.

hazard tree: Dead or dying trees, dead parts of live trees, or unstable live trees that pose an imminent risk of falling into infrastructure (i.e., transmission lines, substations, roads, buildings) or of causing personal injury or fatality to humans.

historic fabric: Building material (masonry, wood, stone, metals, asbestos siding, etc.) from the period of the structure’s potential historical significance.

historic property: Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. Historic property includes artifacts, records, and remains that are related to and located on such properties. The term includes properties of traditional religious and cultural significance to an Indian tribe or Native Hawaiian organization that meet National Register criteria (36 C.F.R. §800.16[l]).

historic structure: Any historic architectural resource that is at least 50 years old.

in-kind replacement: Replacement for a historic element (i.e., >50 years old) that is either missing or beyond repair and which matches all physical and visual aspects of existing materials, including design, form, color, finish, texture, and workmanship, to the greatest extent possible, and does not exceed the existing vertical as well as horizontal disturbance.

loading deck: A staging area for loading timber and other materials onto transport vehicles.

maintained surface: An unpaved road surface (whether surfaced with dirt, gravel, or mulch) that is periodically improved by surface grading, patching, filling in holes, adding gravel, or other means (excluding paving).

maintenance: Activities to maintain existing facilities or structures within structural or functional standards, or to comply with federal regulations or guidelines.

NAGPRA cultural items: Human remains, associated funerary objects, unassociated funerary objects, sacred objects, and cultural patrimony (25 U.S.C. 3001[3]).

post-tensioned anchors: Anchors that hold a cable under tension within the interior concrete structure of the dam to tie it to substrate to deter further movement. The anchors are housed below steel plates, and the cables are not visible as they run within the structure and footing of the dam (and not within open spaces or galleries).

public spaces: Spaces within the interior of historic facilities that are accessible or visible to the visiting public or are designed to be accessible or visible to the visiting public (e.g., reception rooms, lobbies, generator rooms, restrooms, overlooks, control rooms).

pull points: The location on the transmission-line corridor where equipment pulls or provides tension to wire during installation or removal.

re-benching: Re-leveling the trail path by shaving a small portion of the uphill slope that has eroded, to allow for the trail to be widened back to its original configuration.

rock bolts: A long anchor bolt for stabilizing rock on an embankment. Transfers load from the unstable exterior to confined and much stronger interior of the rock mass.

slot cut: a thin cut into the concrete of a dam to control concrete expansion, similar to an expansion joint on a road or concrete bridge.

Secretary's standards: Refers to *The Secretary of the Interiors Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings* (http://www.nps.gov/hps/tps/standguide/). Work carried out on historic properties must meet *The Secretary of the Interior's Standards for the Treatment of Historic Properties* to avoid an adverse effect to historic properties (see 36 C.F.R. §800.5[a][2][ii]).

transmission tower/pole extension: Modification to an existing structure that increases the wire-to-ground clearance.

weed wrench: a long-handled device attached to small shrubs and other woody vegetation, used to pull vegetation from the ground and remove invasive plant species.

Appendix F – National Park Service General Agreement

This page intentionally left blank

United States Department of the Interior

NATIONAL PARK SERVICE
Southeast Regional Office
Atlanta Federal Center
1924 Building
100 Alabama St., SW.
Atlanta, Georgia 30303

IN REPLY REFER TO:
1.A.2 (SERO-PC)

APR 10 2019

Tricia Roelofs
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, Tennessee 37901

Dear Ms. Roelofs:

Enclosed is a signed General Agreement between the Tennessee Valley Authority and the National Park Service (NPS) which addresses vegetation management for electric transmission and distribution line right-of-way easements and permits on NPS lands. If you have any questions, please contact Anita Barnett at Anita_Barnett@nps.gov or 404-507-5706.

Sincerely,

Robert A. Vogel
Regional Director

Enclosure

GENERAL AGREEMENT
ON VEGETATION MANAGEMENT FOR POWERLINE RIGHTS-OF-WAY

Between

TENNESSEE VALLEY AUTHORITY

and

U.S. DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

I. Purpose

This General Agreement (GA) is entered into by the Tennessee Valley Authority (TVA) and the National Park Service (NPS) and addresses vegetation management for electric transmission and distribution line right-of-way (ROW) easements and permits (referred to throughout this GA as powerline ROWs) on NPS lands. The GA will help facilitate cooperation and coordination among TVA and the NPS regarding vegetation management within and immediately adjacent to existing and future powerline ROWs and associated facilities. Specifically, the GA will expedite implementation of cost-effective and environmentally sound vegetation management plans, procedures, and practices for powerline ROWs that will identify and, if possible, reduce any potential adverse environmental and cultural impacts while enhancing the ability of utilities to provide uninterrupted electrical service to customers and address public safety, including the public safety risks that may arise from wildfires caused by inadequate vegetation management.

This GA does not substitute for park-specific agreements, which should be established, or updated where existing, between TVA and individual NPS parks to address issues specific to that park unit, including consideration and/or protection of cultural resources, protection of state and federally listed species and habitats, and other similar relevant issues.

II. Authorities

TVA is a federal agency and instrumentality of the United States, created by and existing pursuant to the TVA Act (1933) to foster the social and economic welfare of the people in the Tennessee River Valley, promote stewardship of the region's natural resources, provide low cost energy, and improve flood control and navigation of the Tennessee River and its tributaries. In furtherance of that mission, TVA operates and maintains the nation's largest public power system, including hydropower, coal, gas, nuclear, solar and wind generation facilities, auxiliary structures and electrical distribution lines and facilities. Also in furtherance of that mission, TVA maintains approximately 237,000 acres of transmission line ROW powerline easements, collectively over 16,200 circuit miles.

The NPS is directed to manage all national park lands to protect and preserve natural and cultural resources, pursuant to the National Park Service Organic Act, 54 U.S.C. 100101. The NPS is responsible for managing nearly 84 million acres with over 400 units of the National Park System. The mission of the NPS is to preserve unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of current and future generations. The NPS also has management responsibilities over other areas, including parts of the National Wild and Scenic Rivers System, National Trails System, National Heritage Areas, and NPS Affiliated Areas, which are closely linked in importance and purpose to those areas directly managed by the NPS. Each park unit has its own enabling legislation that defines the purpose of the park and other specifics related to resource protections. Management, including the issuance of permits, for each NPS unit is directed by each unit's superintendent.

III. Coordination and Cooperation

A number of TVA's powerline easements pass through NPS land. Therefore, coordination and cooperation between TVA and the NPS is important to enhance electric transmission reliability, increase maintenance efficiencies, reduce management costs, prevent the spread of invasive plants, reduce fuel loads, reduce the risk of wildfires, and minimize other potential environmental and cultural resource impacts and human safety risks. This coordination and cooperation should include each party's best efforts toward the following goals:

A. Completion of natural resource surveys to identify sensitive habitats and threatened and endangered flora within TVA ROWs on NPS land where appropriate.
B. Sharing data on state and federal listed species and protected habitats within and adjacent to ROWs to ensure that ROW access and management within ROWs protects sensitive species and habitats to the full extent possible.
C. Development of vegetation management plans that identify vegetation control prescriptions within a given year for each powerline ROW on NPS land. Such vegetation management plans must comply with applicable federal mandates and policies, be consistent with operations and maintenance plans for each powerline, and consider requirements for Federal reliability standards.
D. Develop protocols for maintenance, access, and safety. This includes protocols for wildfire management and response.

IV. Roles and Responsibilities

A. Both TVA and the NPS will:
    a. Facilitate coordination with each other at the local level to develop vegetation management plans, and cooperate to complete any necessary vegetation surveys for plan development. In addition, the Parties will work together on any necessary land use authorizations for powerline ROWs on NPS lands.
    b. Promote safety during vegetation management activities associated with powerline ROWs on NPS lands. The parties to this GA acknowledge that:
        i. In general, the safety of electric utility workers and the public at transmission and distribution facilities is the responsibility of TVA. Moreover, TVA will conduct their operations in accordance with applicable National Electrical Safety Code (NESC) and Occupational Safety and Health Administration (OSHA) standards, and the terms and

conditions in the ROW authorizations, and other worker protection standards where applicable.

ii. The NPS will coordinate with TVA to develop appropriate measures to ensure personal and public safety and protection of NPS lands and resources during vegetation management activities.

c. Address the management of trees that have the potential to interfere with the reliable operation of TVA's transmission system in all vegetation management plans and authorizations.

d. Prevent and control the spread of invasive species through a proactive and integrated management approach along powerline ROWs on NPS lands.

e. Work together to identify resource protection needs or cooperative resource management opportunities within TVA ROWs on NPS lands, such as pollinator enhancement projects and/or establishment of early successional habitat through the use of selective herbicide application or other methods.

f. Coordinate their efforts to comply with Section 106 of the National Historic Preservation Act. NPS and TVA will work together to address any cultural or tribal resources potentially affected by vegetation management and seek ways to balance and integrate cultural and natural resource management, including working together to identify opportunities for selective herbicide use to avoid potential impacts to cultural resources

g. Coordinate measures to protect sensitive species or habitats.

h. Consider the impacts of various vegetation management strategies on other resources, such as potential impacts to water quality from herbicide use or soil erosion.

i. Consider wetland impacts, both permanent and temporary, from vegetation management actions, such as use of heavy equipment, changes to the plant community and potential hydrology alterations.

j. Work together to establish site-specific wildfire prevention and response plans.

B. TVA will:

a. Provide the NPS with the necessary information for development of the proposed or revised vegetation management plan for ROWs on NPS lands. The information will include vegetation surveys, proposed treatment procedures and herbicide or pesticide use, maps, best management practices, and mitigation measures.

b. Develop site-specific vegetation management plans collaboratively with the NPS.

c. Collaborate and coordinate with the NPS on vegetation management activities associated with the powerline ROW with individual parks.

d. Ensure that TVA employees and contractors are informed on the terms and conditions of applicable ROW permits and approved vegetation management plans to best ensure compliance and avoid unauthorized boundary encroachment and resource damage.

e. Ensure this GA is disseminated to appropriate TVA staff and contractors within three months of the effective date.

C. NPS will:

a. To the extent practicable and consistent with other NPS obligations and priorities, strive to review requests for any required, non-emergency vegetation management for powerline ROWs on NPS lands within 60 calendar days of receipt from TVA.
b. Review and provide park-level input on draft vegetation management plans, including wildlife protection requirements and mitigation measures.
c. When necessary, the NPS will use information provided by TVA to develop permit terms and conditions.
d. Ensure this GA is disseminated to all appropriate units of the National Park System within three months of the effective date.
e. Identify cultural resources on NPS lands that may need to be addressed in ROW vegetation plans and any related resource protection requirements; information regarding certain cultural resources, including their exact location, may be legally protected under Federal law and require safeguarding.

V. Principal Contacts

The principal contacts for this GA are:

Tricia Roelofs
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902
(202) 436-6043
tlroelofs@tva.gov

Kim Pilarski-Hall
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902
(865) 632-3405
kpilarski@tva.gov

Niki Stephanie Nicholas
Superintendent, Big South Fork National Recreation Area
4564 Leatherwood Road
Oneida, TN 37841
(423) 569-9778
biso_superintendent@nps.gov

Brad Bennett
Superintendent, Chickamauga and Chattanooga National Military Park
3370 LaFayette Road
Fort Oglethorpe, GA 30742
(706) 866-9241
brad_bennett@nps.gov

Cassius Cash
Superintendent, Great Smoky Mountains National Park
107 Park Headquarters Road
Gatlinburg, TN 37738
(865) 436-1200
cassius_cash@nps.gov

Kim Kirk (Acting)
Superintendent, Little River Canyon National Preserve
4322 Little River Trail NE
Suite 100
Fort Payne, AL 35967
(256) 845-9605
kim_kirk@nps.gov

Mary Risser
Superintendent, Natchez Trace Parkway
2608 Natchez Trace Parkway
Tupelo, MS 38804
(662) 680-4005
mary_risser@nps.gov

Kim Kirk (Acting)
Superintendent, Russell Cave National Monument
3729 County Road 98
Bridgeport, AL 35740
(256) 495-2672
kim_kirk@nps.gov

VI. Implementation, Amendments, and Termination

This GA will become effective on the date it is fully executed and will remain in effect for five years, unless it is terminated in writing by TVA or NPS prior to its expiration. This GA may be amended with the written consent of TVA and NPS.

VII. Non-Fund-Obligating Document

Each party will fund its own participation under this GA and will carry out its separate activities in a coordinated and mutually beneficial manner. Nothing in this Agreement obligates the NPS to expend in any one fiscal year any sum in excess of appropriations made by Congress, or to involve the NPS in any contract or other obligation for the further expenditure of money in excess of such appropriations or allocations.

Although TVA is committed to cooperating with the NPS to the full extent possible, nothing in this Agreement shall obligate TVA to spend funds in excess of its annual ROW vegetation management budget.

VIII. Limitations

This GA is not intended to and does not create any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity, by a party against the United States, its agencies, its officers, or any person. This GA has no legal effect on existing or future land use authorizations for powerline ROWs on NPS lands.

Nothing in this Agreement obligates TVA or the NPS to expand their respective legal obligations under the National Environmental Policy Act, the Endangered Species Act, National Historic Preservation Act, or any other law or regulation applicable to their respective activities on TVA ROW powerline easements.

IX. Authorized Representatives

In Witness Hereof, the Parties hereto have signed their names and executed this General Agreement.

Tricia L. Roelofs Senior Manager Tennessee Valley Authority	5.2.19 Date
Robert A. Vogel Southeast Regional Director National Park Service	4-10-19 Date

Appendix G– Transmission Line Segments by Sector Proposed for Vegetation Management during FY 2021 Planning Cycle

Appendix Table 5-1. TVA Transmission System Line Segments Proposed for Vegetation Management in Fiscal Year 2021

SECTOR NAME	SECTOR ABBREVIATION	PRIMARY LINE NUMBER	PRIMARY LINE NAME
Cleveland	CL	L6080	WATTS BAR NP - SEQUOYAH 1
Cleveland	CL	L5039	SEQUOYAH NP - CONCORD
Cleveland	CL	L5752	CHICKAMAUGA -CONCORD
Cleveland	CL	L6065	SEQUOYAH-GEORGIA STATE LINE
Cleveland	CL	L6183	WIDOWS CREEK-ROCK SPRINGS
Cleveland	CL	L3322	OCOEE HP 2-OCOEE 3
Cleveland	CL	L6081	WATTS BAR NP - SEQUOYAH NP 2
Cleveland	CL	L5866	ATHENS-LOUDON
Cleveland	CL	L5219	HAWTHORNE - RIDGEDALE
Cleveland	CL	L4255	W RINGGOLD - CENTER POINT
Cleveland	CL	L3056	ENGLEWOOD-MADISONVILLE
Cleveland	CL	L5046	SEQUOYAH - CHICKAMAUGA 2
Cleveland	CL	L3373	E CLEVELAND-RICEVILLE
Cleveland	CL	L3330	OCOEE HP 1-E CLEVELAND
Cleveland	CL	L5127	WATTS BAR HP - WATTS BAR 1
Cleveland	CL	L5875	LOUDON - TRDA
Cleveland	CL	L5103	HIWASSEE - ALCOA SW STA
Cleveland	CL	L5044	SEQUOYAH NP-E CLEVELAND
Cleveland	CL	L3314	OCOEE HP 1-ETOWAH SW STA
Centerville	CV	L6069	CUMBERLAND-DAVIDSON
Centerville	CV	L5610	JOHNSONVILLE-LAWRENCEBURG
Centerville	CV	L5138	DAVIDSON-CENTERVILLE
Centerville	CV	L5197	JOHNSONVILLE-CUMBERLAND
Centerville	CV	L3835	CHEATHAM-DICKSON
Centerville	CV	L5739	MAURY-MONSANTO
Centerville	CV	L5285	WHEELER-MAURY
Centerville	CV	L5017	CUMBERLAND-CLARKSVILLE
Centerville	CV	L5206	JOHNSONVILLE-DICKSON
Centerville	CV	L5600	JOHNSONVILLE-MONSANTO2
Centerville	CV	L2561	COLUMBIA-HOOKER SHEA
Centerville	CV	L6061	JOHNSONVILLE-DAVIDSON
Centerville	CV	L3946	DICKSON-MCEWEN
Centerville	CV	L2427	COLUMBIA-COLUMBIA DST
Hopkinsville	HK	L6070	SHAWNEE-LUTESVILLE
Hopkinsville	HK	L5634	KENTUCKY DAM-S CALVERT
Hopkinsville	HK	L5136	SHAWNEE-PEDUCAH

SECTOR NAME	SECTOR ABBREVIATION	PRIMARY LINE NUMBER	PRIMARY LINE NAME
Hopkinsville	HK	L5710	KENTUCKY DAM-CALVERT
Hopkinsville	HK	L5694	MARSHALL-MAYFIELD 1
Hopkinsville	HK	L3341	RUSSELLVILLE-RUSSELLVILLE DST
Hopkinsville	HK	L6072	SHAWNEE-MARSHALL
Hopkinsville	HK	L5034	MARSHALL-CALVERT 1
Hopkinsville	HK	L3934	KENTUCKY DAM-BENTON
Hopkinsville	HK	L5997	BOWLING GREEN-HOPKINSVILLE
Hopkinsville	HK	L5654	KENTUCKY DAM-BARKLEY2
Hopkinsville	HK	L5035	MARSHALL-CALVERT 2
Hopkinsville	HK	L5631	PARADISE-CLARKSVILLE
Hopkinsville	HK	L5630	PARIDISE-BOWLING GREEN
Hopkinsville	HK	L5807	MONTGOMERY-CLARKSVILLE
Hopkinsville	HK	L5653	KENTUCKY DAM-BARKLEY1
Hopkinsville	HK	L3926	PARADISE-HOPKINSVILLE 3
Hickory Valley	HV	L5934	FREE PORT-MILLER
Hickory Valley	HV	L6137	PLEASANT HILL-BENTON
Hickory Valley	HV	L5861	HOLLY SPRINGS-MILLER
Hickory Valley	HV	L5209	OLIVE BRANCH-DESOTO RD
Hickory Valley	HV	L5217	CORDOVA-HICKORY VALLEY 1
Hickory Valley	HV	L5640	BOONEVILLE-N LEE
Hickory Valley	HV	L6089	CORDOVA-SHELBY
Hickory Valley	HV	L5928	BURNSVILLE-BOONEVILLE
Hickory Valley	HV	L5668	COLBERT-BURNSVILLE
Hickory Valley	HV	L2501	HICKORY VALLEY-WALNUT
Hickory Valley	HV	L5606	CORDOVA-OLIVE BRANCH
Hickory Valley	HV	L5937	MILLER-OLIVE BRANCH
Hickory Valley	HV	L6099	PLEASANT HILL-UNION
Hickory Valley	HV	L5379	WEST ADAMSVILLE - SELMER
Manchester	MC	L5696	MCMINNVILLE-MANCHESTER
Manchester	MC	L2477	GREAT FALLS-SPENCER
Manchester	MC	L5258	BELFAST-ELK RIDGE
Manchester	MC	L5257	ELK RIDGE-N LEWISBURG
Manchester	MC	L5072	SEQUOYAH-MOCCASIN
Manchester	MC	L5926	WARTRACE-E SHELBYVILLE 2
Manchester	MC	L5171	GREAT FALLS-MURFREESBORO
Manchester	MC	L2702	WINCHESTER-MONTEAGLE
Manchester	MC	L5925	WARTRACE-E SHELBYVILLE 1
Manchester	MC	L5993	E SHELBYVILLE-UNIONVILLE
Manchester	MC	L3002	JASPER-S PITTSBURG

SECTOR NAME	SECTOR ABBREVIATION	PRIMARY LINE NUMBER	PRIMARY LINE NAME
Manchester	MC	L6107	MAURY-FRANKLIN
Manchester	MC	L5069	CHICKAMAUGA -MOCCASIN2
Manchester	MC	L5073	RACCOON MTN PS - MOCCASIN 1
Madison	MD	L5725	GUNTERSVILLE-DECATUR
Madison	MD	L2701	WINCHESTER-ANDERSON
Madison	MD	L2425	FORT PAYNE-GAYLESVILLE
Madison	MD	L4208	GUNTERSVILLE-FULTON DALE
Madison	MD	L5904	PULASKI-FAYETTEVILLE
Madison	MD	L5968	ARDMORE - FAYETTEVILLE
Madison	MD	L2495	ARAB-BRINDLYE
Madison	MD	L5906	CULLMAN-HANCEVILLE
Madison	MD	L5981	WINCHESTER-FAYETTEVILLE
Madison	MD	L2682	ALBERTVILLE-WHITESBORO
Madison	MD	L2713	COLLINSVILLE-CENTRE
Madison	MD	L5718	WIDOWS CR-BELLEFONTE
Milan	ML	L5941	TIPTONVILLE-NEW MADRID
Milan	ML	L5892	JACKSON-S JACKSON 2
Milan	ML	L5885	UNION CITY-TIPTONVILLE
Milan	ML	L3814	MAYFIELD-WEST MURRAY
Milan	ML	L5604	JOHNSONVILLE-MILAN
Milan	ML	L5276	MCKELLAR-S JACKSON
Milan	ML	L5602	JACKSON-S JACKSON
Milan	ML	L5905	JACKSON-MADISON
Milan	ML	L5798	SHELBY-COVINGTON
Milan	ML	L5835	JACKSON-MILAN
Milan	ML	L5913	COVINGTON-BROWNSVILLE
Milan	ML	L3801	MILAN-MILAN DST
Milan	ML	L6051	JOHNSONVILLE-JACKSON
Milan	ML	L3324	MILAN-TREZEVANT
Milan	ML	L6105	JACKSON-HAYWOOD
Milan	ML	L5274	JACKSON-BUD CROCKETT
Muscle Shoals	MS	L6091	BROWNS FERRY-UNION
Muscle Shoals	MS	L5994	COLBERT-ST LINE2
Muscle Shoals	MS	L5622	COLBERT-CULLMAN
Muscle Shoals	MS	L5840	COLBERT-ST LINE1
Muscle Shoals	MS	L2413	SHOALS-FLORENCE
Muscle Shoals	MS	L5821	UNION-TUPELO 2
Muscle Shoals	MS	L5285	WHEELER-MAURY

SECTOR NAME	SECTOR ABBREVIATION	PRIMARY LINE NUMBER	PRIMARY LINE NAME
Muscle Shoals	MS	L6074	BROWNS FERRY-TRINITY
Muscle Shoals	MS	L5960	TUPELO-TURNER PARK
Muscle Shoals	MS	L5722	WHEELER-ARDMORE
Muscle Shoals	MS	L5889	ST LINE-TUPELO
Muscle Shoals	MS	L5117	WHEELER-Mt PLEASANT 1
Muscle Shoals	MS	L5849	WILSON HP-OCCIDENTAL
Muscle Shoals	MS	L5309	TUPELO-N LEE
Muscle Shoals	MS	L2529	BELMONT-RED BAY
Muscle Shoals	MS	L5778	COLBERT-SHOALS
Muscle Shoals	MS	L2487	WILSON HP-UNION CARBIDE
Morristown	MT	L5109	DOUGLAS-KNOXVILLE
Morristown	MT	L5831	PIGEON FORGE-GATLINBURG
Morristown	MT	L5160	FONTANA - ALCOA SW STA 1
Morristown	MT	L5083	ELIZABETHTON-CRANBERRY 2
Morristown	MT	L5070	SULLIVAN-N BRISTOL
Morristown	MT	L5098	KNOX-VOLUNTEER 1
Morristown	MT	L5806	ELIZABETHTON-CRANBERRY 1
Morristown	MT	L5824	JOHN SEVIER-CHEROKEE 2
Morristown	MT	L5871	DOUGLAS-PIGEON FORGE 2
Morristown	MT	L5940	WHITE PINE-DUMPLIN VALLEY
Morristown	MT	L5955	DUMPLIN VALLEY-NIXON RD
Morristown	MT	L5097	CHEROKEE-VOLUNTEER
Morristown	MT	L5624	JOHN SEVIER-WHITE PINE 2
Morristown	MT	L5963	SULLIVAN-JONESBOROUGH
Morristown	MT	L6094	PHIPPS BEND-NAGEL
Morristown	MT	L5957	DOUGLAS-WHITE PINE
Morristown	MT	L1914	FONTANA HP-PEPPERTREE
Nashville	NA	L5853	S NASHVILLE-WILSON
Nashville	NA	L6083	ROANE-WILSON
Nashville	NA	L5819	GALLATIN-S NASHVILLE
Nashville	NA	L5110	GALATIN FP-SUMMERSHADE
Nashville	NA	L5763	E FRANKLIN-FRANKLIN1
Nashville	NA	L5038	WILSON-MARTHA
Nashville	NA	L5690	DAVIDSON-RADNOR1
Nashville	NA	L5345	GALATIN-HARTSVILLE
Nashville	NA	L5775	GALLATIN FP-WILSON
Oak Ridge	OR	L6083	ROANE - WILSON
Oak Ridge	OR	L3315	HARRIMAN-ADCOCK

SECTOR NAME	SECTOR ABBREVIATION	PRIMARY LINE NUMBER	PRIMARY LINE NAME
Oak Ridge	OR	L5657	BULL RUN-ALCOA
Oak Ridge	OR	L3856	CLINTON - SOLWAY
Oak Ridge	OR	L5158	ALCOA SW STA - ALCOA 2
Oak Ridge	OR	L5234	FT LOUDOUN - SPALLATION NEUTRON SOURCE
Oak Ridge	OR	L5736	WOLF CR-HUNTSVILLE
Oak Ridge	OR	L6059	BULL RUN- WATTS BAR NP 500 KV
Oak Ridge	OR	L5095	VOLUNTEER - KNOXVILLE 2
Oak Ridge	OR	L5302	KINGSTON-FT LOUDOUN 2
Oak Ridge	OR	L5096	NORRIS-VOLUNTEER
Oak Ridge	OR	L5700	WOLF CR-SUMMER SHADE
Oak Ridge	OR	L3380	MELTON HILL-HARRIMAN
West Point	WP	L6054	WEST POINT-FRENCH CAMP
West Point	WP	L5909	LOWNDES-COLUMBUS
West Point	WP	L3918	BRUCE-CALHOUN CITY
West Point	WP	L5675	WEST POINT-STARKVILLE 1
West Point	WP	L5329	CATALPACREEK-CLAYTON VILLAGE
West Point	WP	L5887	ST LINE-WEST POINT
West Point	WP	L5230	LEAKE-FIVE POINTS
West Point	WP	L5060	OKOLONA-COFFEEVILLE
West Point	WP	L5227	PHILADELPHIA-LANGFORD
West Point	WP	L5839	WEST POINT-ABERDEEN
West Point	WP	L5615	WEST POINT-OKOLONA
West Point	WP	L2657	ABERDEEN-MONROE CO
West Point	WP	L5621	COLBERT-LOWNDES
West Point	WP	L5868	COLUMBUS-EKA NOBLE
West Point	WP	L5616	TUPELO-OKOLONA
West Point	WP	L5229	LEAKE-SABASTOPOL
West Point	WP	L5050	PHILADELPHIA-LEAKE 1

Appendix H – TVA Vegetation Management Guidelines

Transmission Environmental Protection Procedures
Right-Of-Way Vegetation Management Guidelines

1.1 Overview

A. The Tennessee Valley Authority (TVA) must manage the vegetation on its rights-of-way and easements to ensure emergency maintenance access and routine access to structures, switches, conductors, and communications equipment. In addition, TVA must maintain adequate clearance, as specified by the National Electrical Safety Code, between conductors and tall growing vegetation and other objects. This requirement applies to vegetation within the right-of-way (ROW) as well as to trees located off the right-of-way.

B. Each year TVA assesses the conditions of the vegetation on and along its rights-of-way. This is accomplished by aerial inspections, ground inspections, periodic field inspections, aerial photography, LiDAR / Phodar data and information from TVA personnel, property owners and the general public. TVA utilizes this data to evaluate vegetation clearances and identifies vegetation on and off ROW that does, or could potentially pose a risk to reliability.

C. TVA transmission foresters develop a vegetation re-clearing plan that is specific to each line segment and is based on terrain conditions, species mix, growth, and density.

2.1 Right-of-Way Management Methods

A. TVA takes an Integrated Vegetation Management (IVM) approach that is based on a carefully planned, multidimensional strategy developed in consultation with forestry and habitat experts. Integrated vegetation management aims to improve safety and prevent power outages by creating healthy and self-sustaining ecosystems in ROWs while ensuring compliance with regulatory standards (NERC 2006). These ecosystems foster beneficial, attractive and low-maintenance habitat where tall trees won’t grow and other, more benign forms of vegetation can thrive. Integrated vegetation management encourages early successional native habitats that pose less threat to power reliability yet offer safe havens for desirable plants and animals. By combining selective use of herbicides with physical removal, integrated vegetation management can more thoroughly eradicate problem vegetation and allow more compatible species to fill in, making it harder for tall-growing trees to reestablish.

   TVA executes its transmission vegetation maintenance on a 2-, 3-, or 4-year cycle based on data that is acquired by various inspection methods. Photogrammetry, LiDAR, ground inspection and aerial inspection data are utilized to evaluate the next year's scheduled work to determine the annual vegetation maintenance work scope. LiDAR and Photogrammetry technologies provide a detailed vegetation threat analysis that can be used to assess risk as well as prioritize vegetation management work plans. This detailed analysis supports TVA’s efforts to target incompatible species as well as promote the growth of compatible vegetation. This precision management approach is effective in reducing overall environmental impact by limiting work to specific areas of incompatibility.

B. TVA uses a variety of herbicides specific to the species present with a variety of possible application techniques. Herbicides are selectively applied from the ground with backpack sprayers or vehicle-mounted sprayers. Any herbicides used are applied in accordance with applicable state and federal laws and regulations. Only herbicides registered with the United States Environmental Protection Agency (USEPA) are used.

C. In very steep terrain, in sensitive environmental areas, in extensive wetlands, at stream banks, and in sensitive property owner land use areas, hand clearing may be utilized. Hand clearing is recognized as one of the most hazardous occupations documented by the Occupational Health and Safety Administration. For that reason, TVA utilizes low volume herbicide applications in these areas when feasible.

D. TVA does not encourage tree re-clearing by individual property owners because of the high hazard potential of hand clearing, possible interruptions of the line, and electrical safety considerations for untrained personnel that might do the work.

E. Mechanical mowers not only cut the tall saplings and seedlings on the right-of-way, they also shatter the stump and the supporting near surface root crown. The tendency of resistant species is to re-sprout from the root crown and shattered stumps can produce a multi-stem dense stand in the immediate area. Repeated use of mowers on short cycle re-clearing with many original stumps re-growing in the above manner can create a single species thicket or monoculture. With the original large root system and multiple stems, the resistant species can produce re-growth at the rate of 5-10 feet in a year. In years with high rainfall, the growth can reach 12-15 feet in a single year. These dense, monoculture stands can become nearly impenetrable for even large tractors. Such stands have low diversity, little wildlife food or nesting potential, and become a property owner concern. Selective herbicide application may be used to control monoculture stands.

3.1 Herbicide Program

A. TVA has worked with universities (such as Mississippi State University, University of Tennessee, Purdue University and others), chemical manufacturers, other utilities, U.S. Department of Transportation, U.S. Fish and Wildlife Service (USFWS), and U.S. Forest Service (USFS) personnel to explore options for vegetation control. The results have been strong recommendations to use species-specific, low volume herbicide applications in more situations. Research, demonstrations, and other right-of-way programs show a definite improvement of rights-of-way treated with selective low-volume applications of new herbicides using a variety of application techniques and timing. Table 1 below identifies herbicides currently used on TVA rights-of-way. Table 2 identifies pre-emergent herbicides currently being used on bare ground areas on TVA rights-of-way and in substations. Table 3 identifies TGRs that may be used on tall trees that have special circumstances that require trimming on a regular cycle, e.g., restrictions on complete removal. The rates of application utilized are those listed on the U.S. Environmental Protection Agency (USEPA) approved label and consistent with utility standard practice throughout the Southeast.

Table 1 - Herbicides Currently Used on TVA Rights-of-Way

Trade Name	Active Ingredient	Label Signal Word
Accord/Accord XRT II	Glyphosate/Liquid	Caution
Arsenal	Imazapyr/Liquid/Granule	Caution
Chopper	Imazapyr/RTU	Caution
Clearstand	Imazapyr/Metsulfuron Methyl/Liquid	Caution
Escort	Metsulfuron Methyl/Dry Flowable	Caution
Garlon	Triclopyr/Liquid	Caution
Garlon 3A	Triclopyr/Liquid	Danger
Habitat	Imazapyr/Liquid	Caution
Krenite S	Fosamine Ammoinium	Caution
Milestone VM	Aminopyralid/Liquid	Caution
Pathfinder II	Triclopyr/RTU	Caution
Rodeo	Glyphosate/Liquid	Caution
Roundup	Glyphosate/Liquid	Caution
Roundup Pro	Glyphosate	Caution
Streamline	Aminocyclopyrachlor/ Metsulfuron Methyl/Liquid	Caution
Transline	Clopyralid/Liquid	Caution
Viewpoint	Imazapyr/Aminocyclopyrachlor/ Metsulfuron Methyl/Liquid	Caution

Table 2 - Pre-Emergent Herbicides Currently Used for Bare Ground Areas
On TVA Rights-of-Way

Trade Name	Active Ingredients	Label Signal Word
Arsenal 5G	Imazapyr/Granule	Caution
Sahara	Diuron/Imazapyr	Caution
SpraKil SK-26	Tebuthiuron/Diuron/Granules	Caution
SpraKil S-5	Tebuthiuron/Granules	Caution
Topsite	Diuron/Imazapyr	Caution

Table 3 - Tree Growth Regulators (TGRs) Currently Used On TVA Rights-of-Way

Trade Name	Active Ingredients	Label Signal Word
Profile 2SC	TGR-paclobutrazol	Caution
TGR	Flurprimidol	Caution

B. The herbicides listed in Table 1 and 2 and TGRs listed in Table 3 have been evaluated in extensive studies in support of registration applications and label requirements. Many have been reviewed in the USFS vegetation management environmental impact statements (EISs), and those evaluations are incorporated here by reference (USFS 1989a, 1989b, 2002a, and 2002b). Electronic copies can be accessed at https://cdxnodengn.epa.gov/cdx-enepa- public/action/eis/search. The result of these reviews has been a consistent finding of limited environmental impact beyond that of control of the target vegetation. All the listed herbicides have been found to be of low environmental toxicity when applied by trained applicators following the label and registration procedures, including prescribed measures, such as buffer zones, to protect threatened and endangered species.

C. Low volume herbicide applications are recommended since research demonstrates much wider plant diversity after such applications. There is better ground erosion protection and more wildlife food plants and cover plants develop. In most situations there is increased development of wild flowering plants and shrubs. In conjunction with herbicides, the diversity and density of low-growing plants provide control of tall-growing species through competition.

D. Herbicides are used in place of rotary mowing in order to avoid damage to nesting and tunneling wildlife. This method retains ground cover year around with a better mix of food species and associated high-protein insect populations for birds in the right seasons. Most also report less damage to soils (even when compared with rubber-tired equipment).

E. Best Management Practices (BMPs) governing application of herbicides are contained within *A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Transmission Construction and Maintenance Activities* (Muncy 2016) which is incorporated by reference. Herbicides can be liquid, granular, or powder and can be applied aerially or by ground equipment and may be selectively applied or broadcast, depending on the site requirements, species present, and condition of the vegetation. Water quality considerations include measures taken to keep herbicides from reaching streams whether by direct application or through runoff of or flooding by surface water. “Applicators” must be trained, licensed, and follow manufacturers’ label instructions, USEPA guidelines, and respective state regulations and laws.

F. When herbicides are used, their potential adverse impacts are considered in selecting the compound, formulation, and application method. Herbicides that are designated “Restricted Use” by USEPA require application by or under the supervision of applicators certified by the respective state control board. Applications are done either by TVA or by contractors in accordance with the following guidelines identified in the TVA BMP manual (Muncy 2016):

   1. The sites to be treated are selected and application directed by the appropriate TVA official.
   2. A preflight walking or flying inspection is made within 72 hours prior to applying herbicides aerially. This inspection ensures that no land use changes have occurred, that sensitive areas are clearly identified to the pilot, and that buffer zones are maintained.
   3. Aerial application of liquid herbicides will normally not be made when surface wind speeds exceed 5 miles per hour, in areas of fog, or during periods of temperature inversion.
   4. Pellet application will normally not be made when the surface wind speeds exceed 10 miles per hour, or on frozen or water saturated soils.
   5. Liquid application is not performed when the temperature reaches 95 degrees Fahrenheit or above.

6. Application during unstable, unpredictable, or changing weather patterns is avoided. Equipment and techniques are used that are designed to ensure maximum control of the spray swath with minimum drift.
7. Herbicides are not applied to surface water or wetlands unless specifically labeled for aquatic use. Filter and buffer strips will conform at least to federal and state regulations and any label requirements. The use of aerial or broadcast application of herbicides is not allowed within a streamside management zone (SMZ) adjacent to perennial streams, ponds, and other water sources. Hand application of certain herbicides labeled for use within SMZs is used only selectively.
8. For aerial inspections, buffers and filter strips (200 feet minimum width) are maintained next to agricultural crops, gardens, farm animals, orchards, apiaries, horticultural crops, and other valuable vegetation.
9. Herbicides are not applied in the following areas or times: (a) in city, state, and national parks or forests or other special areas without written permission and/or required permits (b) off the right-of-way and (c) during rainy periods or during the 48- hour interval prior to rainfall predicted with a 20 percent or greater probability by local forecasters, when soil active herbicides are used.

G. TVA currently uses primarily low volume applications of foliar and basal applications, e.g., Accord (Glyphosate), Arsenal (Imazapyr), Clearstand (Imazapyr / Metsulfuron Methyl), Milestone VM (Aminopyralid) and Streamline (Aminocyclopyrachlor / Metsulfuron Methyl).

4.1 Benefits

A. Proper maintenance—including vegetation management—of ROW and its supporting facilities is crucial to ensuring the reliable transmission of affordable electrical power. Unmanaged and poorly maintained vegetation can cause electricity outages, wildfires, soil erosion, and water quality issues. Utility companies that adopt long-term IVM approaches often benefit from significant vegetation management cost savings, which can be reflected in customer rates.

B. ROW also provide important wildlife habitats. As wildlife habitats in the United States are lost to development, these ROW become increasingly important. The IVM approach can create natural, diverse, and sustaining ecosystems, such as a meadow transition habitat. A variety of wildlife species (including threatened and endangered species) consider these habitats home, such as butterflies, songbirds, small mammals, and deer. These habitats also encourage the growth of native plant species and can increase plant diversity.

C. Invasive and exotic species are often a problem on ROW, and, consequently, the surrounding land. IVM techniques (such as selective herbicide application) can minimize this problem, while ensuring native and endangered species are not affected.

5.0 References

Integrated Vegetation Management (IVM) on Rights-of-Way Fact Sheet. (2012, May) Retrieved from http://www.epa.gov/pestwise/htmlpublications/row_fact_sheet.html

Muncy, J. A. 2016. A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Transmission Construction and Maintenance Activities (revised edition). Edited by Abigail Bowen, Jodie Branum, Corey Chandler, Adam Dattilo, Britta Dimick, Shea Gaither, Casey Henley, Todd Liskey, Joe Melton, Cherie Minghini, Paul Pearman, Kenton Smithson, Joe Turk, Emily Willard, Robby Wilson. Norris: TVA Technical Note TVA/LR/NRM 92/1. Retrieved from <http://www.tva.com/power/projects/bmp_manual_2012.pdf> (n.d.).

U.S. Forest Service. 1989a. Vegetation Management in the Coastal Plain/Piedmont Final Environmental Impact Statement, Volumes I and II. Southern Region Management Bulletin R8-MB-23, January 1989. Atlanta, Ga.: USDA Forest Service.

———. 1989b. Vegetation Management in the Appalachian Mountains Final Environmental Impact Statement, Volumes I and II. Southern Region Management Bulletin R8-MB-38, July 1989. Atlanta, Ga.: USDA Forest Service.

———. 2002a. Vegetation Management in the Appalachian Mountains Final Environmental Impact Statement Supplement. Southern Region Management Bulletin R8-MB-97A, October 2002. Atlanta, Ga.: USDA Forest Service.

———. 2002b. Vegetation Management in the Coastal Plain/Piedmont Final Environmental Impact Statement Supplement. Southern Region Management Bulletin R8-MB-98A, October 2002. Atlanta, Ga.: USDA Forest Service.

Appendix I – Sensitive Areas Class Definitions for Re-clearing

TVA Sensitive Areas Class Definitions for

Right-of-Way Re-clearing

Plants

Class 1: No broadcast herbicide application. Alternatives are: 1) Select spray woody plants, 2) Mechanical or hand-clearing, 3) Request field surveys by TVA botanist to determine if species exists in the subject area.

Class 2: Contact TVA botanist at least three weeks before conducting maintenance activities in subject areas to determine if the proposed activities require restrictions.

Natural Areas

Class 1: No broadcast herbicide application. Alternatives are: 1) Select spray woody plants, 2) Mechanical or hand-clearing, 3) Request field surveys by TVA Biological Compliance staff to determine if species exists in the subject area.

Class 2: Must contact area land manager prior to entering or conducting maintenance in subject area. No broadcast herbicide application. Alternatives are: 1) Select spray woody plants, 2) Mechanical or hand-clearing, 3) Request field surveys by TVA Biological Compliance staff to determine if species exists in the subject area.

Class 3: Contact TVA Natural Areas biologist at least three weeks before conducting maintenance activities to determine if the proposed activities require restrictions.

Wetland Areas

Class 1: Wetland/potential wetland- Refer to "Wetlands ROW Re-clearing and Pole Replacement Guidelines" for restrictions.

Terrestrial Animal Areas

Class BALDEAGLE: Bald Eagle nest- Either 1) Assume presence. No disturbance, spraying or vegetation clearing between Dec. 1 - July 1 within 660 feet of nest site; OR 2) Request seasonal field survey to determine if nest is active.

Class CAVE: Cave - No herbicide use within 200 ft of cave due to potentially sensitive subterranean aquatic resource. Hand or small machinery clearing only (ie: chainsaws, bush hog, mowers). Vehicles and equipment confined to existing access roads. Avoid entering cave.

Class HERONOSPREY: Heronry and Osprey - Either 1) Assume presence. No broadcast spraying. Only use bushogs or mowers for vegetation removal or selective herbicide spraying between February 1 and July 15 within 660 feet of nest site; OR 2) Request seasonal field survey to determine if nests are active.

Class HERONRY: Heronry - Either 1) Assume presence. No broadcast spraying. Only use bushogs or mowers for vegetation removal or selective herbicide spraying between February 1 and July 15 within 660 feet of nest site; OR 2) Request seasonal field survey to determine if nests are active.

Class IBAT: Potential Indiana Bat Summer Roosting Habitat - Cut trees with exfoliating bark Nov 15 - Mar 31. If cutting necessary outside of time restriction a bat and/or habitat survey is required.

Class IBATNLEBAT: Potential Indiana Bat and Northern Long-Eared Bat Summer Roosting Habitat-Cut trees with exfoliating bark during the following seasons differentiated by state: VA, KY, TN and NC = Nov 15-Mar 31; AL, MS and GA = Dec 1 - Mar 15. If cutting necessary outside of time restriction a bat and/or habitat survey is required.

Class NLEBAT: Potential Northern Long-Eared Bat Summer Roosting Habitat - Cut trees with exfoliating bark during the following seasons differentiated by state: VA and KY = Nov 15 - Mar 31; TN and NC = Oct 15 - Mar 31; AL, MS, and GA = Dec 1 - Mar 15. If cutting necessary outside of time restriction a bat and/or habitat survey is required.

Class OSPREY: Osprey nest - Either 1) Assume presence. No broadcast spraying. Only use bushogs or mowers for vegetation removal or selective herbicide spraying between March 1 and July 15 within 660 feet of nest site; OR 2) Request seasonal field survey to determine if nests are active.

Class SPECIAL: Special Circumstance - Contact TVA Terrestrial Zoologist at least three weeks before conducting maintenance activities in buffered area to determine if the proposed activities require restrictions.

Aquatic Animal Areas

Class 1: No broadcast herbicide application. Alternatives are: 1) Select spray woody plants, 2) Mechanical or hand-clearing, 3) Request field surveys by TVA aquatic biologist to determine if species exists in the subject area.

Class 2: Contact TVA aquatic biologist at least three weeks before conducting maintenance activities in subject areas to determine if the proposed activities require restrictions.

ROW ACCESS

O-SAR data is appropriate and applicable to projects where all vehicular access to or within the ROW is existing and no access road improvements are required. The data provided in O-SAR does not apply to work involving road building, upgrading, improvement, or repair, such as but not limited to additional fill greater than 0.10 -acre, new or upgraded stream crossings, and vegetation removal outside the originally cleared ROW footprint. In such cases, a separate environmental review is necessary.

Appendix J – Summary of Vegetation Management Method Impacts

Appendix Table 5-2. Summary of Impacts Associated with Vegetation Management Methods

Resource	Manual	Mechanical	Herbicides	Debris Management	Restoration
Vegetation	Potential impact on non-target vegetation; may result in benefits to some herbaceous species due to improved light penetration. Tree removal may result in conversion of forest or tree dominated communities to herbaceous communities.	May result in substantial impacts to non-target vegetation, potential and increase the spread of invasive species due to soil disturbance. Some methods may reduce adverse effects by minimizing soil disturbance. Repeated mowing may promote dense regrowth of woody stems that suppress herbaceous species.	Direct effects to targeted vegetation. Spot or localized spraying result in reduced impacts to non-target vegetation and may result in some positive effects on species composition. Broadcast and aerial application methods may have high potential for negative impacts to vegetation, including non-target vegetation.	Some methods may hinder or impede plant growth and restoration of treated areas.	Little potential to negatively affect transmission ROW vegetation because standard BMPs would dictate revegetation efforts to avoid the use of invasive weed species.
Wildlife	Lower potential for toxic inputs; less disturbing to soils; short-term noise and odor disturbance; disruptive to wildlife due to more frequent treatments; potential for localized direct injury to wildlife.	Promotes early successional habitat favorable to wildlife; less disruptive to wildlife due to less frequent treatments; short-term disturbance of wildlife; habitat alteration, impact to less mobile biota; short-term soil disturbance.	Use can create low-growing habitat beneficial to some wildlife; less disruptive to wildlife due to less frequent treatments; potential for herbicide toxicity to non-target wildlife, soil, and water.	Leaving debris can be beneficial by creating cover, nutrient recycling, and erosion control; leaving debris increases wildfire fuel load and can harbor tree diseases and pests; debris piles alter habitat; offsite debris removal involves mechanical equipment that increases wildlife disturbance and erosion.	Minor temporary impacts associated with increased erosion and potential for fuel oil leaks or spills. Impacts minimized with standard BMPs. Overall long-term benefit to habitat.

Appendix Table 5-2. Summary of Impacts Associated with Vegetation Management Methods

Resource	Manual	Mechanical	Herbicides	Debris Management	Restoration
Aquatic Ecology	Minor potential for sedimentation; minor chance of chainsaw oil/fuel leaks/spills; likely no impacts to aquatic biota.	Minor potential for sedimentation and stream bank destabilization from soil-disturbing mechanical equipment; minor amounts of cut debris reaching streams; minor chance of oil/fuel leaks/spills; minor potential for altered water quality and impacts to aquatic biota. Minimized through the use of BMPs.	Minor potential for sedimentation from equipment; minimized through the use of BMPs. Potential for herbicides to reach waterways (rarely at toxic concentrations); potential acute and chronic impacts minimized through BMPs, prior planning, proper herbicide mixtures, and advanced technology to reduce or eliminate drift during application.	Minor impacts to aquatic biota as TVA manages placement of debris to avoid placement proximate to streams or other aquatic environments. Minor positive impact as large woody debris can provide fish habitat; wood chips and mulch can reduce erosion.	Minor potential for sedimentation from soil-disturbing equipment; minor amounts of cut debris reaching streams. Overall long-term benefit to the aquatic environment due to reduced erosion and sedimentation.
Threatened and Endangered Species[1]	TVA uses the O-SAR process to avoid and minimize impacts to federally and state-listed species that are known to occur on transmission ROWs and select methods that are least likely to negatively impact those resources.	TVA uses the O-SAR process to avoid impacts to federally and state-listed species that are known to occur on transmission ROWs and select methods that are least likely to negatively impact those resources.	Similar to Vegetation, Wildlife, and Aquatic Ecology impacts. TVA uses the O-SAR process to avoid impacts to federally and state-listed species that are known to occur on transmission ROWs and select methods that are least likely to negatively impact those resources.	TVA uses the O-SAR process to avoid impacts to federally and state-listed species that are known to occur on transmission ROWs and select methods that are least likely to negatively impact those resources.	Minor temporary impacts associated with increased erosion and potential for fuel oil leaks or spills. Impacts minimized with standard BMPs and SMZs. Overall long-term benefit to habitat.

Appendix Table 5-2. Summary of Impacts Associated with Vegetation Management Methods

Resource	Manual	Mechanical	Herbicides	Debris Management	Restoration
Surface Water	Temporary, minor impacts from potential sedimentation; less impact relative to mechanical control.	Temporary, minor impacts from potential fuel/lubricant leaks and spills and sedimentation from soil-disturbing heavy equipment. Minimized through use of BMPs.	Minor potential for herbicides to reach surface waters through leaching, drift, or runoff and potential for sedimentation from heavy equipment. No significant impact expected due to BMPS, prior planning, proper implementation, and proper application of herbicides.	Excess vegetation debris in surface water may alter flows; potential fuel/lubricant leaks and spills; sedimentation from soil-disturbing heavy equipment. Impacts expected to be temporary and minor through use of BMPs.	Minor, temporary impacts from the use of soil disturbing equipment. Overall long-term benefit to water quality due to reduced erosion and sedimentation.
Wetlands	Little/no impact on non-target wetland areas. Tree removal may result in conversion of wetland type and reduction in wetland function; forested wetland conversion may be considered a jurisdictional activity by wetland regulatory agencies.	Minor potential for vehicular rutting and disturbance of wetland soils. Impact minimized with the use of BMPs such as matting, low ground pressure equipment, and dry season work. Tree removal may result in conversion of wetland type and reduction in wetland function; forested wetland conversion may be considered a jurisdictional activity by wetland regulatory agencies.	Impacts to non-target wetland areas due to runoff, leach, or drift of herbicides. Conversion of forest to emergent wetland may result in reduction of wetland function.	Debris left in wetlands may be considered a regulated fill by wetland regulatory agencies due to potential for obstructing flow, altering existing contours, changing water storage, and/or conversion to upland.	Positive benefit to wetlands as restoration would prevent the spread of invasive weeds within the wetlands, promote the establishment of low-growing vegetation, and promote wildlife habitat.

Appendix Table 5-2. Summary of Impacts Associated with Vegetation Management Methods

Resource	Manual	Mechanical	Herbicides	Debris Management	Restoration
Floodplains	No impact.	No significant impact; greater impact relative to manual or selective herbicide. Impacts mitigated through the use of BMPs and measures taken to comply with EO 11988 and the National Flood Insurance Program.	No significant impact Impacts mitigated through the use of BMPs and measures taken to comply with EO 11988 and the National Flood Insurance Program.	Debris left in floodplains can impede the flow of water and create obstructions in the floodplain and floodway. Impacts mitigated through the use of BMPs and measures taken to comply with EO 11988 and the National Flood Insurance Program.	No impact.
Geology/Soils	No impact.	No impact to geology. Potential for localized soil disturbance and erosion.	No impact to geology or soils.	No impact on geology. Potential beneficial impact in erosion control.	No impact on geology. Potential beneficial impact in erosion control.
Groundwater	No impact.	Potential impact associated with contaminant release in proximity to groundwater recharge zones. Impact would be mitigated by BMPs and are anticipated to be minor.	Potential impact associated with contaminant release in proximity to groundwater recharge zones. Impact would be mitigated by BMPs and are anticipated to be minor.	Potential impact associated with contaminant release in proximity to groundwater recharge zones. Impact would be mitigated by BMPs and are anticipated to be minor.	Potential impact associated with contaminant release in proximity to groundwater recharge zones. Impact would be mitigated by BMPs and are anticipated to be minor.

Appendix Table 5-2. Summary of Impacts Associated with Vegetation Management Methods

Resource	Manual	Mechanical	Herbicides	Debris Management	Restoration
Land Use and Land Ownership/ Management	No impact to land use, potential short-term disruption of character of lands. Vegetation management on state and federal lands must adhere to existing Land and Resource Management Plans, Special Use Permits, as well as programmatic or related agreements.	No impact to land use, potential short-term disruption of character of lands. Vegetation management on state and federal lands must adhere to existing Land and Resource Management Plans, Special Use Permits, as well as programmatic or related agreements.	No impact to land use, potential short-term disruption of character of lands. Vegetation management on state and federal lands must adhere to existing Land and Resource Management Plans, Special Use Permits, as well as programmatic or related agreements.	No impact to land use, potential short-term disruption of character of lands. Vegetation management on state and federal lands must adhere to existing Land and Resource Management Plans, Special Use Permits, as well as programmatic or related agreements.	No impact to land use. Vegetation management on state and federal lands must adhere to existing Land and Resource Management Plans, Special Use Permits, as well as programmatic or related agreements.
Prime Farmland	No impact	Localized potential for disturbance or degradation of prime farmland soils from use of mechanized equipment. Minimized using BMPs.	No impact.	No impact.	No impact.
Natural Areas, Parks, Recreation	Minor, short-term impacts from equipment noise and presence of work crews.	Minor, short-term impact from equipment noise and work crews associated with trimming. Impacts from clearing would be greater as the character of vegetation could change.	Potential impacts from noise and odors from application of selective targeting herbicides. Minor beneficial impact associated with erosion protection, enhanced wildlife food and cover, and greater diversity. Greater minor, temporary impact from aerial application indiscriminate treatment of vegetation.	Minor impacts from large debris left in place as it could interfere with recreation activities. Short-term impacts from burning due to presence of smoke and work crews.	Minor temporary impact associated with increased pedestrian traffic and noise. Long-term benefit due to enhancement of Natural Areas.

Appendix Table 5-2. Summary of Impacts Associated with Vegetation Management Methods

Resource	Manual	Mechanical	Herbicides	Debris Management	Restoration
Cultural	No impact on subsurface cultural deposits when cutting methods are employed. Pulling methods have the potential to disturb cultural deposits depending on size of plant and root ball. Caution should be used when cutting or pulling near aboveground historic remains (i.e. foundations, cemeteries) and sacred sites.	If machinery causes soil disturbance, subsurface cultural deposits could be affected. Impacts would be minimized through adherence to BMPs and Section 106 program alternatives, such as the PA, where applicable. Activities that would have the potential to effect historic properties would require Section 106 review on an individual basis.	No impact to subsurface cultural deposits.	No impact to subsurface deposits.	No impact to subsurface deposits.
Visual Resources	Pruned trees and shrubs, exposed stumps, and the resulting debris may seem unsightly to some viewers.	Can leave swaths of disturbed areas that can contrast with surrounding vegetation.	Areas of browned vegetation can be unsightly. However, the impact would be temporary as vegetation would eventually reestablish.	Felled logs and scattered branches can contrast with the surrounding landscape; stacking as windrows can reduce the unkempt look. Mulching and chipping can improve the visual landscape by covering bare earth with woodchips.	Minor, temporary visual discord due to the presence of additional personnel and equipment. Long-term improvement aesthetic condition.

Appendix Table 5-2. Summary of Impacts Associated with Vegetation Management Methods

Resource	Manual	Mechanical	Herbicides	Debris Management	Restoration
Public and Worker Health & Safety	Minimal impact on public safety, minor potential for worker safety in conjunction with type and frequency of tool use and environmental conditions.	Minor potential for public safety issues, improved worker safety in proportion to treated area.	Low potential for public exposure to herbicides; selectively higher risk to workers based on herbicide active ingredient, tool use, and environmental conditions. Potential adverse effects mitigated and minimized by training, safety equipment, and adherence to labeling guidelines.	Debris left in place has potential implications on worker safety. Burning has potential minor localized effects on public and worker health and safety.	Additional workforce increases short-term safety risk. Long-term increase in worker safety through development of a plant community that is compatible to ROW management.
Solid and Hazardous Waste	Low impact. Minor generation of waste oil/fluids from maintenance of equipment.	Maintenance on equipment generates waste oils/fluids. Potential spills/releases of fuel/fluids. Generation of waste containers.	Potential accidental releases/spills. Generation of waste containers for herbicides.	Low impact related to use of mechanized equipment. Reduction in solid waste when debris is left to compost.	Low impact related to use of mechanized equipment.
Transportation	Little to no impact.	No impact with side-wall trimming (from air). Minor traffic volume generated by construction workforce.	No impact with aerial spraying of herbicides. Minor traffic volume generated by construction workforce.	Short-term increase in traffic volumes due to additional haul trucks needed for debris transport. No impact when debris is managed on site.	Minor traffic volume generated by construction workforce.

Appendix Table 5-2. Summary of Impacts Associated with Vegetation Management Methods

Resource	Manual	Mechanical	Herbicides	Debris Management	Restoration
Air Quality and Climate Change	No impact to overall air quality; mobilization of work crews to and from project sites represents a negligible increase in roadway traffic.	No impact to overall air quality; mobilization of work crews to and from project sites, represents minimal localized and temporary emissions from combustion engines.	No impact to overall air quality; in addition to crew mobilization, minor impacts may be from mechanical methods and airborne herbicide constituents.	Chipping, mulching, etc. would have impacts similar to manual control methods; pile burning would produce local smoke and particulate emissions; overall minor impacts to air quality would be temporary and local.	No impact to overall air quality; in addition to crew transport-related impacts minimal localized and temporary emissions from combustion engines.
Noise	Loud intermittent and short-term noise from use of chainsaws.	Loud intermittent and short-term increase in noise from transport of equipment and crews and use of chainsaws and mechanized equipment.	Limited and minor noise from crews on foot. Loud intermittent noise from aerial spraying.	Loud noise from transport of equipment and crews and use of heavy mulchers and chippers.	Intermittent and short-term increase in noise from transport of equipment and crews and use of chainsaw and mechanized equipment.
Socioeconomics and Environmental Justice	Minor short-term impact to local economies due to increased workforce.	Minor short-term impact to local economies due to increased workforce.	Minor short-term impact to local economies due to increased workforce.	Minor short-term impact to local economies due to increased workforce.	Minor short-term impact to local economies due to increased workforce.

Appendix K – List of Threatened and Endangered Species

Appendix Table 5-3. Federally Listed and State-Protected Animal and Plant Species Occurrences Previously Reported from Within 50 feet of TVA ROW Where Vegetation Management is Proposed in FY 20211

Common Name[2]	Scientific Name[2]	Federal Status[3]	State	State Status[3]	State Rank[4]	Sites	Sector[5]
AQUATIC ANIMALS							
Dromedary Pearlymussel	*Dromus dromas*	E	KY	E	S1	1	OR
Tan Riffleshell	*Epioblasma florentina walkeri*	E	TN	E	S1	1	CL
Ashy Darter	*Etheostoma cinereum*	-	TN	E	S2S3	1	OR
Flame Chub	*Hemitremia flammea*	-	TN	D	S3	1	CV
Spiny Riversnail	*Io fluvialis*	-	TN	-	S2	1	MT
Slabside Pearlymussel	*Pleuronaia dolabelloides*	E	TN	E	S2	1	CL
Southern Cavefish	*Typhlichthys subterraneus*	-	TN	D	S3	1	HK
PLANTS							
Ohio Buckeye	*Aesculus glabra*	-	MS	SLNS	S2	1	WP
Little River Canyon Onion	*Allium speculae*	-	AL	SLNS	S2	2	MD
Fen Indian-plantain	*Arnoglossum plantagineum*	-	TN	T	S2	1	MC
Purple Milkweed	*Asclepias purpurascens*	-	TN	S	S1	1	CL
Tennessee Milk-vetch	*Astragalus tennesseensis*	-	TN	S	S3	2	MC
Tennessee Milk-vetch	*Astragalus tennesseensis*	-	AL	SLNS	S1S2	1	MS
Spreading False-foxglove	*Aureolaria patula*	-	TN	S	S3	1	OR
Wild False Indigo	*Baptisia australis*	-	KY	S	S3	1	HK
Screwstem	*Bartonia virginica*	-	KY	T	S2	2	OR
American barberry	*Berberis canadensis*	-	TN	S	S2	1	OR
Nuttall's Rayless Golden-rod	*Bigelowia nuttallii*	-	AL	SLNS	S3	2	MD
Sedge	*Carex hitchcockiana*	-	TN	T	S1	1	MT
Water Hickory	*Carya aquatica*	-	KY	T	S2S3	2	HK
White Turtlehead	*Chelone glabra*	-	MS	SLNS	S3	2	MS
Green-and-gold	*Chrysogonum virginianum*	-	TN	T	S2	1	OR
Whiteleaf Leatherflower	*Clematis glaucophylla*	-	TN	S	S1	3	MC, MD

Common Name[2]	Scientific Name[2]	Federal Status[3]	State	State Status[3]	State Rank[4]	Sites	Sector[5]
Bastard Toad-flax	*Comandra umbellata*	-	AL	SLNS	S1	2	MD, MS
Downy Coreopsis	*Coreopsis pubescens*	-	KY	S	S2S3	2	HK
Woodland Tickseed	*Coreopsis pulchra*	-	AL	SLNS	S2	3	MD
Plukenet's Cyperus	*Cyperus plukenetii*	-	TN	S	S1	1	ML
Showy Lady-slipper	*Cypripedium reginae*	-	TN	E	S1	1	MT
White Prairie-clover	*Dalea candida*	-	KY	S	S3	2	HK
Leafy Prairie-clover	*Dalea foliosa*	E	TN	E	S2S3	2	MC
Leafy Prairie-clover	*Dalea foliosa*	E	AL	SLNS	S1	2	MS
Gattinger Prairie-clover	*Dalea gattingeri*	-	AL	SLNS	S3	3	MS
Bog Oat-grass	*Danthonia epilis*	-	TN	S	S1S2	1	OR
Alabama Larkspur	*Delphinium alabamicum*	-	AL	SLNS	S3	3	MS
Carolina Larkspur	*Delphinium carolinianum*	-	KY	T	S1S2	1	HK
Creamflower Tick-trefoil	*Desmodium ochroleucum*	-	TN	E	S1	1	MD
Small's Stonecrop	*Diamorpha smallii*	-	TN	E	S1S2	2	MC
Dwarf Sundew	*Drosera brevifolia*	-	TN	T	S2	3	MD, MC
Crested Woodfern	*Dryopteris cristata*	-	NC	WL	S3	1	MT
Eastern Purple Coneflower	*Echinacea purpurea*	-	MS	SLNS	S3	1	WP
Harper's Umbrella-plant	*Eriogonum harperi*	-	AL	SLNS	S1	2	MS
Showy Aster	*Eurybia spectabilis*	-	AL	SLNS	S2	3	MD
American Columbo	*Frasera caroliniensis*	-	AL	SLNS	S2	4	MS
Hairy Umbrella-sedge	*Fuirena squarrosa*	-	TN	S	S1	1	ML
Dwarf Huckleberry	*Gaylussacia dumosa*	-	TN	T	S3	3	MC
Eggert's Sunflower	*Helianthus eggertii*	-	AL	SLNS	S2	1	MS
Longleaf Sunflower	*Helianthus longifolius*	-	AL	SLNS	S1S2	3	MD
Narrow Blue Flag	*Iris prismatica*	-	TN	T	S2S3	1	MC
Butler's Quillwort	*Isoetes butleri*	-	AL	SLNS	S2	2	MS
Blackfoot Quillwort	*Isoetes melanopoda*	-	TN	E	S1S2	1	MC
Large Whorled Pogonia	*Isotria verticillata*	-	AL	SLNS	S2	1	MD

Common Name[2]	Scientific Name[2]	Federal Status[3]	State	State Status[3]	State Rank[4]	Sites	Sector[5]
Alabama Jamesianthus	*Jamesianthus alabamensis*	-	AL	SLNS	S3	2	MS
Butternut	*Juglans cinerea*	-	TN	T	S3	5	CV, HV
Red Root	*Lachnanthes caroliana*	-	TN	E	S1	3	MC
Smooth Veiny Peavine	*Lathyrus venosus*	-	AL	SLNS	S1	2	MD
Alabama Glade-cress	*Leavenworthia alabamica*	-	AL	SLNS	S2	5	MS
Slender Blazing-star	*Liatris cylindracea*	-	TN	T	S2	1	MC
Wood Lily	*Lilium philadelphicum*	-	TN	E	S1	1	OR
Globe-fruited Ludwigia	*Ludwigia sphaerocarpa*	-	TN	T	S1	1	MC
Foxtail Clubmoss	*Lycopodiella alopecuroides*	-	TN	T	S2	2	MC
Mohr's Barbara's Buttons	*Marshallia mohrii*	T	AL	SLNS	S3	3	MD
Carolina Anglepod	*Matelea carolinensis*	-	KY	E	S1?	8	OR
Climbing Milkweed	*Matelea obliqua*	-	MS	SLNS	S2	1	WP
Canada Moonseed	*Menispermum canadense*	-	MS	SLNS	S3	1	WP
Torrey Muhly	*Muhlenbergia torreyana*	-	TN	E	S1	2	MC
Nestronia	*Nestronia umbellula*	-	AL	SLNS	S3	1	MD
Missouri Evening-primrose	*Oenothera macrocarpa* ssp. *macrocarpa*	-	TN	T	S2	1	MC
Hairy False Gromwell	*Onosmodium hispidissimum*	-	KY	E	S2	2	HK
Hairy False Gromwell	*Onosmodium hispidissimum*	-	TN	E	S1	1	MT
Limestone Adder's-tongue	*Ophioglossum engelmannii*	-	AL	SLNS	S3	2	MS
American ginseng	*Panax quinquefolius*	-	TN	S-CE	S3S4	3	CV,OR, WP
Maidencane	*Panicum hemitomon*	-	TN	S	S2	2	MC
Tuberous Scurfpea	*Pediomelum subacaule*	-	AL	SLNS	S2	2	MS
Beard-tongue	*Penstemon tenuiflorus*	-	MS	SLNS	S3	1	MS
Limestone Fame-flower	*Phemeranthus calcaricus*	-	TN	S	S3	3	MC,NA
Limestone Fame-flower	*Phemeranthus calcaricus*	-	AL	SLNS	S2	1	MS
Roundleaf Fameflower	*Phemeranthus teretifolius*	-	TN	T	S2	1	MC
Heartleaved Plantain	*Plantago cordata*	-	TN	E	S1	1	MD

Common Name[2]	Scientific Name[2]	Federal Status[3]	State	State Status[3]	State Rank[4]	Sites	Sector[5]
Yellow Fringeless Orchid	*Platanthera integra*	-	TN	E	S1	1	MC
White Fringeless Orchid	*Platanthera integrilabia*	T	AL	SLNS	S2	1	MC
White Fringeless Orchid	*Platanthera integrilabia*	T	TN	E	S2S3	1	MD
Halberd-leaf Tearthumb	*Polygonum arifolium*	-	TN	T	S1	1	ML
Barbed Rattlesnake-root	*Prenanthes barbata*	-	TN	S	S2	1	CV
Mountain-mint	*Pycnanthemum muticum*	-	MS	SLNS	S2S3	2	MS
Bur Oak	*Quercus macrocarpa*	-	MS	SLNS	S2	1	WP
Nodding Beakrush	*Rhynchospora inexpansa*	-	TN	S	S1	3	MD
Globe Beaked Rush	*Rhynchospora recognita*	-	KY	S	S3	1	OR
Sun-facing Coneflower	*Rudbeckia heliopsidis*	-	AL	SLNS	S2	2	MD
Green Pitcher Plant	*Sarracenia oreophila*	E	AL	SLNS	S2	1	MD
Sunnybell	*Schoenolirion croceum*	-	AL	SLNS	S2	4	MS,MD
Nevius' Stonecrop	*Sedum nevii*	-	TN	E	S1	1	CL
Cumberland Rosinweed	*Silphium brachiatum*	-	AL	SLNS	S2	1	MS
Mohr's Rosin-weed	*Silphium mohrii*	-	AL	SLNS	S1	2	MD
Prairie-dock	*Silphium pinnatifidum*	-	TN	T	S2	1	MC
Prairie-dock	*Silphium pinnatifidum*	-	AL	SLNS	S2	2	MS,MD
Gattinger's Goldenrod	*Solidago gattingeri*	-	TN	E	S1	2	MC
Shining Ladies'-tresses	*Spiranthes lucida*	-	TN	T	S1S2	1	MT
Yellow Nodding Ladies'-tresses	*Spiranthes ochroleuca*	-	TN	E	S1	1	CV
Water Stitchwort	*Stellaria fontinalis*	-	TN	S	S3	1	NA
Mountain Camellia	*Stewartia ovata*	-	AL	SLNS	S2S3	1	MS
White Heath Aster	*Symphyotrichum ericoides*	-	MS	SLNS	S2	4	WP
Georgia Aster	*Symphyotrichum georgianum*	-	AL	SLNS	S3	1	MD
Carolina Hemlock	*Tsuga caroliniana*	-	TN	T	S3	2	MT
Elliott's Blueberry	*Vaccinium elliottii*	-	TN	E	S1	1	HV
Eggleston's Violet	*Viola egglestonii*	-	AL	SLNS	S1	2	MS
Yellow-eyed-grass	*Xyris laxifolia* var. *iridifolia*	-	TN	T	S2	1	MC

Common Name[2]	Scientific Name[2]	Federal Status[3]	State	State Status[3]	State Rank[4]	Sites	Sector[5]
White Camas	*Zigadenus glaucus*	-	TN	E	S1	1	MT
TERRESTRIAL ANIMALS							
Eastern Hellbender	*Cryptobranchus alleganiensis*	PS	KY	S	S2S3	1	HK
Eastern Hellbender	*Cryptobranchus alleganiensis*	PS	TN	E	S3	1	CL
Alligator Snapping Turtle	*Macrochelys temminckii*	-	TN	T	S2S3	1	NA
Northern Long-eared Bat	*Myotis septentrionalis*	LT	TN	T	S1S2	5	CV,MT
Tricolored Bat	*Perimyotis subflavus*	-	NC	SR	S3	1	CL
Bachman's Sparrow	*Peucaea aestivalis*	-	TN	E	S1B	1	ML
Northern Pine Snake	*Pituophis melanoleucus melanoleucus*	-	TN	T	S3	1	CV
Virginia Rail	*Rallus limicola*	-	TN	-	S1B,S3N	1	MT
Northern Crawfish Frog	*Rana areolata circulosa*	-	KY	S	S3	1	HK
Southeastern Shrew	*Sorex longirostris*	-	TN	-	S4	1	CV

[1] Source: TVA Natural Heritage Database, queried May 2020.
[2] Species can be listed in the table multiple times if they occur more than one state.
[3] Status Codes: D = Deemed in Need of Management; DM = Delisted but still Monitored; E = Listed Endangered; PS = Partial Status; SR = Significantly Rare; SLNS = State Listed, no status assigned; S = Listed Special Concern; S-CE = Special Concern/ Commercially Exploited; T = Listed Threatened;
[4] State Ranks: S1 = Critically Imperiled; S2 = Imperiled; S3 = Vulnerable; S4 = Apparently Secure; B = Breeding; N = Nonbreeding; S? = Inexact or uncertain; S#S# = Denotes a range of ranks because the exact rarity of the element is uncertain (e.g., S1S2)
[5] ROW Sector Abbreviations: CL = Cleveland, CV = Centerville, HK = Hopkinsville, HV = Hickory Valley, MC = Manchester, MD = Madison, ML = Muscle Shoals, MT = Morristown, NA = Nashville, OR = Oak Ridge, WP = West Point

Appendix L – Natural Areas Crossed by Transmission Line Segments Proposed for Vegetation Management during FY 2021 Planning Cycle

Appendix Table 5-4. Natural Areas Crossed by Transmission Line Segments Proposed for Vegetation Management in the Centerville Sector

CENTERVILLE SECTOR	NAME	ACRES	COUNTY	STATE
CV	Big Turnbull Creek Protection Planning Site	46.29	Dickson (TN)	TN
CV	Bowie Park	687.4	Williamson (TN)	TN
CV	Buffalo State Scenic River	436.54	Multiple	TN
CV	Centennial Elementary School/ Dickson Community Nature Trail	129.37	Dickson (TN)	TN
CV	Chamberlain Property - Monarch Waystation and NWF Certified Wildlife Habitat	9.14	Dickson (TN)	TN
CV	Cheatham Lake - US Army Corps of Engineers	7,724.45	Multiple	TN
CV	Cheatham Reservoir Reservation	6,616.16	Multiple	TN
CV	Cheatham Reservoir Wildlife Management Area Wildlife Observation Area	19,887.64	Cheatham (TN)	TN
CV	Circle A Farm Conservation Easement - Land Trust for TN	103.87	Maury (TN)	TN
CV	Designated Critical Habitat Cumberlandian Combshell	3,067.58	Multiple	Multiple
CV	Designated Critical Habitat Fluted Kidneyshell (TN)	15,839.57	Multiple	Multiple
CV	Designated Critical Habitat For Rabbitsfoot, Slabside Pearlymussel, Fluted Kidneyshell	11,948.67	Multiple	Multiple
CV	Designated Critical Habitat Oyster Mussel (TN)	5,854.86	Multiple	Multiple
CV	Designated Critical Habitat Short's Bladderpod	608.95	Multiple	TN
CV	Designated Critical Habitat Slabside Pearlymussel (TN)	13,851.4	Multiple	Multiple
CV	Designated Critical Habitat Slackwater Darter Lawrence	91,642.36	Multiple	TN
CV	Designated Critical Habitat Unit 1: Kings and Queens Bluff, Short's Bladderpod	26.42	Montgomery (TN)	TN
CV	Duck River State Mussel Sanctuary	6,338.49	Multiple	TN
CV	Harpeth River State Park	501.83	Multiple	TN
CV	Harpeth State Scenic River	166.49	Multiple	TN
CV	Joe Wheeler State Park	2,441.36	Multiple	AL
CV	Jones Creek	40.2	Multiple	TN
CV	Kentucky Reservoir Reservation	135,395.98	Multiple	Multiple

CENTERVILLE SECTOR	NAME	ACRES	COUNTY	STATE
CV	Lake Barkley	51,637.75	Multiple	Multiple
CV	Narrows of the Harpeth State Historical Area	130.59	Cheatham (TN)	TN
CV	Natchez Trace National Parkway	44,142.09	Multiple	Multiple
CV	Natchez Trace State Scenic Trail	1,496.01	Multiple	TN
CV	Newsom's Mill Historic Site	1.76	Davidson (TN)	TN
CV	Porters Bluff Protection Planning Site	62.43	Montgomery (TN)	TN
CV	South Harpeth River	34.89	Multiple	TN
CV	Sweet Easy Farm Conservation Easement - Land Trust for TN	220.05	Maury (TN)	TN
CV	The Land Trust For Tennessee Easement	166.14	Hickman (TN)	TN
CV	The Land Trust For Tennessee Easement	1,399	Humphreys (TN)	TN
CV	Turnbull Creek	364.27	Multiple	TN
CV	Turnbull Creek	32.57	Multiple	TN
CV	Twin Creek Farm	406.28	Dickson (TN)	TN
CV	Wheeler Dam Reservation	2,028.64	Multiple	AL
CV	Wheeler Dam Tailwater Restricted Mussel Harvest Area	2,028.64	Multiple	AL
CV	Yellow Creek	21.59	Multiple	TN

Appendix Table 5-5. Natural Areas Crossed by Transmission Line Segments Proposed for Vegetation Management in the Cleveland Sector

CLEVELAND SECTOR	NAME	ACRES	COUNTY	STATE
CL	Chickamauga Wildlife Management Area	3,489.25	Multiple	TN
CL	Chilhowee Dairy Farm	220.28	Polk (TN)	TN
CL	Chota Peninsula State Wildlife Observation Area	1,114.75	Monroe (TN)	TN
CL	Cloudland Canyon State Park/Potential National Natural Landmark	3,598.32	Multiple	GA
CL	Designated Critical Habitat Fluted Kidneyshell (TN)	15,839.57	Multiple	Multiple
CL	Designated Critical Habitat Slabside Pearlymussel (TN)	13,851.40	Multiple	Multiple
CL	Fourth Fractional Township Wildlife Management Area	829.55	Polk (TN)	TN
CL	Georgia -Alabama Land Trust - Conservation Easement	1,605.16	Catoosa (GA)	GA
CL	Georgia Alabama Land Trust - Conservation Easement (GA6)	267.00	Walker (GA)	GA
CL	Gunstocker Glade	61.07	Meigs (TN)	TN
CL	Harrison Bay State Park	1,844.44	Hamilton (TN)	TN
CL	Hiwassee Refuge State Wildlife Management Area	8,054.03	Multiple	TN
CL	Hiwassee Reservoir Reservation	6,256.08	Cherokee (NC)	NC
CL	Hiwassee River	76.32	Multiple	Multiple
CL	Hiwassee River State Mussels Sanctuary	161.39	Polk (TN)	TN
CL	John Muir National Recreation/State Scenic Trail	168.37	Polk (TN)	TN
CL	Kilpatrick Spring- Harsh Family Farm - Conservation Easement Land Trust Of TN	630.52	Monroe (TN)	TN
CL	Little Frog Mountain Wilderness	4,691.74	Polk (TN)	TN
CL	Little Tennessee River	74.76	Multiple	TN
CL	Nantahala National Forest	1,327,388.36	Multiple	Multiple
CL	Nantahala State Game Land	530,464.60	Multiple	Multiple
CL	Ocoee No. 1 Dam Reservation	41.39	Polk (TN)	TN
CL	Ocoee No. 2 Reservoir Reservation	153.42	Polk (TN)	TN
CL	Ocoee River	29.76	Polk (TN)	TN

CLEVELAND SECTOR	NAME	ACRES	COUNTY	STATE
CL	Ocoee River Gorge/Ruth's Golden Aster Protection Planning Site	1,293.30	Polk (TN)	TN
CL	Ocoee State Bear Reserve	18,191.27	Multiple	Multiple
CL	Raccoon Creek State Wildlife Management Area	4,714.16	Jackson (AL)	AL
CL	Red Clay Farm	35.59	Bradley (TN)	TN
CL	South Cherokee National Forest And Wildlife Management Area	290,765.61	Multiple	Multiple
CL	Sugarloaf Mountain Park	475.63	Polk (TN)	TN
CL	Tellico Bluff	20.13	Monroe (TN)	TN
CL	Tellico Bluff TVA Ecological Study Area	20.13	Monroe (TN)	TN
CL	Tellico Dam Reservation	25,657.41	Multiple	TN
CL	Tellico Lake Wildlife Management Area	4,969.00	Multiple	TN
CL	Tellico Reservoir Reservation	25,657.41	Multiple	TN
CL	Tellico River	133.76	Multiple	Multiple
CL	Tellico River Nonessential Experimental Fish Population	225.46	Monroe (TN)	TN
CL	The Land Trust For Tennessee Easement	218.91	Loudon (TN)	TN
CL	Trail Of Tears (Section)	4.95	Bradley (TN)	TN
CL	University Of Tennessee Friendship Forest	600.01	Hamilton (TN)	TN

Appendix Table 5-6. Natural Areas Crossed by Transmission Line Segments Proposed for Vegetation Management in the Hickory Valley Sector

HICKORY VALLEY SECTOR	NAME	ACRES	COUNTY	STATE
HV	Ames Plantation	25,694.61	Multiple	TN
HV	Divide Canal Section Wildlife Management Area	16,409.88	Multiple	MS
HV	Holly Springs National Forest	529411	Multiple	MS
HV	John S. Porter Conservation Area	267.84	Fayette (TN)	TN
HV	Piperton Wetland Complex (Wolf River) - TWRA	1,217.79	Multiple	TN
HV	Shaws Creek Bottoms	1,673.38	Multiple	TN
HV	Strawberry Plains Audubon Center	2,594.17	Marshall (MS)	MS
HV	The Land Trust for Tennessee Easement	525.21	Fayette (TN)	TN
HV	Wolf River Macrosite	13,834.94	Multiple	Multiple

Appendix Table 5-7. Natural Areas Crossed by Transmission Line Segments Proposed for Vegetation Management in the Hopkinsville Sector

HOPKINSVILLE SECTOR	NAME	ACRES	COUNTY	STATE
HK	Austin Peay State University Farm	433.17	Montgomery (TN)	TN
HK	Barkley Reservoir Reservation	81,082.86	Multiple	Multiple
HK	Clarks River Refuge Acquisition Boundary	17,650.41	Multiple	KY
HK	Clifty Creek Gorge KY	35.97	Todd (KY)	KY
HK	Cumberland River 3	67.04	Multiple	KY
HK	Cypress Creek Swamp (Marshall County)	1,221.26	Marshall (KY)	KY
HK	Cypress Creek Swamp Fee - The Nature Conservancy - Fee Ownership	560.11	Marshall (KY)	KY
HK	Designated Critical Habitat For Rabbitsfoot, Slabside Pearlymussel, Fluted Kidneyshell	11,948.67	Multiple	Multiple
HK	Gasper River	93.71	Multiple	KY
HK	Hogskin Ridge Bottomland Forest	9,226.12	Multiple	KY
HK	Kentucky Dam Village State Resort Park	1,365.95	Multiple	KY
HK	Lake Malone State Fishing Lake	985.43	Multiple	KY
HK	Metropolis Lake Outstanding Resource Water	37.15	McCracken (KY)	KY
HK	Metropolis Lake State Nature Reserve	123.23	McCracken (KY)	KY
HK	Metropolis Lake TVA Habitat Protection Area	0.77	McCracken (KY)	KY
HK	Peabody Wildlife Management Area	8,970.25	Multiple	KY
HK	Proposed Tupelo Gum Swamp Habitat Protection Area	65.35	Multiple	KY
HK	Sunny Side Farm	151.57	Todd (KY)	KY
HK	Tennessee River (RM 12 to 22.4 -KY Lake Dam) Outstanding Resource Water	1,700.59	Multiple	KY
HK	Tennessee River Outstanding State Resource Water	1,659.23	Multiple	KY
HK	Tupelo Gum Swamp TVA Habitat Protection Area	65.35	Marshall (KY)	KY
HK	West Fork Red River	117.25	Multiple	Multiple
HK	Wetlands Reserve Program	81.03	Logan (KY)	KY

Appendix Table 5-8. Natural Areas Crossed by Transmission Line Segments Proposed for Vegetation Management in the Madison Sector

MADISON SECTOR	NAME	ACRES	COUNTY	STATE
MD	Bear Hollow Mountain Wildlife Management Area - TWRA	16,696.09	Multiple	Multiple
MD	Cave Mountain TVA Small Wild Area	81.14	Marshall (AL)	AL
MD	Cowan Marsh - TWRA	50.65	Franklin (TN)	TN
MD	Crow Creek State State Wildlife Management Area	3,432.85	Jackson (AL)	AL
MD	David Carter TNC Preserve	7,056.03	Franklin (TN)	TN
MD	Designated Critical Habitat Alabama Moccasinshell	19,007.02	Multiple	Multiple
MD	Designated Critical Habitat Black Warrior Waterdog	810.19	Multiple	AL
MD	Designated Critical Habitat Coosa Moccasinshell	5,230.58	Multiple	Multiple
MD	Designated Critical Habitat Dark Pigtoe	4,745.83	Multiple	AL
MD	Designated Critical Habitat Fine Lined Pocketbook	5,230.58	Multiple	Multiple
MD	Designated Critical Habitat Fluted Kidneyshell (TN)	15,839.57	Multiple	Multiple
MD	Designated Critical Habitat Georgia Pigtoe Terrapin Creek/Coosa River Unit 2	5,230.58	Multiple	Multiple
MD	Designated Critical Habitat Interrupted (Georgia) Rocksnail 1	1,268.79	Multiple	Multiple
MD	Designated Critical Habitat Locust Fork River Unit 12	852.01	Multiple	AL
MD	Designated Critical Habitat Orangenacre Mucket	15,028.51	Multiple	Multiple
MD	Designated Critical Habitat Ovate Clubshell	16,859.01	Multiple	Multiple
MD	Designated Critical Habitat Slabside Pearlymussel (TN)	13,851.4	Multiple	Multiple
MD	Designated Critical Habitat Southern Acornshell	6,049.55	Multiple	Multiple
MD	Designated Critical Habitat Southern Clubshell	17,951.01	Multiple	Multiple
MD	Designated Critical Habitat Southern Pigtoe	5,230.57	Multiple	Multiple
MD	Designated Critical Habitat Triangular Kidneyshell	9,043.03	Multiple	Multiple
MD	Designated Critical Habitat Upland Combshell	9,102.68	Multiple	Multiple
MD	Desoto Woods Preserve	5,233.98	Multiple	AL
MD	Elk River	276.99	Multiple	Multiple
MD	Farm & Ranch Lands Protection Program	215.13	Cherokee (AL)	AL

MADISON SECTOR	NAME	ACRES	COUNTY	STATE
MD	Flintville Hatchery State Wildlife Management Area	704.35	Lincoln (TN)	TN
MD	Grasslands Reserve Program	57.53	Cherokee (AL)	AL
MD	Little River Canyon/Little River Canyon Potential National Natural Landmark	15,423.97	Multiple	AL
MD	Little River State Wildlife Management Area	12,659.58	Multiple	AL
MD	Locust Fork	221.31	Multiple	AL
MD	Mingo Swamp State Wildlife Management Area	370.61	Franklin (TN)	TN
MD	Mingo Swamp/TN Potential National Natural Landmark/PPS	743.04	Franklin (TN)	TN
MD	Mud Creek State Wildlife Management Area	8,196.11	Jackson (AL)	AL
MD	Newsome Sinks Karst Area National Natural Landmark	1783	Morgan (AL)	AL
MD	Stewart's Swamp/Cowan Marsh TWRA Wildlife Management Area	91.47	Franklin (TN)	TN
MD	Tim’s Ford Reservoir Reservation	14,717.09	Multiple	TN
MD	Tim’s Ford State Rustic Park	2,974.5	Multiple	TN
MD	Wheeler National Wildlife Refuge	37,553.98	Multiple	AL
MD	Wheeler Reservoir Reservation	95,205.86	Multiple	AL

Appendix Table 5-9. Natural Areas Crossed by Transmission Line Segments Proposed for Vegetation Management in the Manchester Sector

MANCHESTER SECTOR	NAME	ACRES	COUNTY	STATE
MC	Arnold Engineering Development Center/Woods State Wildlife Management Area/Tullahoma Barrens	39,289.34	Multiple	TN
MC	Aedc Spring Creek Road Barrens	578.82	Franklin (TN)	TN
MC	Bark Camp Barrens Wildlife Management Area	2,761.76	Coffee (TN)	TN
MC	Boyd Barrens	18.52	Warren (TN)	TN
MC	Cedar Grove Road Glade	62.83	Bedford (TN)	TN
MC	Collins Scenic River	151.55	Multiple	TN
MC	Cripple Creek	31.51	Rutherford (TN)	TN
MC	Cumberland Springs Former Wildlife Management Area Privately Owned/Former Protection Planning Site	7,003.55	Multiple	TN
MC	Double Powerline Barrens	293.54	Multiple	TN
MC	Duck River State Mussel Sanctuary	6,338.49	Multiple	TN
MC	Great Falls Reservoir Reservation	1,300.94	Multiple	TN
MC	Guntersville Reservoir State Mussel Sanctuary	1,258.71	Multiple	Multiple
MC	Headwaters Wildlife Management Area	554.69	Cannon (TN)	TN
MC	Hickory Flat Wildlife Management Area TWRA	767.27	Coffee (TN)	TN
MC	J And J Organic Berry Farm	83.66	Franklin (TN)	TN
MC	May Prairie State Natural Area	353.26	Coffee (TN)	TN
MC	Morrison Bog Botanical Site	45.01	Warren (TN)	TN
MC	Morrison Meadow Designated State Natural Area	18.52	Warren (TN)	TN
MC	Mountain Creek	57.22	Multiple	TN
MC	Nickajack Cave/Nickajack Cave State Wildlife Observation Area/TVA Habitat Protection Area/Small Wild Area	401.85	Multiple	Multiple
MC	North Chickamauga Creek	43.33	Multiple	TN
MC	North Chickamauga Creek Wildlife Management Area	3,037.07	Multiple	TN

MANCHESTER SECTOR	NAME	ACRES	COUNTY	STATE
MC	Rivermont Park	114.03	Hamilton (TN)	TN
MC	Rock Island State Park	1,208.91	Multiple	TN
MC	Rocky River	75.09	Multiple	TN
MC	Sewanee University Campus and Arboretum	3,787.32	Franklin (TN)	TN
MC	Shellmound Road Bluff	99.33	Marion (TN)	TN
MC	Shellmound Road Bluff TVA Habitat Protection Area	99.33	Marion (TN)	TN
MC	Stringers Ridge Park	123.7	Hamilton (TN)	TN
MC	Tennessee River Gorge	29,407.87	Multiple	TN
MC	Tennessee River Gorge Trust Easement	52.19	Hamilton (TN)	TN
MC	Williams Island State Archaeological Area	462.68	Hamilton (TN)	TN

Appendix Table 5-10. Natural Areas Crossed by Transmission Line Segments Proposed for Vegetation Management in the Milan Sector

MILAN SECTOR	NAME	ACRES	COUNTY	STATE
ML	Agricultural Conservation Easement	66.28	Decatur (TN)	TN
ML	Agricultural Conservation Easement	69.28	Madison (TN)	TN
ML	Agricultural Conservation Easement	246.79	Lake (TN)	TN
ML	Camden State Wildlife Management Area	3,721.72	Benton (TN)	TN
ML	Cedar Lake Dam Reservation	125.2	Henderson (TN)	TN
ML	Col. Forrest v. Durand Wetland - State Habitat Area	389.44	Madison (TN)	TN
ML	Emergency Watershed Protection Program - Floodplain Easement	341	Madison (TN)	TN
ML	Hatchie River	496.19	Multiple	Multiple
ML	Kentucky Reservoir	117,657.4	Multiple	Multiple
ML	Kentucky Reservoir Reservation	135,396	Multiple	Multiple
ML	Natchez Trace State Forest	36,889.86	Multiple	TN
ML	Natchez Trace State Wildlife Management Area	37,867.91	Multiple	TN
ML	Reelfoot Lake State Natural Area	12,923.66	Multiple	TN
ML	Reelfoot Lake State Park	281.09	Multiple	TN
ML	Reelfoot Lake/TN State Wildlife Management Area/Wildlife Observation Area	20,232.46	Multiple	TN
ML	Wetland Reserve Program	99.76	Lake (TN)	TN

Appendix Table 5-11. Natural Areas Crossed by Transmission Line Segments Proposed for Vegetation Management in the Morristown Sector

MORRISTOWN SECTOR	NAME	ACRES	COUNTY	STATE
MT	Abrams Creek	63.94	Multiple	TN
MT	Boone Reservoir Reservation	4,908.52	Multiple	TN
MT	Cherokee (North) State Wildlife Management Area	229,570.8	Multiple	Multiple
MT	Cherokee Dam Reservation	334.39	Multiple	TN
MT	Cherokee National Forest	656,051.3	Multiple	Multiple
MT	Cherokee Reservoir Reservation	38,340.54	Multiple	TN
MT	Chilhowee Reservoir Reservation	1744.70	Multiple	TN
MT	Chilhowee Reservoir State Recreation Area	1,371.69	Multiple	TN
MT	Clear (Bristol Project) Dam Reservation	84.75	Washington (VA)	VA
MT	Clinch River State Mussel Sanctuary	997.29	Multiple	TN
MT	Cruze Farm Conservation Easement - Land Trust for Tennessee	442.55	Knox (TN)	TN
MT	Designated Critical Habitat Clinch River Unit 5	3,580.35	Multiple	Multiple
MT	Designated Critical Habitat Cumberlandian Combshell	3,067.58	Multiple	Multiple
MT	Designated Critical Habitat Fluted Kidneyshell (TN)	15,839.57	Multiple	Multiple
MT	Designated Critical Habitat Indiana Bat Habitat 1	518442.70	Multiple	Multiple
MT	Designated Critical Habitat Oyster Mussel (TN)	5,854.86	Multiple	Multiple
MT	Designated Critical Habitat Purple Bean	7,490.48	Multiple	Multiple
MT	Designated Critical Habitat Rough Rabbitsfoot	6,716.84	Multiple	Multiple
MT	Designated Critical Habitat Slabside Pearlymussel (TN)	13,851.4	Multiple	Multiple
MT	Designated Critical Habitat Slender Chub	5,730.89	Multiple	Multiple
MT	Douglas Dam Reservation	123.7	Sevier (TN)	TN
MT	Douglas Reservoir Reservation	30,115.45	Multiple	TN
MT	Elk River Gorge Potential National Natural Landmark	3,358.12	Multiple	Multiple
MT	Fontana Dam Reservation	138.27	Multiple	NC
MT	Foothills National Parkway	3,613.14	Blount (TN)	TN
MT	Foothills Wildlife Management Area	6,247.71	Blount (TN)	TN
MT	French Broad River (West)	78.91	Multiple	TN
MT	Great Smoky Mountains National Park	518,442.70	Multiple	Multiple

MORRISTOWN SECTOR	NAME	ACRES	COUNTY	STATE
MT	Griffith Branch Cove	144.04	Carter (TN)	TN
MT	Highlands of Roan	24,224.67	Multiple	Multiple
MT	Holston River	128.09	Multiple	TN
MT	Kyles Ford	50.08	Hancock (TN)	TN
MT	Kyles Ford Wildlife Management Area	952.6	Multiple	TN
MT	Lower French Broad and Lower Holston Nonessential Experimental Population Status	4,790.05	Multiple	TN
MT	Mossy Creek TVA Ecological Study Area	38340.54	Multiple	TN
MT	Mt. Pisgah Proposed State Natural Area	511249.4	Multiple	Multiple
MT	Nantahala National Forest	1327388	Multiple	Multiple
MT	Nantahala State Game Land	530464.6	Multiple	Multiple
MT	National Forest - North Carolina	1042224	Multiple	Multiple
MT	North Cherokee NF And Wildlife Management Area	334706.5	Multiple	Multiple
MT	North Cherokee NF And Wildlife Management Area	334706.5	Multiple	Multiple
MT	Overmountain Victory State Scenic Trail	1304.11	Multiple	Multiple
MT	Pearson's Cave Refuge	44.54	Multiple	TN
MT	Pine Bottom Branch	3.59	Johnson (TN)	TN
MT	Pine Knob	8.48	Johnson (TN)	TN
MT	Pisgah National Forest	1123035	Multiple	Multiple
MT	Pisgah State Game Land	511249.4	Multiple	Multiple
MT	Pond Mountain Wilderness	6939.95	Carter (TN)	TN
MT	Rankin Bottom Wildlife Management Area	711.7	Multiple	TN
MT	Tapoco Lands Conservation Area Easement - The Nature Conservancy - Conservation Easement	4053.11	Multiple	Multiple
MT	The Highlands Of Roan	24224.67	Multiple	Multiple
MT	Tuckahoe Creek State Scenic River	363.58	Multiple	TN
MT	TVA Programmatic Agreement 2003 (French Broad)	1956.42	Multiple	TN
MT	TVA Programmatic Agreement 2003 (Holston)	2419.58	Multiple	TN
MT	Watauga Lake Protection Planning Committee Rare Plants Site	61.9	Johnson (TN)	TN
MT	Watauga Reservoir Reservation	7003.17	Multiple	TN
MT	Watauga River	80.68	Multiple	Multiple

MORRISTOWN SECTOR	NAME	ACRES	COUNTY	STATE
MT	Watauga River Potential National Natural Landmark	619.59	Multiple	Multiple
MT	Watauga Scenic Area	1104.99	Carter (TN)	TN
MT	Waterfall Creek Potential National Natural Landmark	1123035	Multiple	Multiple
MT	Wilbur Cliffs	369.37	Carter (TN)	TN
MT	Wilbur Lake State Wildlife Observation Area	107	Carter (TN)	TN
MT	Wilbur Reservoir Reservation	71.42	Carter (TN)	TN

Appendix Table 5-12. Natural Areas Crossed by Transmission Line Segments Proposed for Vegetation Management in the Nashville Sector

NASHVILLE SECTOR	NAME	ACRES	COUNTY	STATE
NA	Bledsoe Creek	34.38	Sumner (TN)	TN
NA	Bledsoe Creek State Park State Wildlife Observation Area	407.97	Sumner (TN)	TN
NA	Caney Fork	65.75	Multiple	TN
NA	Center Hill Lake - US Army Corps of Engineers	39704.26	Multiple	TN
NA	Cheatham Lake - US Army Corps of Engineers	7724.45	Multiple	TN
NA	Falling Water River	113.43	Multiple	TN
NA	Goose Creek	46.32	Multiple	TN
NA	J. Percy Priest Lake - Army Corps of Engineers	33686.57	Multiple	TN
NA	Mill Creek Macrosite	2352.71	Multiple	TN
NA	Old Hickory Reservoir Reservation	23997.87	Multiple	TN
NA	Old Hickory State Wildlife Management Area	26682.04	Multiple	TN
NA	Radnor Lake State Natural Area	1334.86	Davidson (TN)	TN
NA	Smith Fork Creek	72.16	Multiple	TN
NA	Sneed Road Hills Protection Planning Site	116.67	Williamson (TN)	TN
NA	Warner Parks Registered State Natural Area	2606.86	Multiple	TN

Appendix Table 5-13. Natural Areas Crossed by Transmission Line Segments Proposed for Vegetation Management in the Oak Ridge Sector

OAK RIDGE SECTOR	NAME	ACRES	COUNTY	STATE
OR	Big South Fork National River And Recreation Area	122510.1	Multiple	Multiple
OR	Big South Fork National River And Recreation Area	113609	Multiple	Multiple
OR	Clear Creek	81.49	Multiple	TN
OR	Clear Fork	65.82	Multiple	TN
OR	Clear Fork Crooked Creek 1	182.88	Fentress (TN)	TN
OR	Clinch River 1	80.22	Multiple	TN
OR	Clinch State Scenic River	3234.87	Multiple	TN
OR	Colditz Cove Designated State Natural Area	161.38	Fentress (TN)	TN
OR	Cordell Hull Lake - US Army Corps of Engineers	26773.41	Multiple	Multiple
OR	Crab Orchard Creek	49.13	Multiple	TN
OR	Crooked Creek	44.93	Multiple	TN
OR	Cumberland River 1	184.24	Multiple	KY
OR	Cumberland Trail 1	13951.26	Multiple	TN
OR	Cumberland Trail State Park	16570.51	Multiple	TN
OR	Dale Hollow Lake - US Army Corps of Engineers	44755.69	Multiple	Multiple
OR	Dale Hollow Reservoir Reservation	26586.53	Multiple	Multiple
OR	Daniel Boone - Ownership Boundaries (South)	285055.9	Multiple	Multiple
OR	Designated Critical Habitat Big South Fork Unit 9	1225.31	Multiple	Multiple
OR	Designated Critical Habitat Cumberland Elktoe	3874.09	Multiple	Multiple
OR	Designated Critical Habitat Cumberlandian Combshell	3067.58	Multiple	Multiple
OR	Designated Critical Habitat Fluted Kidneyshell (KY)	3887.55	Multiple	Multiple
OR	Designated Critical Habitat Fluted Kidneyshell (TN)	15839.57	Multiple	Multiple
OR	Designated Critical Habitat Oyster Mussel (TN)	5854.86	Multiple	Multiple
OR	Designated Critical Habitat Spotfin Chub - Little Tennessee River	7052.69	Multiple	Multiple
OR	Dillon Pond Park	22.3	Overton (TN)	TN
OR	East Fork Obey River	66.09	Multiple	TN
OR	Emory River	88.16	Multiple	TN
OR	Flint Fork Cove Protection Planning Site	1153.18	Multiple	Multiple

OAK RIDGE SECTOR	NAME	ACRES	COUNTY	STATE
OR	Haw Ridge Park	762.22	Anderson (TN)	TN
OR	Lake Cumberland Reservoir	46753.24	Multiple	KY
OR	Lake Cumberland Wildlife Management Area	51681.8	Multiple	KY
OR	Little South Fork	111.4	Multiple	Multiple
OR	Little South Fork of the Cumberland River (RM 4.1 to 14.5) Outstanding Resource Water	96.18	Multiple	KY
OR	Marrowbone State Forest & Wildlife Management Area	1955.41	Multiple	KY
OR	New River (TN)	21.86	Scott (TN)	TN
OR	Oak Ridge National Laboratory Reservation	32848.61	Multiple	TN
OR	Obed River Park, Crossville	93.49	Cumberland (TN)	TN
OR	Orr Black Oak Ridge Conservation Easement	2962.94	Roane (TN)	TN
OR	Orr Blackoak Ridge Mixed Pine and Hardwood Forest [PRA-D]	41.3	Roane (TN)	TN
OR	Orr Chestnut Ridge Springs Area [RA21]	7.62	Roane (TN)	TN
OR	Orr Mccoy Branch Embayment Barren [NA8]	91.75	Anderson (TN)	TN
OR	Orr Solway Bend Bluffs [NA23]	13.94	Anderson (TN)	TN
OR	Pellissippi State Community College Park	135.74	Knox (TN)	TN
OR	Pickett State Forest and Wildlife Management Area	20632.59	Multiple	TN
OR	Pickett State Park	769.91	Pickett (TN)	TN
OR	Roaring Paunch Creek Macrosite	3777.24	McCreary (KY)	KY
OR	Rock Creek (TN)	69.52	Multiple	Multiple
OR	Scott State Forest	2832.96	Multiple	TN
OR	Sugar Grove TVA Habitat Protection Area	6.39	Roane (TN)	TN
OR	Three Bends Scenic and Wildlife Refuge	3209.22	Multiple	TN
OR	Twin Arches Designated State Natural Area	1605.74	Multiple	TN
OR	Watts Bar Reservoir Reservation	43581.58	Multiple	TN
OR	West Fork Obey River	71.08	Multiple	TN
OR	White County Lumber Company	3406.39	Multiple	TN
OR	White Oak Creek	38.52	Multiple	TN
OR	Wolf River	61.88	Multiple	TN
OR	Wolf River Nationwide River Inventory Stream	36	Pickett (TN)	TN

Appendix Table 5-14. Natural Areas Crossed by Transmission Line Segments Proposed for Vegetation Management in the West Point Sector

WEST POINT SECTOR	NAME	ACRES	COUNTY	STATE
WP	Bienville National Forest	225647.3	Multiple	MS
WP	Bienville State Wildlife Management Area	27445.95	Scott (MS)	MS
WP	Bull Mountain Creek Protection Planning Site	2229.9	Itawamba (MS)	MS
WP	Buttahatchee River	303.6	Multiple	Multiple
WP	Buttahatchie Macrosite	3522.91	Multiple	Multiple
WP	Buttahatchie River MB	981.67	Monroe (MS)	MS
WP	Canal Section WMA	29406.14	Multiple	MS
WP	Chickasaw/Ms State Wildlife Management Area	26946.03	Multiple	MS
WP	Designated Critical Habitat Alabama Moccasinshell	19007.02	Multiple	Multiple
WP	Designated Critical Habitat Buttahatchee River Unit 3	830.47	Multiple	Multiple
WP	Designated Critical Habitat Orangenacre Mucket	15028.51	Multiple	Multiple
WP	Designated Critical Habitat Ovate Clubshell	16859.01	Multiple	Multiple
WP	Designated Critical Habitat Southern Clubshell	17951.01	Multiple	Multiple
WP	Designated Critical Habitat Unit 4: Yellow and Luxapalia Creek	167.25	Multiple	Multiple
WP	Grasslands Reserve Program	146.06	Chickasaw (MS)	MS
WP	Grasslands Reserve Program	57.25	Monroe (MS)	MS
WP	Natchez Trace National Parkway	44142.09	Multiple	Multiple
WP	Northeast Mississippi Branch Experiment Station	123.83	Lee (MS)	MS
WP	Tennessee Tombigbee Waterway / Protection Planning Site	13793.61	Multiple	Multiple
WP	TN-Tom Aberdeen Reservoir Reservation	6580.85	Monroe (MS)	MS
WP	TN-Tom Columbus Reservoir Reservation	4122.1	Multiple	MS
WP	Tombigbee National Forest	119504.7	Multiple	MS