Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

CNL-17-017

February 3, 2017

10 CFR 50.90

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Browns Ferry Nuclear Plant, Units 1, 2, and 3
Renewed Facility Operating License Nos. DPR-33, DPR-52, and DPR-68
NRC Docket Nos. 50-259, 50-260, and 50-296

Subject: **Proposed Technical Specifications (TS) Change TS-505 - Request for License Amendments - Extended Power Uprate (EPU) - Supplement 37, Transmission System Update – Environmental Aspects**

References:

1. Letter from TVA to NRC, CNL-15-169, "Proposed Technical Specifications (TS) Change TS-505 - Request for License Amendments - Extended Power Uprate (EPU)," dated September 21, 2015 (ML15282A152)

2. Letter from TVA to NRC, CNL-16-091, "Proposed Technical Specifications (TS) Change TS-505 - Request for License Amendments - Extended Power Uprate (EPU) - Supplement 18, Responses to Requests for Additional Information and Updates associated with Interconnection System Impact Study," dated May 27, 2016 (ML16197A563)

3. Letter from TVA to NRC, CNL-17-015, "Proposed Technical Specifications (TS) Change TS-505 - Request for License Amendments - Extended Power Uprate (EPU) - Supplement 36, Transmission System Update – Safety Aspects," dated January 20, 2017

4. Letter from NRC to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Draft Environmental Assessment and Finding of No Significant Impact Related to the Proposed Extended Power Uprate," dated November 21, 2016 (ML16287A525)

By the Reference 1 letter, the Tennessee Valley Authority (TVA) submitted a license amendment request (LAR) for the Extended Power Uprate (EPU) of Browns Ferry Nuclear Plant (BFN) Units 1, 2 and 3. The proposed LAR modifies the renewed operating licenses to increase the maximum authorized core thermal power level from the current licensed thermal power of 3458 megawatts to 3952 megawatts. The Reference 2 letter supplemented the BFN EPU LAR and submitted Revision 1 of the interconnection System Impact Study (SIS). Revision 1 of the interconnection SIS identifies the need to replace six breaker failure relays, install 764 megavolt-ampere reactive (MVAR) capacitor banks in five locations throughout the TVA transmission system, and modify the excitation system of all three BFN main generators. The Reference 2 letter also provided associated updates to information previously submitted in the BFN EPU LAR, responses to Requests for Additional Information (RAIs), and updates to responses to RAIs. During the development of implementation guidance for the stability studies at EPU power levels, and subsequent to the submittal of the Reference 2 letter, an error was identified in generator field parameters used in the development of the interconnection SIS. This legacy error involved data contained in a recently updated generator performance computer code used by the original equipment manufacturer. This condition has been entered into the TVA Corrective Action Program. As a result of this error, the following changes to the information provided in Reference 2 letter are required.

- The static exciters described in BFN EPU LAR Supplement 18 will not be installed on the BFN units. Instead, the existing exciters on the BFN units will each be modified to be self-excited using a shaft driven alternator. The existing exciters on the BFN units are bus-fed through transformers.

- BFN EPU LAR Supplement 18 described installing 764 MVAR capacitor banks at five substation locations. Instead, capacitor banks will be installed at four of the five identified substations. In addition, a static volt-ampere reactive (VAR) compensator will be installed at an existing substation near BFN. The combination of the static VAR compensator and the additional capacitor banks will provide a minimum reactive compensation of 764 MVAR.

This letter provides BFN EPU LAR Supplement 37. This supplement addresses the environmental aspects associated with the above changes. The safety aspects of the above changes are addressed in BFN EPU LAR Supplement 36 (Reference 3).

Enclosure 1 of this letter provides the updated responses to NRC RAIs RERP-GE-RAI 2, RERP-GE-RAI 3, and RERP-GE-RAI 4. The update has been made to reflect the changes to the transmission system upgrades included in Revision 3 of the interconnection SIS. Revision 1 of the NRC RERP-GE-RAI 2 and RERP-GE-RAI 4 responses and Revision 2 of the NRC RAI RERP-GE-RAI 3 response provided in Enclosure 1 of this letter supersede and replace the responses provided in the Reference 2 letter.

Enclosure 2 of this letter provides Revision 2 of the BFN EPU Supplemental Environmental Report. The BFN EPU Supplemental Environmental Report is revised to reflect the transmission system upgrades included in Revision 3 of the interconnection SIS. Enclosure 2 supersedes and replaces Revision 1 of the BFN EPU Supplemental Environmental Report, provided in Enclosure 6 of the Reference 2 letter.

The Reference 4 letter provided the NRC's draft Environmental Assessment and Finding of No Significant Impact related to the proposed BFN EPU. Enclosure 3 of this letter provides markups of the draft Environmental Assessment and Finding of No Significant Impact to reflect the changes associated with the Transmission System update included in this supplement.

TVA has reviewed the information supporting the environmental consideration provided to the NRC in the Reference 1 letter. The supplemental information in this submittal does not affect the bases for concluding that an environmental impact statement does not need to be prepared in connection with the proposed license amendment. Additionally, in accordance with 10 CFR 50.91(b)(1), TVA is sending a copy of this letter to the Alabama State Department of Public Health.

There are no new regulatory commitments associated with this submittal. If there are any questions or if additional information is needed, please contact Mr. Edward D. Schrull at (423) 751-3850.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 3rd day of February 2017.

Respectfully,

J. W. Shea
Vice President, Nuclear Licensing

Enclosures

cc: See Page 4

Enclosures:

1. Updated Responses to NRC Requests for Additional Information RERP-GE-RAI 2, RERP-GE-RAI 3, and RERP-GE-RAI 4
2. BFN EPU LAR, Attachment 42, Supplemental Environmental Report, Revision 2
3. Draft Environmental Assessment and Finding of No Significant Impact Change Markup

cc (Enclosures):

NRC Regional Administrator - Region II
NRC Senior Resident Inspector - Browns Ferry Nuclear Plant
State Health Officer, Alabama Department of Public Health

ENCLOSURE 1

Responses to NRC Requests for Additional Information
RERP-GE-RAI 2, Revision 1, RERP-GE-RAI 3, Revision 2, and RERP-GE-RAI 4 Revision 1

Response to RERP-GE-RAI 2 includes the following Attachments:

Attachment 1, Supplemental Environmental Information for Transmission System and BFN Main Generator Upgrades (excluding Limestone substation)

Attachment 2, Supplemental Environmental Information for Limestone Substation Static VAR Compensator Construction

Attachment 3, TVA letter to the Mississippi State Historic Preservation Office - TVA, Corinth and Holly Springs Substation Expansion Project, Phase 1 Cultural Resources Survey, Alcorn and Marshall Counties, Mississippi

Attachment 4, TVA letter to the Alabama State Historic Preservation Office - TVA, Limestone Substation Static VAR Compensator Construction, Phase 1 Cultural Resources Survey, Limestone County, Alabama

ENCLOSURE 1

RERP-GE-RAI 2

By letter dated December 18, 2015 TVA submitted to the NRC copies of an Interconnection System Impact Study and a Transmission System Stability Evaluation as the supplements to the proposed EPU. The Interconnect System Impact Study concludes that the proposed EPU will require the replacement of six breaker failure relays at BFN, the installation of 774 megavolt-ampere reactive (MVAR) of capacitors at four locations throughout the TVA transmission system, and the construction of a Limestone-East Point 500-kilovolt (kV) transmission line.

For each of these three upgrades, describe the affected environment, environmental consequences of and any mitigating actions related to construction and implementation of the upgrades for each environmental resource that would be affected. The environmental resources that may be affected and should be described include: land use, visual resources, air quality, noise, geologic environment, surface water resources, groundwater resources, terrestrial resources, aquatic resources, special status species and habitats, historic and cultural resources, socioeconomics, environmental justice, human health, and waste management. For each upgrade, please also describe the projected timeline for completion of the upgrade, whether the upgrade will require the use of construction equipment, the amount of natural habitats that would be disturbed (if applicable), the amount of offsite land that would be disturbed (if applicable), and descriptions of any best-management practices, procedures, or other guidelines that workers would follow to minimize impacts to cultural resources or sensitive species and habitats, if present. For the new 500- kV transmission line, describe the length of the new line, the anticipated origin and terminus of the line, the planned regional study area, possible routes for the line and preferred alternative (if known at this time), and whether the new line would share an existing right-of-way or require a new right-of-way.

TVA Response:

TVA performed an Interconnection System Impact Study (SIS) for the extended power uprate (EPU) of all three Browns Ferry Nuclear Plant (BFN) units. The Interconnection SIS documents transmission system and BFN main generator excitation system upgrades required to support the BFN EPU. Revision ~~1~~ 3 of the Interconnection SIS identified replacing six 500 kilovolt (kV) breaker failure relays, installing a minimum of 764 megavolt-ampere reactive (MVAR) ~~capacitor banks~~reactive compensation in five locations throughout the TVA transmission system, and modifying the excitation system of all three BFN main generators. The additional reactive compensation will consist of one static VAR compensator (SVC) at Limestone substation and multiple capacitor banks at four locations throughout the TVA transmission system. Therefore the new 500 kV transmission line will no longer be required to support BFN EPU . The environmental impact of a ~~new~~ modified excitation system and reactive compensation will be addressed in this response in lieu of a new transmission line. For each upgrade, the environmental reviews are being performed by TVA and the results to date are discussed in Attachment 1, Supplemental Environmental Information for Transmission System and BFN Main Generator Upgrades (Excluding Limestone Substation) and in Attachment 2, Supplemental Environmental Information for Limestone Substation Static VAR Compensator Construction.

<u>Breaker Failure Relay Replacement</u>

As discussed in the TVA response to RERP-GE-RAI 3, all six breaker failure relays will be replaced prior to the first unit uprate (Unit 3) in the Spring of 2018. The physical work to replace the 500 kV breaker failure relays will be performed within the existing structure of the BFN control building. The work will not require construction equipment or involve use of previously

undisturbed land. The environmental review of the breaker failure relay replacements is discussed in Attachment 1. Because all the work to replace the six breaker failure relays occurs within existing BFN structures and does not involve the use of additional undisturbed land, there are no best-management practices (BMPs), guidelines, or procedures beyond the normal BFN site work procedures that workers would follow to minimize impacts to cultural resources or sensitive species and habitats.

Main Generator Excitation System Modification

~~Replacement~~ Modification of the BFN main generator excitation system is in the preliminary phase of the design change notice development and therefore no specific timeline for implementation has been developed. The projected completion for Unit 1 is Fall 2020, Spring 2020 for Unit 3, and in ~~2023~~ Spring 2021 and ~~2024 respectively~~ for Unit~~s~~ 2 ~~and 3~~. The modification will occur within existing BFN structures and does not require construction equipment or involve use of previously undisturbed land. The environmental review of the main generator excitation systems modifications is discussed in Attachment 1. Because all the work to upgrade the BFN main generator excitation systems occurs within existing BFN structures and does not involve the use of additional undisturbed land, there are no best-management practices (BMPs), guidelines, or procedures beyond the normal BFN site work procedures that workers would follow to minimize impacts to cultural resources or sensitive species and habitats identified or required.

~~Capacitor Banks~~Reactive Compensation

As discussed in the TVA response to RERP-GE-RAI 3 revision 2, the preliminary estimated completion of the final capacitor bank is ~~Spring~~ December of ~~2019~~2018 and the preliminary estimated completion of the SVC is Spring of 2020. The proposed locations are the Clayton Village ~~Substation~~ substation located in Oktibbeha County, Mississippi, Holly Springs ~~Substation~~ substation located in Marshall County, Mississippi, Corinth ~~Substation~~ substation located in Alcorn County, Mississippi, East Point ~~Substation~~ substation located in Cullman County, Alabama, and the ~~Wilson~~ Limestone ~~Substation~~ substation located in ~~Wilson~~ Limestone County, ~~Tennessee~~Alabama. The environmental review for the capacitor bank installations at each substation is discussed in Attachment ~~-~~1. Construction equipment, land that would be disturbed, and descriptions of any BMP, procedures, or other guidelines that workers would follow to minimize impacts to cultural resources or sensitive species and habitats are also discussed in Attachment 1. The environmental information for the SVC installation at the Limestone substation is discussed in Attachment 2. Note that Attachment ~~2~~ 3 , and Attachment ~~3~~4 are letters to the State Historic Preservation Office for the states of ~~Tennessee and~~ Mississippi and Alabama.

Response to RERP-GE-RAI 2, Attachment 1

Supplemental Environmental Information for Transmission System and BFN Main Generator Upgrades (excluding Limestone substation)

Browns Ferry Nuclear Plant

RERP-GE-RAI 2 Response, Attachment 1 Revision 1

Supplemental Environmental Information for Transmission System and BFN Main Generator Upgrades (Excluding Limestone Substation)

Table of Contents

1.0 Executive Summary E1-Att1-1
2.0 Introduction E1-Att1-1
3.0 Purpose of and Need For Action E1-Att1-2
3.1 The Proposed Action E1-Att1-2
3.2 Need for TVA Action E1-Att1-2
3.3 Alternatives to the Proposed Action E1-Att1-2
4.0 Overview of Operational And Equipment Changes - Project Characteristics E1-Att1-3
5.0 Socioeconomic and Environmental Justice Considerations E1-Att1-4
5.1 Socioeconomic E1-Att1-4
5.2 Environmental Justice E1-Att1-4
6.0 Cost Benefit Analysis E1-Att1-5
7.0 Environmental Impacts E1-Att1-5
7.1 Terrestrial Effects E1-Att1-5
7.1.1 Land Use, Wetlands, and Natural Areas E1-Att1-5
7.1.2 Cultural Resources E1-Att1-6
7.1.3 Transmission Facilities, Electric Shock, and Electromagnetic Fields. E1-Att1-7
7.1.4 Noise, Odor, and Visual Aesthetics E1-Att1-7
7.1.5 Air Impacts E1-Att1-7
7.1.6 Terrestrial Biota and Habitat E1-Att1-8
7.1.7 Non-Radiological Waste Streams and Potential for Pollutant Generation E1-Att1-8
7.1.8 Geological Environment E1-Att1-9
7.2 Hydrology and Aquatic Ecology Effects E1-Att1-11
7.2.1 Aquatic Resources-Rivers, Streams, and Reservoirs E1-Att1-11
7.2.2 Groundwater E1-Att1-12
7.2.3 Surface Water E1-Att1-12
7.2.4 Drinking Water E1-Att1-13
7.3 Endangered, Threatened, or Special Status Species E1-Att1-13
7.3.1 Aquatic E1-Att1-13
7.3.2 Terrestrial -Botany E1-Att1-14
7.3.3 Terrestrial - Zoology E1-Att1-15
7.4 Compliance, Permits, and Reporting E1-Att1-17

8.0 Results and Conclusion Summary E1-Att1-17

9.0 Best Management Practices, and Environmental Quality Protection .... Specifications E1-Att1-18

RERP-GE-RAI 2 Response, Attachment 1 Rev. 1

1.0 Executive Summary

Tennessee Valley Authority (TVA) performed an Interconnection System Impact Study (SIS) for the extended power uprate (EPU) of all three Browns Ferry Nuclear Plant (BFN) units. The Interconnection SIS documents transmission system upgrades and BFN main generator excitation system ~~upgrades~~ modifications required to support the BFN EPU. Specifically, revision 3 of the Interconnection SIS identified replacement of six 500 kilovolt (kV) breaker failure relays, installation of a minimum of 764 megavolt-ampere reactive (MVAR) ~~capacitor banks~~reactive compensation in five locations throughout the TVA transmission system, and ~~upgrades~~ modification of~~to~~ all three BFN main generator excitation systems. The additional reactive compensation will consist of one static VAR compensator (SVC) at Limestone substation and multiple capacitor banks at four locations throughout the TVA transmission system. As a federal agency subject to the requirements of the National Environmental Policy Act (NEPA), TVA is evaluating the effects on the environment of these proposed upgrades. A categorical exclusion checklist (CEC) was performed for the SVC installation at the Limestone substation. The results are discussed in RERP-GE-RAI 2 Response, Attachment 2, Supplemental Environmental Information for Limestone Substation Static VAR Compensator Construction. The intent of this report is to document TVA's assessment of environmental impacts for each of the remaining upgrade and modification projects.

2.0 Introduction

TVA has proposed to uprate each BFN unit from the current licensed thermal power (CLTP) to approximately 120 percent of the original licensed thermal power (OLTP). The material modification will uprate each BFN unit electrical output by approximately 155 megawatts (MWe). In ~~May 2016~~January 2017, TVA revised (revision 3) the Interconnection SIS that evaluated the proposed material modification to the existing BFN units. ~~The revised~~Revision 3 of the Interconnection SIS identified some deficiencies that would require transmission ~~stability~~ system upgrades in order to support the planned BFN unit uprates.

Revision 3 of the~~The~~ Interconnection SIS identified six 500 kV breakers in the BFN switchyard which have inadequate critical clearing time for a stuck 500 kV breaker coincident with a single line to ground fault event. These 500 kV breakers require upgrades to the breaker failure relays. The breaker failure relays are located in the BFN control building.

Revision 3 of the~~The~~ Interconnection SIS also identified an issue with the BFN main generators when one of four specific 500 kV transmission lines are out of service coincident with a three phase fault. To mitigate this issue TVA will install a static VAR compensator at the Limestone substation and modify the excitation system of each of the BFN main generators~~ will need to be upgraded~~.

TVA imposes applicable FERC requirements on all generation projects. New generation must have the capability to operate at a power factor of 0.95 at the point of interconnection. Revision 3 of the~~The~~ Interconnection SIS determined that the BFN reactive power capability after uprate would be deficient 764 MVAR for the additional power. To fulfill FERC requirements TVA identified installation of a ~~total~~ minimum of 764 MVAR ~~capacitor~~

~~banks~~reactive compensation (one SVC site and four capacitor bank sites) distributed in five locations throughout the TVA transmission system.

TVA is evaluating the environmental effects for each of these proposed Interconnection SIS upgrades. TVA's procedures that implement NEPA regulations include a categorical exclusion suitable for use on ~~this~~ these projects. A CEC was performed for the SVC installation at the Limestone substation. The environmental effects are discussed in RERP-GE-RAI 2 Response, Attachment 2, Supplemental Environmental Information for Limestone Substation Static VAR Compensator Construction. ~~Therefore, categorical exclusion checklists (~~CECs~~) will be completed~~were performed for each of the remaining upgrade and modification projects. This ~~report~~ attachment summarizes the environmental impact information for each of the remaining projects collected for these environmental reviews.

3.0 Purpose of and Need For Action

3.1 The Proposed Action

TVA proposes to upgrade six 500 kV breaker failure relays, install a minimum of 764 MVAR ~~capacitor banks~~reactive compensation (one SVC site and four capacitor bank sites) ~~in~~ distributed throughout five locations ~~throughout~~ within the TVA transmission system, and ~~upgrade~~ modify the BFN main generators excitation system.

3.2 Need for TVA Action

BFN EPU will increase the electrical output of each BFN unit by approximately 155 megawatts (MWe). TVA conducted an Interconnection SIS to evaluate the material modification to the existing BFN units. Revision 3 of ~~The~~ the Interconnection SIS identified some transmission system impacts that will require modifications and upgrades in order to support the planned BFN unit uprates.

3.3 Alternatives to the Proposed Action

There are no viable alternatives identified in revision 3 of the Interconnection SIS for upgrading the six breaker failure relays.

There are ~~three~~ four options for ~~capacitor bank installations~~adding a minimum of 764 MVAR reactive compensation. The first option is to install 774 MVAR capacitor banks distributed across four existing locations throughout the TVA transmission system. The second ~~preferred~~ alternative is to install 764 MVAR capacitor banks distributed across five existing locations throughout the TVA transmission system. The third option is to uprate the BFN main generator stator to 1,375 mega volt-amperes (MVA) thereby reducing the MVAR requirement to 252 MVAR of capacitor banks distributed across three existing locations throughout the TVA transmission system. The fourth option is to install an SVC at the Limestone substation and install capacitor banks distributed across four existing substations throughout the TVA transmission system. The first two options address MVAR deficiency but do not assist resolving transient stability issues. Therefore, neither of the first two options was selected. Based on cost and technical issues with ~~this~~ the third option, BFN EPU project management determined this option would not meet the needs of the EPU project. The fourth option mitigates both the reactive compensation and transient stability issues. TVA's Transmission Power Supply (TPS)

organization and BFN EPU project management determined that ~~better grid reliability and operational control would result from 764 MVAR capacitor banks~~ an SVC at the Limestone substation and capacitor banks distributed across ~~five~~ four locations was the optimal solution for BFN EPU and the TVA transmission system.

A new 500 kV transmission line between the Limestone and East Point ~~S~~substations was considered as an alternative to the BFN main generator excitation system ~~upgrade~~modification and SVC installation. Based upon refined technical evaluation, the 500 kV line was determined to be inadequate to completely address the transient stability issues. Therefore, BFN EPU project management, in conjunction with TPS, determined that the BFN main generator excitation system ~~upgrades~~ modifications and use of an SVC would be the preferred alternative~~, based on cost, schedule, and environmental considerations~~.

4.0 Overview of Operational And Equipment Changes - Project Characteristics

TVA proposes to upgrade the 500 kV breaker failure relays for breakers 5204, 5208, 5254, 5258, 5274, and 5278. The relays are physically located in panels in the relay room inside the BFN control building and do not involve use of additional undisturbed land. The relays are being upgraded to mitigate potential transmission system issues resulting from specific fault events on the transmission system and will have no operational impact on BFN. Relay replacement is considered to be routine maintenance.

TVA proposes to install a minimum of 764 MVAR ~~capacitor banks~~reactive compensation (one SVC site and four capacitor bank sites) ~~in~~ distributed throughout five locations in the TVA transmission system. The proposed locations for the capacitor banks are the Clayton Village 161 kV ~~Substation~~ substation located in Oktibbeha County, Mississippi; the Holly Springs 161 kV ~~Substation~~ substation located in Marshall County, Mississippi; the Corinth 161 kV ~~Substation~~ substation located in Alcorn County, Mississippi; and the East Point 500 kV ~~161 kV Substation~~ substation (161 kV line) located in Cullman County, Alabama.~~; and the Wilson 500 kV Substation located in Wilson County, Tennessee.~~ The capacitor banks are intended to address MVAR deficiencies associated with the additional BFN generation and will have no operational impact on BFN. Two of the ~~five~~ four capacitor bank installations will be within existing substation boundaries. ~~Three~~ Two of the ~~five~~ four proposed capacitor bank installations will require expansion (small amount of land) of the existing substation footprint. The capacitor bank installations are considered to be a minor system upgrade.

TVA proposes to install an SVC at the Limestone substation located in Limestone County, Alabama. The SVC will address both the MVAR deficiency and transient stability issues. The SVC installation will require expansion of the existing substation footprint. The SVC is discussed in RERP-GE-RAI 2 Response, Attachment 2, Supplemental Environmental Information for Limestone Substation Static VAR Compensator Construction.

BFN will ~~replace~~also -modify the existing BFN main generator ~~Alterrex~~ excitation system for each unit. ~~with a bus-fed static excitation system. The static excitation system consists of a 3-phase power potential transformer (PPT), an automatic voltage regulator (AVR), and a power~~

~~section.~~ The modifications will occur within existing BFN structures and does not involve use of additional undisturbed land.

5.0 Socioeconomic and Environmental Justice Considerations

5.1 Socioeconomic

All physical work related to the 500 kV breaker failure relay upgrade and BFN main generator exciter ~~upgrades~~ modifications will be performed within existing BFN structures and will not impact highway or railroad travel, will not interfere with river use or navigation, will not interfere with recreational or educational use of facilities remote to BFN, will not create public health effects, or increase the potential for accidents affecting the public. These projects will not cause the displacement or relocation of businesses, residences, cemeteries, or farms. Relay replacements are not expected to require significant additional labor resources. The BFN main generator exciter ~~upgrades~~ modifications ~~will~~ may involve additional supplemental staffing (contractor and vendor resources) during the associated ~~installation~~ outage. However, BFN does not anticipate this additional supplemental staffing to significantly deviate from the typical outage workforce size. These upgrades and ~~upgrades~~ modifications will not, by themselves, increase power sales or change the book value of BFN and therefore will not impact TVA's payment in lieu of taxes payments or distributions.

All physical work related to installation of the capacitor banks will take place at locations distant to BFN. The work will be performed by a combination of TVA personnel and vendor supplied resources. Given the widespread nature of the work, no single construction site will be significantly impacted. For each of the capacitor bank sites, installation will not impact highway or railroad travel, will not interfere with river use or navigation, will not interfere with recreational or educational use of facilities remote to BFN, will not create public health effects, or increase the potential for accidents affecting the public. These projects will not cause the displacement or relocation of businesses, residences, cemeteries, or farms. The components and equipment installed will be inorganic inanimate objects and therefore will not contain genetically engineered organisms or materials. The capacitor banks will not, by themselves, increase power sales or change the book value of BFN and therefore will not impact TVA's payment in lieu of taxes payments or distribution.

5.2 Environmental Justice

The breaker failure relay upgrades and the BFN main generator exciter ~~upgrades~~ modifications occur within existing BFN structures and will not impact the surrounding general population. Two of the capacitor bank installation sites will be within existing substation boundaries. Two ~~Three~~ of the ~~five~~ four capacitor bank sites (Holly Springs~~,~~ and Corinth substations~~, and Wilson substations~~) will require expansion (small amount of land) of the existing substation footprint and additional grading and clearing. TVA's best management practices (BMPs) and specifications will apply throughout construction activities. The proposed upgrades and modifications will improve the TVA transmission system reliability. Improved transmission system reliability results in fewer unplanned power losses and therefore the surrounding population will benefit from the upgrades and modifications.

6.0 Cost Benefit Analysis

TVA performed analysis to study the cost effectiveness of implementing EPUs at the BFN site. The proposed EPUs provide additional supply of approximately 155 MWe per unit (465 MWe total) capacity and approximately 4 terawatt-hours (TWh) per year of reliable, carbon-free energy to the TVA system. The EPU project is expected to be economically beneficial by $450 million through the end of the current operating licenses at Browns Ferry.

Based on TVA's load forecast, capacity plans have shown TVA would need to purchase market capacity and employ new generation without the uprates in order to satisfy firm requirements. Detailed model simulations were completed to estimate the capacity and energy (mostly fuel) cost impacts. The capacity savings from the EPU project are largely driven by deferring or reducing the need for new capacity. The low variable cost of the additional nuclear generation delivers significant fuel savings by offsetting more expensive coal generation, gas generation, and the need for market purchases. This also includes reduced carbon emissions. TVA projects the total cost of the project to be $479 million which includes transmission expenses.

An Interconnection SIS was also conducted to determine all adverse system impacts on TVA's transmission system caused by the EPUs at BFN. Several projects are required to mitigate the identified adverse system impacts and the estimated cost of these projects is $~~45~~75.5 million. The cost and timeframe for these required projects is significantly reduced from the prior study because TVA plans to modify the excitation system for all three units at BFN instead of building a new 500 kV transmission line. While the transmission related expense lowers the economic benefit, it is still highly positive.

7.0 Environmental Effects

7.1 Terrestrial Effects

7.1.1 Land Use, Wetlands, and Natural Areas

The breaker failure relay upgrades and the BFN main generator exciter ~~upgrades~~ modifications occur within existing BFN structures and do not involve use of additional undisturbed land. Therefore there is no potential to take prime or unique farmland out of production. These upgrades and modifications will not affect ecologically critical areas, wetlands, park land (federal, state, or local), national or state forests, wilderness areas, scenic areas, wildlife management areas, recreational areas, greenways, or trails.

The capacitor bank installations will take place at locations ~~distant~~ offsite to BFN. Two of the capacitor bank installation sites will be within existing substation boundaries. ~~Three~~ Two of the capacitor bank installation sites~~five sites~~ (Holly Springs ~~,~~and Corinth~~, and Wilson substations~~) will require expansion (small amount of land) of the existing substation footprint and additional grading and clearing. TVA expects to purchase approximately 3.5 acres of adjacent land and disturb approximately 3 acres for the Corinth substation expansion. TVA expects to purchase approximately 2.5 acres of adjacent land and disturb approximately 2.25 acres for the Holly Springs substation expansion. ~~TVA owns the land required for the Wilson substation expansion and estimates it will disturb approximately five acres.~~ No prime or unique farmland will be taken

out of production. There are no ecologically critical areas, wetlands, park land (federal, state, or local), national or state forests, wilderness areas, scenic areas, wildlife management areas, recreational areas, greenways, or trails within the proposed project footprints or within three miles for the ~~five~~ four substation sites.

7.1.2 Cultural Resources

The breaker failure relay upgrades and the BFN main generator exciter ~~upgrades~~ modifications occur within existing BFN structures and therefore do not affect historic structures, historic sites, Native American religious or cultural properties, or archeological sites. Two of the capacitor bank installation sites occur within existing substation boundaries and therefore will not affect historic structures, historic sites, Native American religious or cultural properties, or archeological sites. TVA retained the service of a qualified vendor to conduct a Phase 1 archaeological and historic cultural resource survey for the expansion area of the other ~~three~~ two affected substations. The archaeological area of potential effects (APE) encompasses the new areas of land disturbance. The historic APE for each substation was defined to be a 0.5 mile radius surrounding the substation site from which unobstructed views of the project area would be possible. The results and conclusions of the vendor research for each substation are described below:

- Corinth: Background research performed prior to the field survey indicated no previously identified archaeological sites in the APE. The field study identified no archaeological sites. Background research identified 14 previously inventoried historic architectural properties in the 0.5-mile radius. Of these, one is non-extant and one is located outside the viewshed. TVA has determined that the remaining 13 previously-recorded architectural resources are ineligible for inclusion in the National Register of Historic Places (NRHP). The study also identified six previously unrecorded historic architectural resources. Based on the study results, and ~~pending agreement by~~concurrence from the Mississippi State Historic Preservation Office (SHPO), TVA finds that the proposed undertaking would not be within a direct line of sight to either historic district, and so would have no effect.
- Holly Springs: Background research performed prior to the field survey indicated no previously identified archaeological sites in the APE. The field study identified no archaeological sites. The architectural survey identified 14 previously unrecorded historic architectural properties in the 0.5-mile radius. Based on the field survey, TVA has determined that all 14 properties lack architectural and historic significance and are ineligible for inclusion in the NRHP. The study also investigated two previously unrecorded historic districts within the above-ground APE, the Depot-Compress Historic District and the East Holly Springs Historic District. Based on the study results, and concurrence from ~~the pending agreement by~~ the Mississippi SHPO, TVA finds that the proposed undertaking would not be within a direct line of sight to either historic district, and so would have no effect.
- ~~Wilson: Background research performed prior to the field survey indicated no previously identified archaeological sites in the APE. The field study identified no archaeological sites. Based on the study results, and pending agreement by the Tennessee SHPO, TVA~~

~~finds that the proposed undertaking would not affect any archaeological sites included or eligible for inclusion in the NRHP.~~

7.1.3 Transmission Facilities, Electric Shock, and Electromagnetic Fields.

The breaker failure relay upgrades and the BFN main generator exciter ~~upgrades~~ modifications occur within existing BFN structures. Due to the isolation of these components, they do not have the potential to create an electric shock or electromagnetic field hazard to the public. The capacitor banks will be installed at existing TVA substations. Design criteria that limit hazards to human health from steady-state currents are based on the National Electric Safety Code (NESC). TVA designs transmission systems to exceed requirements given in the NESC. The substations have barrier fences that separate the general public from hazardous electrical components. Because substations already contain multiple high voltage and high current components, addition of the new capacitor banks does not significantly alter the electric shock or electromagnetic field hazard.

7.1.4 Noise, Odor, Microbiological, and Visual Aesthetics

The breaker failure relay upgrades and the BFN main generator exciter ~~upgrades~~ modifications occur within existing BFN structures and therefore do not generate noise or odor, or produce light with off-site impacts. These upgrades and modifications will not produce visual contrast or visual discord and do not involve external structures over 200 feet above ground level. These upgrades and modifications will not introduce, or promote the growth of, thermophilic microorganisms and therefore do not affect microbiological hazards to human health.

Capacitor bank installations will generate transient noise during construction activity. Noise control and suppression during construction activity will be in accordance with the TVA's BMPs and specifications. Specific noise control and suppression measures are discussed in section 9.0; Best Management Practices, and Environmental Quality Protection Specifications of this attachment. Installation of capacitor banks does not create a potential to produce odors with off-site impacts. Installation of new capacitor banks may require new light sources. TVA will adhere to the requirements in the TVA Substation Lighting Guidelines to ensure light disturbance from the new capacitor banks installations is small. Lighting guidelines include design controls that address luminaire optical properties, light levels, neighboring property uses, physical security and surveillance requirements, mounting height and location, terrain, and substation safety. New capacitor banks will not produce visual contrast or visual discord and do not involve external structures over 200 feet above ground level. New capacitor banks will not introduce, or promote the growth of, thermophilic microorganisms and therefore do not affect microbiological hazards to human health.

7.1.5 Air Impacts

For relay upgrades and BFN main generator ~~upgrades~~ modifications there is no potential to release air pollutants and air permits are not required. For capacitor bank installations, there may be small impacts from construction vehicle emissions and fugitive dust from ground disturbance and vehicle travel on unpaved roads. These impacts are small, temporary, and controlled with TVA BMPs.

7.1.6 Terrestrial Biota and Habitat

The breaker failure relay upgrades and the BFN main generator exciter ~~upgrades~~ modifications occur within existing BFN structures and do not affect unique or important terrestrial habitat. The breaker failure relay upgrades and the BFN main generator exciter modifications will not contribute to the spread of exotic or invasive species and have no potential to affect migratory bird populations.

The capacitor bank installations will take place at locations distant to BFN. Two of the capacitor bank installation sites will be within existing substation boundaries. All work at these two sites will occur on previously disturbed land and no additional clearing is required. Therefore, there is no potential at these two sites to affect unique or important terrestrial habitat, contribute to the spread of exotic or invasive species, or affect migratory bird populations. ~~Three~~ Two of the ~~five~~ four sites (Holly Springs~~,~~ and Corinth~~, and Wilson~~ substations) will require expansion (small amount of land) of the existing substation footprint and additional grading and clearing. These sites likely contain sizeable proportion of non-native, invasive botanical species. Because these non-native, invasive, botanical species are widely distributed throughout the region, and the area of disturbance is small, installation of the capacitor banks at these substations will not adversely affect the percentage of this type of habitat in the area. Because TVA's BMPs require the use of native plants and non-invasive species for landscaping, the installation of the capacitor banks will not significantly contribute to the spread of invasive or exotic botanical species. No wading bird colonies, heronries, or aggregations of migratory birds have been documented within three miles of the project footprint and none were observed during field reviews. Therefore, activities associated with the proposed capacitor banks would not affect wading bird colonies or other aggregations of migratory birds.

7.1.7 Non-Radiological Waste Streams and Potential for Pollutant Generation

The breaker failure relay upgrades and the BFN main generator exciter ~~upgrades~~ modifications occur within existing BFN structures and are therefore subject to BFN waste management procedures. These upgrades and modifications will not generate water pollutants or create new waste water streams, cause soil erosion, or involve dredged or fill materials. They will not generate or release hazardous waste, universal or special waste, or used oil. These upgrades and modifications will not generate or release toxic substances. No materials involved in these upgrade and modification projects will require special handling. The upgrade and modification projects may generate small quantities of solvents for cleaning purposes. Chemicals brought on the BFN site require the approval of the Chemical Traffic Control (CTC) Coordinator. Retired relays are collected and evaluated for reuse or disposal. Relays identified for reuse are entered into inventory and then properly stored. Relays identified for disposal are collected in a properly marked, and Department of Transportation approved, container. Solid waste generated during the upgrade and modification projects will be collected, stored, and disposed of per BFN site procedures. Retired equipment may be retained for spare inventory or scrapped/recycled. The upgrade and modification projects at BFN will not release, or otherwise use substances on the publicly available Toxic Release Inventory (TRI) list. Components and materials removed from the BFN Radiologically Controlled Area (RCA) will be surveyed prior to removal. If radioactive

contamination is found, the material will require disposal as low level radioactive waste. These upgrades and modifications will not introduce new or different radiological release pathways and will not alter the onsite or offsite dose rates. Therefore, these upgrades and modifications will not alter the BFN radiological hazard to human health.

The capacitor bank installation projects will occur outdoors at ~~five~~ four substations remote to BFN. Standard TVA BMPs and proper containment, treatment, and disposal of wastewaters, storm-water runoff, wastes and potential pollutants will be implemented to control potential surface water impacts. The capacitor bank projects will not produce point source or non-point source wastewater discharge. Soil erosion impacts will be small with implementation of standard TVA BMPs. A state construction storm-water permit will be required for disturbance at the Holly Springs and Corinth substations. ~~At the Wilson Substation, a state construction general storm-water permit and a Wilson County Land Disturbance permit (Municipal Separate Storm Sewer, or MS4) will be required. In addition, an Aquatic Resource Alteration Permit (ARAP) is required at the Wilson Substation (i.e., in Tennessee) if waters of the state will be impacted.~~ Any fill material for the substation expansions would be obtained from an approved borrow pit. Any spoil accumulated from grading, trenching, or digging for new foundations would be placed in a permitted spoil area on the substation property, or spread back onsite. The disturbed areas would be re-graveled and/or re-surfaced. If any spoil is taken off site, it would be tested and disposed. Any solid waste generated at the substations will be scrapped/recycled when feasible. These capacitor bank installations will not generate or release radioactive contamination, hazardous waste, universal or special waste, or used oil. Substations are not radiologically controlled and do not represent a radiological hazard to human health. Capacitor bank installations will not generate or release toxic substances. No materials involved in these upgrade and modification projects will require special handling. Capacitor bank installation involves new equipment. No existing equipment that could contain PCBs, solvents, asbestos, sandblasting material, mercury, lead, or paints will be disturbed. Capacitor bank installation will not release, or otherwise use substances on the TRI list.

7.1.8 Geological Environment

The BFN area is underlain by flat-lying, under-formed limestone of the Mississippian age. The site lies on the southeastern flank of the Nashville structural dome where it merges into the foreland slope of the Appalachian geosyncline. The seismic hazard is small at BFN in comparison to most other areas in the United States. No active faults showing recent surface displacement are known within a 200-mile radius of the site. The breaker failure relay upgrades and the BFN main generator exciter ~~upgrades~~ modifications occur within existing BFN structures and are bounded by existing geologic and seismic analysis.

The Clayton Village project area is located in the East Gulf Coast Section of the Coastal Plain Physiographic Province and is underlain by Upper Cretaceous age sediments. Available mapping indicates the site is underlain by the Selma Group and locally by the Prairie Bluff chalk formation. The New Madrid seismic area of west Tennessee, the highest risk seismic zone in the region, is located approximately 250 miles north-northwest of the Clayton Village project site. According to the 2014 Seismic Probabilistic Hazard Map published by United States

Geologic Survey (USGS), the project area is located in a risk zone with a hazard rating of 2 percent probability of 0.1 – 0.14 g peak acceleration in 50 years. While there is a very slight carbonate component to the chalky bedrock underlying the project area, the site poses a very small risk for the development of karstic features. There are no known rare or unique geologic resources located on or adjacent to the subject property.

The Corinth project area is located in the East Gulf Coast Section of the Coastal Plain Physiographic Province and is underlain by Upper Cretaceous age sediments. Available mapping indicates the site is underlain by units of the Selma Group and locally by the Demopolis chalk. The New Madrid seismic area of west Tennessee is located approximately 150 miles northwest of the Corinth project site and is the highest risk seismic zone in the region. According to the 2014 Seismic Probabilistic Hazard Map published by USGS, the project area is located in a risk zone with a hazard rating of 2 percent probability of 0.2 – 0.3 g peak acceleration in 50 years. While there is a carbonate component to the chalky bedrock underlying the project area, the site poses a very small risk for the development of karstic features. There are no known rare or unique geologic resources located on or adjacent to the subject property.

The Holly Springs project area is located in the East Gulf Coast Section of the Coastal Plain Physiographic Province and is underlain by Tertiary age sediments. Available mapping indicates the site is underlain by the Wilcox Group and locally by the Hatchetigbee Formation. The New Madrid seismic area of west Tennessee, the highest risk seismic zone in the region, is located approximately 150 miles north-northwest of the Holly Springs project site. According to the 2014 Seismic Probabilistic Hazard Map published by USGS, the project area is located in a risk zone with a hazard rating of 2 percent probability of 0.2 – 0.3 g peak acceleration in 50~~-~~ years. While there is a slight carbonate component to the sandy bedrock underlying the project area, the site poses a very small risk for the development of karstic features. There are no known rare or unique geologic resources located on or adjacent to the subject property.

~~The Wilson project area is located in the Central Basin Physiographic Province and is underlain by rock units of the Ordovician age Lebanon Limestone. The project site lies on the flank of the Nashville structural dome which controls the regional geologic structure. The New Madrid seismic area of west Tennessee is approximately 240 miles west of the Wilson Substation site and would be considered the highest risk seismic zone in the region. According to the 2014 Seismic Probabilistic Hazard Map published by USGS, the project area is located in the lowest risk zone in the State of Tennessee with a hazard rating of 2 percent probability of 0.1 - 0.14 g peak acceleration in 50 years. The carbonate bedrock underlying the project area does pose a risk for the development of karstic features such as sinkholes and caves at the site. These factors should be considered during site development.~~

The East Point project area is located in the Appalachia Plateau (Cumberland Plateau) Physiographic Province and is underlain by upper members of the Pottsville Formation which is comprised of relatively flat lying interbedded dark gray shale, siltstone, medium gray sandstone, conglomeratic sandstone and bituminous coal in cyclic sequences. The New Madrid seismic

area of west Tennessee, the highest risk seismic zone in the region, is located approximately 250 miles northwest of the project site. The site is also located approximately 175 miles southwest of the East Tennessee Seismic Zone. According to the 2014 Seismic Probabilistic Hazard Map published by USGS, the project area is located in a risk zone with a hazard rating of 2 percent probability of 0.1 – 0.14 g peak acceleration in 50 years. The bedrock underlying the project site is siliceous in nature and lacks a carbonate component. The site poses a very small risk for the development of karstic features. There are no known rare or unique geologic resources located on or adjacent to the subject property.

7.2 Hydrology and Aquatic Ecology Effects

7.2.1 Aquatic Resources-Rivers, Streams, and Reservoirs

The breaker failure relay upgrades and the BFN main generator exciter ~~upgrades~~ modifications occur within existing BFN structures and will not adversely affect wild and scenic rivers or their tributaries. The work has no potential to affect a stream on the National River Inventory list or impact the 100 year flood plain. The work has no potential to affect water flow, stream banks, or stream channels. These upgrade and modification projects will not affect operation of the Tennessee River or require special water elevations or flow conditions, involve water withdrawal from the Tennessee River, and will not affect any unique or important aquatic habitat.

The capacitor bank installations will take place at locations distant to BFN. Two of the capacitor bank installation sites will be within existing substation boundaries. All work at these two sites will occur on previously disturbed land and therefore have no potential to affect wild and scenic rivers or their tributaries, or a stream on the National River Inventory list. Activities at these two sites will not impact the 100 year and 500 year flood plains and have no potential to affect water flow, stream banks, or stream channels. ~~Three~~ Two of the ~~five~~ four sites (Holly Springs~~,~~ and Corinth,~~ and Wilson~~ substations) will require expansion (small amount of land) of the existing substation footprint. There are no wild or scenic rivers/tributaries or streams on the National River Inventory list at or adjacent to these substations and therefore the proposed actions will not affect these types of waterways. The proposed projects at Holly Springs and Corinth substations will not involve construction within the 100 year flood plain. ~~A small area within the proposed expanded footprint of the Wilson substation lies within the 100 year flood plain. No construction activities will occur in this area.~~ A review of the ~~Wilson and~~ Holly Springs substation~~s~~ identified no intermittent or perennial streams and one wet weather conveyance (ephemeral stream) in the project area. A review of the Corinth substation identified no watercourses that could be affected. Ground disturbance will be minimized and all work done in accordance with applicable TVA BMPs and specifications. With proper implementation of specifications and BMPs, minimal impacts to water flow, stream channels, or stream banks would occur. No federally designated critical habitat occurs within the potentially affected ~~Cumberland River watershed, the~~ Bridge Creek-Tuscumbia River Canal watershed, or the Big Spring Creek-Little Tallahatchie River and Byhalia Creek Canal-Pigeon Roost Creek watersheds. Therefore, no impacts to unique or important aquatic habitats would occur. For all ~~five~~ four substations, capacitor bank installation will not require water withdrawal from any river or reservoir.

7.2.2 Groundwater

The breaker failure relay upgrades and the BFN main generator exciter ~~upgrades~~ modifications occur within existing BFN structures and will not affect groundwater resources.

All construction activities at the Clayton Village and East-Point substations occur on previously disturbed TVA property and will not affect groundwater resources.

The Holly Springs and Corinth project areas are located in the East Gulf Coast Section of the Coastal Plain Physiographic Province and are underlain by Cretaceous age sediments. The Southeastern Coastal Plain aquifer system is the principal aquifer in the proposed project areas and is predominantly comprised of interbedded sand and gravel, deltaic sand, silt, and clay. These rock units are not prone to solution weathering; therefore, the development of karstic features is not anticipated. Project activity could cause soil erosion resulting in the movement of sediment into groundwater infiltration zones. Spills or leaks by construction equipment is possible and could impact groundwater. Standard construction TVA BMPs will be implemented to avoid contamination of groundwater by surface activity in the project area. Potential impacts to groundwater as a result of this project will be small.

~~The Wilson substation project area is underlain by Ordovician Age rocks of the Central Basin Physiographic Province. These rock units may contain karstic features such as sinkholes, springs, and caves. Public water is available for residents in the project area but private water wells and springs may exist near the project site. Project activity could potentially cause erosion resulting in the movement of sediment into groundwater infiltration zones. Standard construction TVA BMPs will be implemented to avoid contamination of groundwater by surface activity in the project area. Potential impacts to groundwater as a result of this project would be small.~~

7.2.3 Surface Water

The breaker failure relay upgrades and the BFN main generator exciter ~~upgrades~~ modifications occur within existing BFN structures and will not affect surface water resources.

The Corinth substation project potentially affects the Bridge Creek-Tuscumbia River Canal watershed. According to a table top review by TVA Aquatics and Surface Water staff, no streams are located within the proposed project footprint. Bridge Creek which is a tributary of the Tuscumbia River Canal, an unnamed tributary of Bridge Creek, Railroad Branch, and Elam Creek are located in the vicinity of the project, but not within the project footprint. The Tuscumbia River Canal is listed on Mississippi's list for impaired waters, as required by the US Clean Water Act, section 303(d), due to pH issues. A total maximum daily load (TMDL) has been completed for the Tuscumbia River Canal. The primary designation for the streams listed in this project vicinity is for fish and wildlife use. With proper implementation of standard TVA BMPs and proper containment/treatment/disposal of wastewaters, storm-water runoff, wastes, and potential pollutants, surface water impact would be small.

The Holly Springs substation project potentially affects the Big Spring Creek-Little Tallahatchie River and Byhalia Creek Canal-Pigeon Roost Creek watersheds. According to a desktop review by TVA Aquatics and Surface Water staff, no perennial streams and one ephemeral stream (wet

weather conveyance) were located within the proposed project footprint. Big Spring Creek which is a tributary of the Cold Water River, an unnamed tributary of Big Spring Creek, and Nunnally Creek are located in the vicinity of the project, but not within the project footprint. None of the streams are listed as impaired on Mississippi's 303(d) list. The primary designation for the streams listed in this project vicinity is for fish and wildlife use. With proper implementation of standard TVA BMPs and proper containment/treatment/disposal of wastewaters, storm-water runoff, wastes, and potential pollutants, surface water impact would be small.

At the Clayton Village~~, Wilson,~~ and East Point Substations, with proper implementation of standard TVA BMPs and proper containment/treatment/disposal of wastewaters, storm-water runoff, wastes and potential pollutants, surface water impact would be small.

7.2.4 Drinking Water

The breaker failure relay upgrades and the BFN main generator exciter ~~upgrades~~ modifications occur within existing BFN structures and are therefore will not affect drinking water resources.

Installation of the capacitor banks at all ~~five~~ four locations will not require water withdrawal and thus will not affect drinking water supply.

7.3 Endangered, Threatened, or Special Status Species

The breaker failure relay upgrades and the BFN main generator exciter ~~upgrades~~ modifications occur within existing BFN structures and will not affect endangered, threatened, or special status species.

Work at the Clayton Village and East-Point substations occurs on previously disturbed TVA property and inside existing fences and will not affect endangered, threatened, or special status species.

7.3.1 Aquatic

Holly Springs: A query of the TVA Regional Natural Heritage database on April 11, 2016, for records of listed aquatic animal species indicated no federally protected species are present within the potentially affected Big Spring Creek-Little Tallahatchie River and Byhalia Creek Canal-Pigeon Roost Creek watersheds. There are three state-listed fish (spotfin shiner, steelcolor shiner, and yazoo darter) present within the potentially affected Big Spring Creek-Little Tallahatchie River and Byhalia Creek Canal-Pigeon Roost Creek watersheds. An April 2016 desktop review of the proposed project identified no intermittent or perennial streams and one wet weather conveyance (ephemeral stream). Therefore, no impacts to these aquatic endangered or special status species could occur.

~~Wilson: A query of the TVA Regional Natural Heritage database April 12, 2016, for records of listed aquatic animal species indicated no federally protected species are present in this locality. There are three state-listed fish (blackfin sucker, slenderhead darter, and lake sturgeon) within the potentially affected Cumberland River watershed. An April 2016 desktop review of the proposed project identified no intermittent or perennial streams and one wet weather~~

~~conveyance (ephemeral stream). Therefore, no impacts to these state-listed species could occur.~~

Corinth: A query of the TVA Regional Natural Heritage database April 12, 2016, for records of listed aquatic animal species indicated two state-listed species (northern madtom and suckermouth minnow) are present within the potentially affected Bridge Creek-Tuscumbia River Canal watershed encompassing the proposed project area. An April 2016 desktop review documented no streams within the proposed project footprint. Ground disturbance activities associated with construction work could result in increased suspended solids entering nearby watercourses from surface water runoff. In order to eliminate potential impacts to sensitive aquatic life outside the project footprint, ground disturbance will be minimized, and all work will be conducted according to applicable TVA BMPs, with emphasis on preventing waste materials associated with construction from entering adjacent watercourses. These BMPs are designed in part to minimize erosion and subsequent sedimentation in streams. Therefore, with proper implementation of TVA BMPs, no impacts to these state-listed species could occur as a result of the proposed project.

7.3.2 Terrestrial -Botany

Holly Springs: A query of the TVA Natural Heritage Database March 31, 2016, indicated that no federally listed and one state-listed plant species, Lovage (Lisgusticum canadense), are known from within five miles of the proposed project. No federally listed plant species are known from Marshall County, Mississippi, where the project would be located. Desktop evaluation of the project area, including a review of TVA's Regional Natural Heritage database, on-site photos, and topographic maps, indicates that no habitat capable of supporting state or federal listed plant species occurs in the project area. The proposed action would not affect federal or state-listed plant species.

~~Wilson: A query of the TVA Natural Heritage Database March 31, 2016, indicated that no federally listed and two state-listed plant species are known from within five miles of the proposed project. Three federally listed plant species are known from Wilson County, Tennessee, where the project would be located. Desktop evaluation of the project area, including a review of TVA's Natural Heritage database, on-site photos, and topographic maps, indicates that no habitat capable of supporting state or federal listed plant species occurs in the project area. The proposed action would not affect federal or state-listed plant species.~~

Corinth: A query of the TVA Natural Heritage Database March 31, 2016, indicated that no federally listed and no state-listed plant species are known from within five miles of the proposed project. One proposed threatened federally listed plant species, White Fringeless Orchid (Platanthera integrilabia), is known from Alcorn County, Mississippi, where the project would be located. Desktop evaluation of the project area, including a review of TVA's Natural Heritage database, on-site photos, and topographic maps, indicates that no habitat capable of supporting state or federal listed plant species occurs in the project area. The proposed action would not affect federal or state-listed plant species.

7.3.3 Terrestrial - Zoology

Holly Springs: A query of the TVA Natural Heritage database on April 15, 2016, indicated one federally listed species (American burying beetle) and no state-listed terrestrial animal records within three miles of the project area. No additional federally listed terrestrial animal species are known from Marshall County, Mississippi. The US Fish and Wildlife Service (USFWS) has determined that the federally listed Indiana bat, northern long-eared bat, and wood stork have the potential to occur in Marshall County. Although no records of these species are known from Marshall County, habitat suitability and potential impacts to these species are addressed below.

American burying beetles are scavengers, feeding on carrion. They can occur in a wide variety of vegetative habitats, where populations still exist. This species is thought to be extirpated from the state of Mississippi. One record of this species occurs approximately 0.6 miles from the project footprint. However, this record is likely historical since this species is only known to have extant populations in two northeastern US states and six mid-western states. The proposed actions would not affect American burying beetle.

Wood storks are wading birds known to inhabit freshwater wetlands as well as brackish wetlands in natural and man-made impoundments adjacent to streams and shallow lakes. They nest in large rookeries in the canopies of trees such as cypress, in mangroves, or in snags. No records of wood storks are known from Marshall County. No habitat for wood stork occurs within the project area. Wood storks would not be impacted by the proposed actions.

Indiana bats inhabit caves during winter and migrate to roost under exfoliating bark and within cavities of trees (typically greater than or equal to 5 inches in diameter) during summer. Foraging occurs along riparian areas and along the tops of trees, forested edges, and tree lines. Some habitat requirements overlap between the Indiana bat and the northern long-eared bat ~~(NLEB)~~, which roosts in caves or cave-like structures in winter, and utilizes cave-like structures as well as live and dead trees with exfoliating bark and crevices in the summer. There are no known records of either bat species from Marshall County, Mississippi. Per communication with the US Fish and Wildlife Service, Mississippi Field Office, impacts to Indiana bats and northern long-eared bats~~NLEBs~~ should be reviewed in the northern counties of the state, therefore it must be assumed that these species have the potential to occur in the project area. There are no documented caves within three miles of the project area. Field reviews on April 12, 2016 determined that no caves, other potential winter roosting structures, or summer roosting structures/trees occur within the project footprint. Foraging habitat for the Indiana bat and the northern long-eared bat~~NLEB~~ exists over one ephemeral stream within the project footprint. TVA BMPs would be used around this ephemeral stream, thereby minimizing impacts to this small amount of seasonal foraging habitat. Indiana bats and northern long-eared bats would not be impacted by the proposed actions.

~~Wilson: A query of the TVA Natural Heritage Database on April 15, 2016, indicated no state or federally listed species within three miles of the project footprint. Three federally listed species (gray bat, Indiana bat, and northern long-eared bat) have been documented in Wilson County, Tennessee.~~

~~Gray bats are associated with caves year-round, roosting in different caves throughout the year. Bats disperse from colonies at dusk to forage along waterways. The nearest gray bat record is from a cave approximately 7.8 miles away from the project footprint. No caves have been reported within 3 miles of the project footprint, and no caves were observed within the project footprint during field review on April 3, 2016. The proposed actions would not impact any known cave habitat. Suitable foraging habitat does exist over one ephemeral stream within the project footprint. TVA BMPs will be used around this ephemeral stream to ensure there are no impacts to hydrology and water quality and that this foraging habitat is still available to gray bat. With the implementation of TVA BMPs during proposed project activities, gray bats would not be impacted by the proposed actions.~~

~~The closest records of the Indiana bat are summer maternity roosts approximately 14.6 miles from the project footprint. The closest records of NLEBs in Wilson County are also summer maternity roosts approximately 21.85 miles from the project footprint. Closer summer survey records of NLEB do exist from Rutherford County approximately 14.3 miles away. No caves have been reported within 3 miles of the project footprint, and no caves or other winter roosting habitat were observed within the project footprint during field reviews on April 3, 2016. The proposed actions would not impact any known winter roosting habitat. Suitable foraging habitat does exist over an ephemeral stream and forested tree lines within the project footprint. TVA BMPs will be used around this ephemeral stream to ensure there are no impacts to hydrology and that these foraging habitats are still available to foraging bats. Similarly suitable forested tree lines are available in the surrounding area. Removal of this small amount of foraging habitat would have no measurable effect on foraging bats. No suitable summer roosting habitat for either species was observed within the project footprint. The proposed actions would not impact the Indiana bat or the northern long-eared bat.~~

Corinth: A query of the TVA Natural Heritage Database on April 15, 2016, indicated one state-listed species (red salamander) and no federally listed terrestrial animal records within three miles of the project area. No federally listed terrestrial animal species are known from Alcorn County, Mississippi. The USFWS has determined that the federally listed Mitchell's satyr butterfly, Indiana bat, northern long-eared bat, and wood stork have the potential to occur in Alcorn County. Although no records of these species are known from Alcorn County, habitat suitability and potential impacts to these species are addressed below.

Red salamanders are found in forested wetlands and riparian areas along cold, clear, rocky streams and springs. The closest record of this species is a historical record approximately 2.1 miles from the project footprint. Suitable habitat for red salamander does not occur within the project area. Red salamander would not be impacted by the proposed actions.

Mitchell's satyr butterfly is one of the most geographically restricted eastern butterflies. It occurs in wetlands where low nutrient systems receive carbonate-rich ground water from seeps and springs. In Mississippi, Mitchell's satyr has been found in small upland wetlands created by beaver dams and in wetlands formed by road culverts. No records of this species are known from Alcorn County. Suitable habitat for Mitchell's satyr does not exist within the project footprint. Proposed actions are not likely to affect Mitchell's satyr.

No records of wood storks are known from Alcorn County. No habitat for wood stork occurs within the project area. Wood storks would not be impacted by the proposed actions.

There are no known records of the Indiana bat or ~~NLEB~~ northern long eared bat species from Alcorn County, Mississippi. Per communication with the US Fish and Wildlife Service-Mississippi Field Office, impacts to Indiana bats and ~~NLEBs~~ northern long eared bats should be reviewed in the northern counties of the state; therefore, it must be assumed that these species have the potential to occur in the project area. There are no documented caves within three miles of the project area. Field review on April 12, 2016, determined that no caves or other potential winter roosting structures occur within the project footprint. The only tree with exfoliating bark documented in the project area is a sycamore tree. Live, healthy, sycamores are not thought to be used for roosting by the Indiana bat or the ~~NLEB~~ northern long eared bat due to the thin bark and small size of bark flakes. Therefore, no suitable summer roosting habitat occurs in the project footprint or would be impacted by the proposed actions. Foraging habitat for the Indiana bat and the ~~NLEB~~ northern long eared bat exists over two forested areas within the project footprint (totaling less than 1 acre). Removal of this small amount of foraging habitat would have no measurable effect on foraging bats. Indiana bats and ~~NLEBs~~ northern long eared bats would not be impacted by the proposed actions.

7.4 Compliance, Permits, and Reporting

BFN Site: Chemicals used during performance of work on the BFN site (oils, solvents) will be approved by the CTC Site Coordinator prior to use. Only quantities required to complete the work will be brought on site. The safety data sheets (SDSs) for all products brought on BFN site are provided to, and approved by, the BFN site environmental contact prior to being brought on site. Work performed at BFN will not require modification to existing environmental permits or to existing equipment with an environmental permit. Installation of new equipment will not require new environmental permits. Equipment installed will be contained within existing BFN structures and would therefore not require Federal Aviation Administration (FAA) notification for structures greater than 200 feet.

Substations: The SDSs for all products are provided to, and approved by, the TVA environmental support personnel prior to chemicals being brought on site. The *Spill Prevention Control and Countermeasures Plan* for each substation will be revised as needed, to reflect the equipment changes at the substations. Installation of new equipment will not require new environmental permits. Equipment installed will be similar to existing equipment at the substation and would therefore not require FAA notification for structures greater than 200 feet.

8.0 Results and Conclusion Summary

TVA performed an Interconnection SIS for the EPU of all three BFN units. Revision 3 of the~~The~~ Interconnection SIS documents transmission ~~stability~~ system upgrades required for the TVA transmission system in order to support the BFN EPU. Specifically, revision 3 of the~~the~~ Interconnection SIS identified replacing six 500 kV breaker failure relays, installing a minimum of 764 MVAR ~~capacitor banks~~reactive compensation in five locations throughout the TVA

transmission system, and ~~upgrading~~ modifying all three BFN main generator excitation systems. As a federal agency subject to the requirements of NEPA, TVA evaluates the effects on the environment of these proposed upgrades. The non-radiological environmental impacts for the transmission ~~stability~~ system upgrades has been reviewed and assessed. This review did not identify moderate or large environmental impacts from installation of the proposed upgrades. TVA anticipates that installation of the proposed upgrades will not affect human health or significantly impact the environment.

9.0 Best Management Practices, and Environmental Quality Protection Specifications

TVA's BMPs, in conjunction with specifications, are used to manage the environmental impact from construction activities. Each project/site is individually evaluated environmentally. Specific environmental protection BMPs and environmental quality specifications for each project are identified as applicable in the environmental review package for each project. TVA environmental quality specifications and BMPs are effective methods for ensuring that TVA's construction activities contribute to a high standard of water quality throughout the Tennessee River Watershed and the TVA Power Service Area. The TVA BMPs are chosen to minimize erosion or control sedimentation and other pollutants from land disturbances and land management activities. When properly applied, TVA BMPs help protect the quality of surface waters and ground waters.

TVA and/or the assigned contractor and subcontractors plan, coordinate, and conduct transmission construction activities in a manner that protects the quality of the environment and complies with TVA's environmental expectations. TVA environmental quality specifications contains provisions that are considered in all TVA and contract construction, clearing, and grading activities at these sites. At all site perimeters, structure, foundation, conduit, grounding, fence, drainage ways, etc., appropriate protective measures to prevent erosion or release of contaminants are taken. Those protective measures are inspected and maintained throughout construction. Additional TVA specifications are used for projects requiring clearing and/or grading.

Table RERP-RAI-GE-2-1, TVA Specifications for Transmission Substation Construction and/or Site Clearing and Grading, summarizes the TVA specifications to be used for construction, clearing, and grading activities at the substations. Table RERP-RAI-GE-2-2, TVA Best Management Practices, summarizes the TVA BMPs used for construction activities at the substations. Breaker failure relay upgrades and BFN main generator excitation system ~~upgrades~~ modifications occur within existing BFN structures.

Table RERP-RAI-GE-2-1
TVA Specifications for Transmission Substation Construction and/or Site Clearing and Grading

Specifications	Substation Applicability	Description
Regulations	All ~~Five~~ Four Substations	Compliance with all applicable federal, state, and local environmental and antipollution laws, regulations, and ordinances related to environmental protection and prevention, control, and abatement of all forms of pollution.
	~~Holly Springs, Corinth, and~~Holly Springs and Corinth ~~Wilson~~	All applicable federal, state, and local environmental and antipollution laws, regulations, and ordinances are complied with, including without limitation, all air, water, solid and hazardous waste, noise, and nuisance laws, regulations, and ordinances.
Land and Landscape Preservation	All ~~Five~~ Four Substations	Care is exercised to preserve the natural landscape in the entire construction area as well as use areas, in or outside of the ROW, and on or adjacent to access roads.
	~~Holly Springs, Corinth, and~~Holly Springs and Corinth ~~Wilson~~	TVA or contract personnel exercises care to preserve the condition of cleared soils by avoiding as much compacting and deep scarring as possible in areas not to be developed for buildings, structures, or foundations. As soon as possible after initial disturbance of the soil and in accordance with any permit(s) or other state or local environmental regulatory requirements, cover material is placed to prevent erosion and sedimentation of water bodies or conveyances to surface water or groundwater.
Sensitive Area Preservation	All ~~Five~~ Four Substations	Certain areas along the access and/or the ROW may be designated by the specifications as environmentally sensitive. These areas include, but are not limited to, areas classified as erodible, geologically sensitive, scenic, historical and archeological, fish and wildlife refuges, endangered species habitat, water supply watersheds, and public recreational areas. Crews take all necessary actions to avoid adverse impacts to these sensitive areas and their adjacent buffer zones.

Table RERP-RAI-GE-2-1
TVA Specifications for Transmission Substation Construction and/or Site Clearing and Grading

	~~Holly Springs, Corinth, and~~Holly Springs and Corinth ~~Wilson~~	If prehistoric or historic artifacts or features that might be of archaeological or historical significance are discovered during clearing, grading, borrow, or fill operations, the activity immediately ceases within a 100-foot radius, and a TVA project manager, an environmental specialist, and the TVA Cultural Resources program manager is notified. The site is protected and left as found until a determination about the resources, their significance, and site treatment is made by TVA's Cultural Resources Program.
Water Quality Control	All ~~Five~~ Four Substations	Activities are performed by methods that prevent entrance or accidental spillage of solid matter, contaminants, debris, and other objectionable pollutants and wastes into flowing caves, sinkholes, streams, dry watercourses, lakes, ponds, and underground water sources. Erected erosion and/or sedimentation controls are maintained.
	~~Holly Springs, Corinth, and~~Holly Springs and Corinth ~~Wilson~~	Clearing, grading, borrow and fill, and/or disposal activities are performed using BMPs that will prevent erosion and entrance of spillage, contaminants, debris, and other pollutants or objectionable materials into drainage-ways, surface waters, or groundwater. Special care is exercised in refueling equipment to prevent spills. Fueling areas are remote from any sinkhole, crevice, stream, or other water body. BMPs, such as silt fences, on steep slopes and adjacent to any steam, wetland, or other water body. BMPs are inspected by the TVA field engineer or other designated personnel routinely and at least as frequently as required by the permit or good management practices and during periods of high runoff; any necessary repairs are made as soon as practicable.
Turbidity and Blocking of Streams	~~All Five Substations~~All Four Substations	Activities in or near streamside management zones or other bodies of water are controlled to prevent the water turbidity from exceeding state or local water quality standards for that stream. All conditions of a general storm water permit, aquatic resource alteration permit, or site specific permit are met.

Table RERP-RAI-GE-2-1
TVA Specifications for Transmission Substation Construction and/or Site Clearing and Grading

	~~Holly Springs, Corinth, and~~Holly Springs and Corinth~~ Wilson~~	If temporary clearing, grading, borrow, or fill activities must interrupt natural drainage, appropriate drainage facilities and erosion/sediment controls are provided to avoid erosion and siltation of streams and other water bodies or water conveyances. Turbidity levels in receiving waters or at storm water discharge points are monitored, documented, and reported if required by the applicable permit. Erosion and sediment control measures such as silt fences, water bars, and sediment traps are installed as soon as practicable after initial access, site, borrow, fill, or right-of-way disturbance and after sequential disturbance of stabilized areas due to stepwise construction requirement in accordance with applicable permit or regulatory requirements.
Streamside Management Zones (SMZs)	~~Holly Springs, Corinth, and~~Holly Springs and Corinth~~ Wilson~~	Clearing and/or grading activity leaves as many rooted ground cover plants as possible in buffer zones along streams and other bodies of water or wet-weather conveyances thereto. Cutting of trees within SMZs is accomplished by using either hand-held equipment or other appropriate clearing equipment (e.g., a feller-buncher) that would result in minimal soil disturbance and damage to low-lying vegetation. Only approved herbicides are used, and herbicide application is conducted by certified applicators from the Transmission Operations and Maintenance (TOM) organization after initial clearing and construction. Disturbed soils in SMZs are stabilized by appropriate methods immediately after the access or site is cleared. Stabilization occurs within the time frame specified in applicable storm water permits or regulations.

Table RERP-RAI-GE-2-1
TVA Specifications for Transmission Substation Construction and/or Site Clearing and Grading

Wetlands	~~Holly Springs, Corinth, and~~Holly Springs and Corinth ~~Wilson~~	In forested wetlands, tall trees are cut near the ground, leaving stumps and roots in place. Cutting of trees within wetlands is accomplished by using either hand-held equipment or other appropriate clearing equipment (e.g., a feller-buncher) that would result in minimal soil disturbance and damage to low-lying vegetation. The cambium may be treated with herbicides applied by certified applicators from the TOM organization to prevent regrowth. Understory trees that must be initially cut and removed may be allowed to grow back or may be treated with tree growth regulators selectively to slow growth and increase the reclearing cycle. The decision is situationally made based on existing ground cover, wetland type, and tree species, since tall tree removal may “release” understory species and allow them to quickly grow to “electrical clearance problem” heights. In many circumstances, herbicides labeled for water and wetland use may be used in reclearing.
Floodplain Evaluation	~~All Five Substations~~All Four Substations	During the planning and design phase, floodplain information is obtained to avoid locating flood damageable facilities in the 100 year floodplain. If the preferred site is located within a floodplain area, alternative sites are evaluated and documentation prepared to support a determination of “no practicable alternative.” Steps taken to minimize adverse impacts are documented.
Clearing	~~All Five Substations~~All Four Substations	No activities may clear additional site or ROW vegetation or disturb remaining vegetation, stumps, or regrowth at locations other than the substation or access thereto. Appropriate erosion or sediment controls for areas disturbed are established as soon as practicable after disturbance.
Brush and Timber Disposal	~~Holly Springs, Corinth, and~~Holly Springs and Corinth ~~Wilson~~	For initial clearing, trees are commonly part of the contractor’s contract to remove as they wish. Trees may be removed from the site for lumber or pulpwood, or they may be chipped or stacked and burned. All such activities are coordinated with the TVA field engineer and the open burning permits; notifications and regulatory requirements are met. On ROW, trees may be cut and left in place only in areas specified by TVA and approved by appropriate regulatory agencies. These areas may include sensitive wetlands or SMZs where tree removal would cause excessive ground disturbance or in very rugged terrain where windrowed trees are used as sediment barriers along the edge of the right-of-way, site, or access.

Table RERP-RAI-GE-2-1
TVA Specifications for Transmission Substation Construction and/or Site Clearing and Grading

Air Quality Control	~~All Five Substations~~All Four Substations	Crews take appropriate actions to minimize the amount of air pollution created by construction activities.
	~~Holly Springs, Corinth, and~~Holly Springs and Corinth ~~Wilson~~	Appropriate actions are taken to limit the amount of air emissions created by clearing and disposal operations to be well within the limits of clearing or burning permits and/or forestry or local fire department requirements. All operations are conducted in a manner that prevents nuisance conditions or damage to adjacent land, crops, dwellings, highways, or people.
Dust and Mud Control	~~All Five Substations~~All Four Substations	Activities are conducted to minimize the creation of dust. This may require limitations as to types of equipment, allowable speeds, and routes utilized. Water, straw, wood chips, dust palliative, gravel, combinations of these, or similar controls may be used subject to TVA approval.
	~~Holly Springs, Corinth, and~~Holly Springs and Corinth ~~Wilson~~	Clearing, grading, borrow, fill, or transport activities are conducted in a manner that minimizes the creation of fugitive dust. This may require limitations as to type of equipment, allowable speeds, and routes utilized. Control measures such as water, gravel, etc., or similar measures may be used subject to TVA approval.
Sanitation	~~All Five Substations~~All Four Substations	Sanitary chemical toilets convenient to all principal points of operation are provided for every working party and at each construction step. The facilities comply with applicable federal, state, or local health laws and regulations.
	~~Holly Springs, Corinth, and~~Holly Springs and Corinth ~~Wilson~~	Sanitation facilities are not located closer than 100 feet to any stream or tributary or to any wetland.
Use Areas	~~All Five Substations~~All Four Substations	Use areas include but are not limited to site office, shop, maintenance, parking, storage, staging, assembly areas, utility services, and access roads to the use areas.
Damage Prevention	~~All Five Substations~~All Four Substations	Movement of construction equipment is conducted in a manner that causes as little intrusion and damage as possible to property features and vegetation.

Table RERP-RAI-GE-2-1
TVA Specifications for Transmission Substation Construction and/or Site Clearing and Grading

Equipment	~~All Five Substations~~All Four Substations	All major equipment and proposed methods of operation are subject to the approval of TVA. The use or operation of heavy equipment in areas outside the right-of-way (ROW), access routes, or site will not be permitted without permission from the TVA inspector or field engineer. Steps are taken to limit ground disturbance caused by heavy equipment.
Refuse Disposal	~~All Five Substations~~All Four Substations	Designated personnel are responsible for daily inspection, cleanup, proper labeling, storage, and disposal of all refuse and debris.
Vehicle Exhaust	~~All Five Substations~~All Four Substations	Crews maintain and operate equipment to limit vehicle exhaust emissions.
Vehicle Servicing	~~All Five Substations~~All Four Substations	Routine maintenance of personal vehicles is not performed on the ROW or access route to the site. Heavy equipment is not serviced on site except adjacent to or in designated areas. TVA properly maintains these vehicles with approved spill protection controls and countermeasures.
Smoke and Odors	~~All Five Substations~~All Four Substations	Combustible and volatile materials that could create objectionable smoke, odor, or fumes are properly stored and handled. Personnel do not burn oil or refuse that includes trash, rags, tires, plastics, or other manufactured debris.
Noise Control	~~All Five Substations~~All Four Substations	Measures are taken to avoid the creation of noise levels that are considered nuisances, safety, or health hazards for employees, the public, or the site and adjacent property owners. Critical areas including, but not limited to, residential areas, parks, public use areas, and some ranching areas require special considerations. Concentration of individual noisy pieces as well as the hours and locations of operation are considered.
Noise Suppression	~~All Five Substations~~All Four Substations	All internal combustion engines are properly equipped with mufflers. The equipment and mufflers are maintained at peak operating efficiency. Air compressors and other noisy equipment may require sound reducing enclosures.
Burning	~~All Five Substations~~All Four Substations	Permits are obtained and notification provided as required to state forestry offices and/or local fire departments. Burning complies with requirements of state and local air pollution control and is only allowed in approved locations and during appropriate hours and weather conditions.

Table RERP-RAI-GE-2-1
TVA Specifications for Transmission Substation Construction and/or Site Clearing and Grading

Site Restoration	~~All Five Substations~~All Four Substations	Disturbed areas are stabilized in the following manner unless another method is previously specified. • Subsoil is loosened to minimum depth of six inches and worked to remove unnatural ridges/depressions. • Appropriate soil amendments are added as needed. • Disturbed areas are initially seeded with temporary ground cover. Final restoration and final seeding is performed when construction is completed. • TVA holds the option, depending on time of year and weather conditions, to delay or withdraw the requirement of seeding until more favorable planting conditions are certain. • The site is protected from species designated by the Federal Invasive Species Council and equipment being transported from location to location is inspected to ensure removal and destruction of live material.
Final Site Cleanup and Inspection	~~All Five Substations~~All Four Substations	All construction related debris, products, materials, and wastes are properly handled, labeled as required, and removed from the site. Upon completion, the designated TVA person walks down the site and completes an approval inspection.

Table RERP-RAI-GE-2-2
TVA Best Management Practices

BMP	Substation Applicability	Description
Sediment and Erosion Control	~~All Five Substations~~All Four Substations	a. Limit the amount of vegetation disturbed and the exposure of soil to erosive elements. b. Plan clearing, grading and construction to minimize the area and duration of soil exposure. c. Minimize disturbance of natural contours and drains. d. When possible, operate on dry soils when they are least susceptible to structural damage and erosion. e. Divert runoff away from disturbed areas. f. Provide for dispersal of surface flow that carry sediment into undisturbed surface zones that have high infiltration capacity and ground cover conditions. g. Prepare drainage ways and outlets to handle runoff. h. Minimize length and steepness of slopes. Interrupt long slopes frequently. i. Maintain runoff velocities low. j. Trap sediment on-site. k. Inspect and maintain control measures on a regular basis and after significant rainfall events. l. Revegetate and mulch disturbed areas as soon as practical after each disturbance.
Preconstruction Planning	~~All Five Substations~~All Four Substations	Prior to ground disturbing activity, a plan is developed to address erosion, sediment, and storm water control issues. A copy of the plan is kept on-site. Field changes to the plan are communicated to the plan preparer.

Table RERP-RAI-GE-2-2
TVA Best Management Practices

Clearing Practices	~~Holly Springs, Corinth, and~~Holly Springs and Corinth ~~Wilson~~	Clearing operations are conducted in a manner that prevents unnecessary destruction, scarring, or defacing of natural vegetation. In sensitive public or environmental areas, appropriate buffer zones are observed and methods of clearing modified to protect the buffer zone and the sensitive area. The following BMPs use TVA specifications described in Table RERP-RAI-GE-2-1 above to implement the environmental protective element. a. Streamside Management Zones b. Wetlands c. Historic Area Preservation d. Water Quality Control e. Air Quality Control f. Dust Control g. Brush and Timber Disposal
Construction Site Measures	~~All Five Substations~~All Four Substations	a. When possible, large construction projects are staged/phased to minimize exposure time of cleared soil. b. Grading activities are avoided during months of highly erosive rainfall. c. Initial erosion and sediment control measures are in place and functional prior to earth moving operations. d. Construction debris is kept from entering surface waters, wetlands, wet weather conveyances, or other access points to existing bodies of water. e. Stockpiled soils are located far enough from streams, wetlands, and drainage ways so runoff cannot carry sediment downstream or into adjacent wetlands.
Good House Keeping	~~All Five Substations~~All Four Substations	Proper application of good housekeeping prevent pollutants and sediment from reaching runoff or floodwaters.

Table RERP-RAI-GE-2-2
TVA Best Management Practices

Waste Disposal	~~All Five Substations~~All Four Substations	Solid Waste: Trash and construction debris is hauled to an approved landfill. No solid waste is buried or burned on site. Clearing debris (brush and timber) may be burned on-site in accordance with the TVA specification described in Table RERP-RAI-GE-2-1 above. Hazardous Waste: Hazardous waste generation is not anticipated for these projects. If hazardous waste is generated, all waste is properly collected, managed, and disposed of in accordance with governing regulation. Sanitary Waste: Sanitary waste is handled in accordance with the applicable TVA specification described in Table RERP-RAI-GE-2-1 above. Concrete Waste: Concrete that is delivered to the site but remains unused is transported offsite by the concrete vendor. Concrete trucks use designated washout area to clean the mixer chute. Concrete wash is not permitted to be discharged directly onto the ground in areas within 50 feet of streams, storm drains, or areas with potential for runoff directly into streams and/or storm drains.
Herbicide Use	~~Holly Springs, Corinth, and~~Holly Springs and Corinth~~ Wilson~~	Herbicide applicators must be trained and licensed; and follow manufacturers' label instructions, EPA guidelines, and respective state/local regulations including NPDES pesticide general permit requirements. Herbicide equipment is properly maintained and adjusted to prevent spillage. Herbicide equipment is never cleaned near streams, water bodies, or infiltration zones.
Storm Water Discharge Management	~~All Five Substations~~All Four Substations	All potential sources of pollution that could affect storm water discharge quality are identified and appropriate control measures implemented.
Inspection, Recordkeeping and Reporting	~~All Five Substations~~All Four Substations	Control measures are routinely checked and repaired as necessary. Inspection are performed during dry periods and after rainfall events. Records are kept on all inspections and repairs to erosion and sediment control measures. Records are maintained on-site or at a nearby office.
Sensitive Resources and Buffer Zones	~~Holly Springs, Corinth, and~~Holly Springs and Corinth~~ Wilson~~	a. SMZs: In conjunction with the specification described in Table RERP-RAI-GE-2-1 above, establish standard SMZ controls along each intermittent and perennial stream and perennial water body. b. Wetlands: The most desirable BMP pertaining to wetlands is avoidance and leaving natural wetland buffers intact.

Table RERP-RAI-GE-2-2
TVA Best Management Practices

Structural Controls, Standards, and Specifications	~~All Five Sites~~All Four Substations	Temporary sediment barriers such as straw bales, straw waffles, mulch berms, silt fences, check dams, rock filter dams, diversions, and riprap are used, as appropriate, to capture sediment by slowing and filtering construction storm water. Temporary stabilization of access roads and parking areas with stone is used to reduce erosion of temporary roadbeds caused by construction traffic. Water turnouts dissipate water energy near roads and ditches. Water bars intercept and divert surface water off the access road to minimize erosion.
Seeding and Stabilization	~~All Five Sites~~All Four Substations	In conjunction with site restoration specification described in Table RERP-RAI-GE-2-1 above, disturbed areas are seeded and stabilized to minimize soil erosion. Mulch is applied to disturbed land to reduce erosion, maintain soil moisture, moderate soil temperature, and to promote seed germination. Fast growing temporary vegetation is sewn on disturbed sites to reduce erosion when it is not possible or appropriate (construction delays or season unsuitable) to establish permanent vegetation.

Response to RERP-GE-RAI 2, Attachment 2

Supplemental Environmental Information for Limestone Substation Static VAR Compensator Construction

Note: All the information provided in this attachment is new and associated with Revision 1 of the NRC RAI RERP-GE-RAI 2.

Browns Ferry Nuclear Plant

RERP-GE-RAI 2 Response, Attachment 2

Supplemental Environmental Information for Limestone Substation Static VAR Compensator Construction

January 2017

RERP-GE-RAI 2 Response, Attachment 2

Table of Contents

1.0 Executive Summary E1-Att2-3
2.0 Introduction E1-Att2-3
3.0 Purpose of and Need for Action E1-Att2-3
3.1 The Proposed Action E1-Att2-3
3.2 Need for TVA Action E1-Att2-3
3.3 Alternatives to the Proposed Action E1-Att2-4
4.0 Overview of Operational and Equipment Changes - Project Characteristics E1-Att2-4
5.0 Socioeconomic and Environmental Justice Considerations E1-Att2-4
5.1 Socioeconomic E1-Att2-4
5.2 Environmental Justice E1-Att2-5
6.0 Cost Benefit Analysis E1-Att2-5
7.0 Environmental Impacts E1-Att2-5
7.1 Terrestrial Effects E1-Att2-5
7.1.1 Land Use, Wetlands, and Natural Areas E1-Att2-5
7.1.2 Cultural Resources E1-Att2-5
7.1.3 Transmission Facilities, Electric Shock, and Electromagnetic Fields E1-Att2-6
7.1.4 Noise, Odor, Microbiological, and Visual Aesthetics E1-Att2-6
7.1.5 Air Impacts E1-Att2-6
7.1.6 Terrestrial Biota and Habitat E1-Att2-6
7.1.7 Non-Radiological Waste Streams and Potential for Pollutant Generation E1-Att2-7
7.1.8 Geological Environment E1-Att2-7
7.2 Hydrology and Aquatic Ecology Effects E1-Att2-7
7.2.1 Aquatic Resources-Rivers, Streams, and Reservoirs E1-Att2-7
7.2.2 Groundwater E1-Att2-8
7.2.3 Surface Water E1-Att2-8
7.2.4 Drinking Water E1-Att2-8
7.3 Endangered, Threatened, or Special Status Species E1-Att2-9
7.4 Compliance, Permits, and Reporting E1-Att2-10

8.0 Results and Conclusion Summary E1-Att2-10

9.0 Procedures, Best Management Practices, and Environmental Quality Protection Specifications E1-Att2-10

RERP-GE-RAI 2 Response, Attachment 2

1.0 Executive Summary

Tennessee Valley Authority (TVA) performed an interconnection system impact study (SIS) for the extended power uprate (EPU) of all three Browns Ferry Nuclear Plant (BFN) units. The SIS documents the transmission system and BFN main generator excitation system modifications required to support the BFN EPU. Specifically, the interconnection SIS identified replacement of six 500 kilovolt (kV) breaker failure relays, installation of a minimum of 764 megavolt-ampere reactive (MVAR) reactive compensation in five locations throughout the TVA transmission system, and upgrades to all three BFN main generator excitation systems. The additional reactive compensation will consist of one static VAR compensator (SVC) at the Limestone substation and multiple capacitor banks at four locations throughout the TVA transmission system. As a federal agency subject to the requirements of the National Environmental Policy Act (NEPA), TVA evaluated the effects on the environment of these proposed upgrades. The intent of this report is to document TVA's assessment of environmental impacts of the SVC installation. The environmental information for the breaker failure relay replacements, main generator excitation modifications, and the four capacitor bank sites is discussed in RERP-GE-RAI 2 Attachment 1, Supplemental Environmental Information for Transmission System and BFN Main Generator Upgrades (Excluding Limestone Substation).

2.0 Introduction

Revision 3 of the SIS identified an issue with the BFN main generators when one of four specific 500 kV transmission lines is out of service coincident with a three phase fault. To mitigate this issue TVA will install a static VAR compensator at the Limestone substation and modify the excitation system of each of the BFN main generators. In addition, TVA imposes applicable Federal Energy Regulatory Commission (FERC) requirements on all generation projects. New generation must have the capability to operate at a power factor of 0.95 at the point of interconnection. Revision 3 of the interconnection SIS determined that the BFN reactive power capability after uprate would be deficient 764 MVAR for the additional power. To fulfill FERC requirements TVA identified installation of a minimum of 764 MVAR reactive compensation (one SVC site and four capacitor bank sites) distributed in five locations throughout the TVA transmission system.

TVA is evaluating the environmental effects for the installation of the SVC at the Limestone substation. This report summarizes the environmental impact information collected for this environmental review.

3.0 Purpose of and Need for Action

3.1 The Proposed Action

TVA proposes to install an SVC at the Limestone substation.

3.2 Need for TVA Action

BFN EPU will increase the electrical output of each BFN unit by approximately 155 megawatts electric (MWe). TVA conducted an interconnection SIS to evaluate the material modification to the existing BFN units. Revision 3 of the interconnection SIS identified BFN main generator transient stability and reactive power deficiency issues. The SVC is being installed as part of the mitigation for those issues.

3.3 Alternatives to the Proposed Action

There are four options for adding a minimum of 764 MVAR reactive compensation. The first option is to install 774 MVAR capacitor banks distributed across four existing substations throughout the TVA transmission system. The second alternative is to install 764 MVAR capacitor banks distributed across five existing substations throughout the TVA transmission system. The third option is to uprate the BFN main generator stator to 1,375 mega volt-amperes (MVA) thereby reducing the MVAR requirement to 252 MVAR of capacitor banks distributed across three existing substations throughout the TVA transmission system. The fourth option is to install an SVC at the Limestone substation and install capacitor banks distributed across four existing substations throughout the TVA transmission system.

The first two options address MVAR deficiency but do not assist in resolving the transient stability issues. Therefore, neither of the first two options was selected. Based on cost and technical issues with the third option, BFN EPU project management determined that this option would not meet the needs of the EPU project. The fourth option mitigates both the reactive compensation and transient stability issues. TVA’s Transmission Power Supply (TPS) organization and BFN EPU project management determined that an SVC at the Limestone substation and capacitor banks distributed across four locations was the optimal solution for BFN EPU and the TVA transmission system.

A new 500 kV transmission line between the Limestone and East Point substations was considered as an alternative to the BFN main generator excitation system modification and SVC installation. Based on refined technical evaluation, the 500 kV line was determined to be inadequate to completely address the transient stability issues. Therefore, BFN EPU project management, in conjunction with TPS, determined that the BFN main generator excitation system modifications and use of an SVC would be the preferred alternative.

4.0 Overview of Operational and Equipment Changes - Project Characteristics

TVA proposes to install an SVC at the Limestone substation located in Limestone County, Alabama. The SVC will address both the MVAR deficiency and transient stability issues. The SVC installation will require expansion of the existing substation footprint.

5.0 Socioeconomic and Environmental Justice Considerations

5.1 Socioeconomic

All physical work related to installation of the SVC will take place offsite to BFN. The work will be performed by a combination of TVA personnel and vendor supplied resources. Installation will not impact highway or railroad travel, will not interfere with river use or navigation, will not interfere with recreational or educational use of facilities remote to BFN, will not create public health effects, or increase the potential for accidents affecting the public. This project will not cause the displacement or relocation of businesses, residences, cemeteries, or farms. The components and equipment installed will be inorganic inanimate objects and therefore will not contain genetically engineered organisms or materials. The SVC will not, by itself, increase power sales or change the book value of BFN and therefore will not impact TVA’s payment in lieu of taxes or distribution.

5.2 Environmental Justice

The Limestone substation is located in Limestone County. The demographics of Limestone County is described in BFN License Amendment Request, Attachment 42, Supplemental Environmental Report. This section describes the impact on that population. Installation of the SVC will require expansion of the existing Limestone substation footprint and additional grading and clearing. TVA's *Best Management Practices (BMPs)* and *Environmental Quality Protection Specifications for Transmission Substations or Communications Construction* will apply throughout construction activities. The proposed upgrade will ensure the TVA transmission system reliability is maintained. Therefore, the surrounding population will benefit from the upgrade.

6.0 Cost Benefit Analysis

The cost benefit analysis discussed in the BFN license amendment request (LAR), Attachment 42, Supplemental Environmental Report, and in RERP-GE-RAI 2, Attachment 1, Supplemental Environmental Information for Transmission System and BFN Main Generator Upgrades (Excluding Limestone Substation) includes the cost estimate of the SVC.

7.0 Environmental Impacts

7.1 Terrestrial Effects

7.1.1 Land Use, Wetlands, and Natural Areas

The SVC installation will take place at a location offsite from BFN. The SVC (Limestone substation) will require expansion of the existing substation footprint and additional grading and clearing. Work at the Limestone site will disturb approximately 25 acres of previously disturbed TVA property. No prime or unique farmland will be taken out of production. There are no ecologically critical areas, wetlands, park land (federal, state, or local), national or state forests, wilderness areas, scenic areas, wildlife management areas, recreational areas, greenways, or trails within the proposed project footprints or within three miles for the substation site.

7.1.2 Cultural Resources

TVA retained the service of a qualified vendor to conduct a Phase 1 archaeological and historic cultural resource survey for the expansion area of the affected substation. The archaeological area of potential effects (APE) includes the new areas of land disturbance. The historic APE for the substation was defined to be a 0.5 mile radius surrounding the substation site from which unobstructed views of the project area would be possible. The results and conclusions of the vendor research for each substation are described below:

No new archaeological resources were documented within the boundaries of the APE. One farm complex was located within the line of sight of the project area. The *Lowe Hereford Farm-Belle Mina Farms* complex includes four cinderblock residential houses, one cinderblock outbuilding, as well as several other wood and metal outbuildings. The construction dates for the structures that comprise the complex range from 1944 to 1970. TVA determined that the farm complex is not eligible for the National Register of Historic Places (NRHP). The property has not been identified as having been associated with any important event (criteria A), or significant people (criteria B) nor does it display distinct characteristics of a type, period, or

method of construction (criteria C). Based on the study results, and pending agreement by the Alabama State Historic Preservation Officer (SHPO), TVA finds that no historic properties listed or eligible for listing in the NRHP would be affected by the proposed action.

7.1.3 Transmission Facilities, Electric Shock, and Electromagnetic Fields

The SVC will be installed at an existing TVA substation. Design criteria that limit hazards to human health from steady-state currents are based on the National Electric Safety Code (NESC). TVA designs transmission systems to exceed requirements given in the NESC. The substations have barrier fences that separate the general public from hazardous electrical components. Because substations already contain multiple high voltage and high current components, addition of the new SVC does not significantly alter the electric shock or electromagnetic field hazard.

7.1.4 Noise, Odor, Microbiological, and Visual Aesthetics

The SVC installation will generate transient noise during construction activity. Noise control and suppression during construction activity will be in accordance with the TVA *Environmental Quality Protection Specifications for Transmission Substation or Communications Construction*. Specific noise control and suppression measures are discussed in section 9.0; Procedures, Best Management Practices, and Environmental Quality Protection Specifications of this report. Installation of the SVC does not create a potential to produce odors with off-site impacts. Installation of the SVC may require new light sources. TVA will adhere to the requirements in the *TVA Substation Lighting Guidelines* to ensure light disturbance from the new installations is small. Lighting guidelines include design controls that address luminaire optical properties, light levels, neighboring property uses, physical security and surveillance requirements, mounting height and location, terrain, and substation safety. The SVC will not produce visual contrast or visual discord and does not involve external structures over 200 feet above ground level. The SVC will not introduce, or promote the growth of, thermophilic microorganisms and therefore does not affect microbiological hazards to human health.

7.1.5 Air Impacts

For the SVC installation, there may be small impacts from construction vehicle emissions and fugitive dust from ground disturbance and vehicle travel on unpaved roads. Diesel powered construction equipment will be of modern design, equipped with all required emission controls and use low sulfur diesel fuel to limit emissions. These impacts are small, temporary, and controlled with TVA's BMPs.

7.1.6 Terrestrial Biota and Habitat

The SVC installation will take place at a location offsite from BFN. The SVC installation will require expansion of the existing substation footprint and additional grading and clearing. The Limestone substation expansion will occur on previously disturbed TVA property and no unique or important terrestrial habitat exists within the proposed project area. This site will likely contain a sizeable proportion of non-native, invasive botanical species. Because these non-native, invasive, botanical species are widely distributed throughout the region, and the area of disturbance is small, installation of the SVC at this substation will not adversely affect the percentage of this type of habitat in the area. Because TVA's BMPs require the use of native plants and non-invasive species for landscaping, the installation of the SVC will not significantly

contribute to the spread of invasive or exotic botanical species. No wading bird colonies, heronries, or aggregations of migratory birds have been documented within three miles of the project footprint and none were observed during field reviews. Therefore, activities associated with the proposed SVC would not affect wading bird colonies or other aggregations of migratory birds.

7.1.7 Non-Radiological Waste Streams and Potential for Pollutant Generation

The SVC installation project will take place outdoors at a substation location offsite to BFN. TVA's BMPs and proper containment, treatment, and disposal of wastewaters, storm-water runoff, wastes and potential pollutants will be implemented to control potential surface water impacts. The SVC project will not produce point source or non-point source wastewater discharge. Soil erosion impacts will be small with implementation of TVA's BMPs. A construction storm-water discharge permit will be needed at the Limestone substation. Any fill material for the substation expansions would be obtained from an approved borrow pit. TPS's Environmental Protection Procedures - *Soil Management Guidelines* identify requirements applicable to excavations at transmission projects to address excavated soil. Any spoil accumulated from grading, trenching, or digging for new foundations would be placed in a permitted spoil area on the substation property, or spread back onsite. The disturbed areas would be re-graveled, re-vegetated, and/or re-surfaced. If any spoil is taken off site, it would be tested and disposed. Any solid waste generated at the substations will be scrapped/recycled when feasible. The SVC installation will not generate or release radioactive contamination, hazardous waste, universal or special waste, or used oil. Substations are not radiologically controlled and do not represent a radiological hazard to human health. The SVC installation will not generate or release toxic substances. No materials involved in these upgrade projects will require special handling. The SVC installation involves new equipment. No existing equipment that could contain PCBs, solvents, asbestos, sandblasting material, mercury, lead, or paints will be disturbed. The SVC installation will not release, or otherwise use substances on the Toxic Release Inventory (TRI) list.

7.1.8 Geological Environment

The Limestone project area is underlain by carbonate bedrock of the Mississippian age. The carbonate bedrock underlying the project area does pose a risk for the development of karstic features such as sinkholes and caves at the site. The seismic hazard is small at Limestone in comparison to most other areas in the United States. No active faults showing recent surface displacement are known within a 200-mile radius of the site. The New Madrid seismic area of west Tennessee, the highest risk seismic zone in the region, is located approximately 275 miles north-northwest of the Limestone project site. The site is also located approximately 180 miles southwest of the East Tennessee Seismic Zone. According to the 2014 Seismic Probabilistic Hazard Map published by the USGS, the project area is located in a risk zone with a hazard rating of 2 percent probability of 0.1 – 0.14 g peak acceleration in 50 years.

7.2 Hydrology and Aquatic Ecology Effects

7.2.1 Aquatic Resources-Rivers, Streams, and Reservoirs

The SVC installation will take place at a location offsite to BFN. The SVC installation at the Limestone substation will require expansion of the existing substation footprint. The proposed

project at the Limestone substation will not involve construction within the 100 year flood plain. A field survey of the Limestone substation documented three wet weather conveyances (ephemeral streams) in the project area. Ground disturbance will be minimized and all work done in accordance with applicable procedures and TVA's BMPs. With proper implementation of procedures and BMPs, minimal impacts to water flow, stream channels, or stream banks would occur. No federally designated critical habitat occurs within the potentially affected Limestone Creek (0603000207) 10-digit Hydrologic Unit Code (HUC). Therefore, no impacts to unique or important aquatic habitats would occur. The SVC installation will not require water withdrawal from any river or reservoir.

7.2.2 Groundwater

The Limestone substation project area is underlain by Mississippian Age carbonate bedrock. These rock units are susceptible to development of karstic features such as sinkholes, springs, and caves. Public water is available for residents in the project area but private water wells and springs exist near the project site. Project activity could potentially cause erosion resulting in the movement of sediment into groundwater infiltration zones. Standard construction TVA BMPs will be implemented to avoid contamination of groundwater by surface activity in the project area. Springs and sinkholes would be avoided by construction activity. The use of petroleum fuels, lubricants, and hydraulic fluids in construction and maintenance vehicles could result in the potential for small on-site spills. However, the use of BMPs to properly maintain vehicles to avoid leaks and spills and procedures to immediately address any spills that did occur would minimize the potential for adverse impacts to groundwater. During re-vegetation and maintenance activities, fertilizers and herbicides would be avoided in areas that flow to springs or would be used sparingly to avoid contamination of groundwater. Potential impacts to groundwater as a result of this project would be small.

7.2.3 Surface Water

The Limestone substation project area drains to Limestone Creek, which is a tributary of the Tennessee River. This section of Limestone Creek is classified by the state for fish and wildlife. This section of Limestone Creek is not on the state 303 (d) list as impaired. The embayed portion of Limestone Creek, where it meets Wheeler Reservoir is on the state 303 (d) list for impairments from mercury due to atmospheric deposition. With proper implementation of standard TVA BMPs and proper containment/treatment/disposal of wastewaters, storm-water runoff, wastes, and potential pollutants, surface water impact would be small.

7.2.4 Drinking Water

Public drinking water is available to residents in the area of the Limestone substation, however private wells are also being used. Mitigation measures to control potential impacts to groundwater relating to the proposed action include the use of erosion control BMPs. During re-vegetation and maintenance activities, fertilizers and herbicides would be avoided in areas that flow to springs or would be used sparingly to avoid contamination of groundwater. With the use of these BMPs, potential impacts to groundwater would be insignificant.

7.3 Endangered, Threatened, or Special Status Species

Aquatic:

A query of the TVA Natural Heritage Database on January 18, 2017, for records of listed aquatic animal species indicated 21 federally listed aquatic species (three fish, 15 mussels, and three snails) within the ten digit HUC Limestone Creek (0603000207) watershed, a 10-mile radius of the proposed project area, and/or within Limestone County, AL. A field survey on January 9, 2017, documented no intermittent or perennial streams and three wet weather conveyances (ephemeral streams). The three ephemeral streams contain no suitable habitat for federally listed species. In order to eliminate potential impacts to sensitive aquatic life, ground disturbance would be minimized, and all work would be conducted according to BMPs, with emphasis on preventing waste materials associated with construction from entering adjacent watercourses. These BMPs are designed in part to minimize erosion and subsequent sedimentation in streams. Therefore, no impacts to aquatic endangered, threatened, or special status species are anticipated to occur.

Terrestrial - Botany:

Limestone: A field survey conducted January 2017 indicates that the project would have no impact on federally listed plant species or designated critical habitat because neither exist within the area that would be affected by the proposed work. The field survey also indicated that no rare plants or habitat capable of supporting state-listed species occurs in the project area. The proposed action would not affect federal or state-listed plant species.

Terrestrial - Zoology:

A query of the TVA Natural Heritage Database in January 2017, indicated no state or federally listed species within three miles of the project footprint. One federally protected species (bald eagle) and two federally listed species (gray bat and Indiana bat) are known from Limestone County, Alabama. Additionally, the United States Fish and Wildlife Service (USFWS) has determined that the federally listed northern long-eared bat may occur in Limestone County, Alabama. Thus impacts to these species are evaluated for this project.

No suitable nesting or foraging habitat for bald eagle exists within the project area. Bald eagle records are known approximately 9 and 17.5 miles from the project footprint. No additional nests or individuals are known from the project area and none were observed during field surveys in January 2017 when active nesting behavior would have been apparent. No waterways or wetlands are present or would be affected by the proposed actions, thus bald eagle habitat would not be impacted by the proposed actions. Therefore, bald eagles will not be affected by the proposed actions.

No caves or other winter hibernacula for gray, Indiana, or northern long-eared bats exist in the project footprint or would be impacted by the proposed actions. Summer roosting habitat surveys were performed in January 2017. During these surveys, no suitable roost trees were identified within the forested habitat in the area to be cleared. Suitability was determined based on absence of white oaks, shagbark hickories, and snags with exfoliating bark, cavities, or crevices as well as the complete lack of water sources. No suitable summer roosting habitat for gray, Indiana, or northern long-eared bats would be removed for the proposed SVC. No

wetlands or waterways are present within the proposed action area, thus foraging habitat for these three bat species would not be affected. The proposed project would have no effect on gray, Indiana, or northern long-eared bats.

7.4 Compliance, Permits, and Reporting

The safety data sheets (SDSs) for all products are provided to, and approved by, the TVA environmental support personnel prior to chemicals being brought on site. The *Spill Prevention Control and Countermeasures Plan* for each substation would be revised as needed, to reflect the equipment changes at the substations. No new environmental permits will be required as a result of the SVC equipment planned for installation. Equipment installed will be similar to existing equipment at the substation and would therefore not require Federal Aviation Administration (FAA) notification for structures greater than 200 feet.

8.0 Results and Conclusion Summary

TVA performed an interconnection SIS for the EPU of all three BFN units. The SIS documents transmission system upgrades required in order to support the BFN EPU. Specifically, the SIS identified replacing six 500 kV breaker failure relays, installing a minimum of 764 MVAR reactive compensation in five locations throughout the TVA transmission system, and upgrading all three BFN main generator excitation systems. As a federal agency subject to the requirements of NEPA, TVA evaluated the effects on the environment of these proposed upgrades. The environmental information for the breaker failure relay replacements, main generator excitation modifications, and the four capacitor bank sites is discussed in RERP-GE-RAI 2 Attachment 1, Supplemental Environmental Information for Transmission System and BFN Main Generator Upgrades (Excluding Limestone Substation). The environmental impacts for the SVC installation at the Limestone substation has been reviewed and assessed as described in this attachment. This review did not identify moderate or large environmental impacts from installation of the SVC. TVA anticipates that the impacts of the installation of the proposed SVC on human health and the environment would be small.

9.0 Procedures, Best Management Practices, and Environmental Quality Protection Specifications

TVA BMPs, in conjunction with specifications and procedures, are used to manage the environmental impact from construction activities. *A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Transmission Construction and Maintenance Activities*, dated 2012, serves as a practical resource for TVA personnel and contractors for planning and conducting transmission construction activities. The environmental review package for each project contains BMPs that should be used. The TVA BMPs are effective methods for ensuring that TVA's construction activities contribute to a high standard of water quality throughout the Tennessee River Watershed and the TVA Power Service Area. The BMPs are chosen to minimize erosion or control sedimentation and other pollutants from land disturbances and land management activities. When properly applied, BMPs help protect the quality of surface waters and ground waters.

TVA and/or the assigned contractor and subcontractors plan, coordinate, and conduct transmission construction activities in a manner that protects the quality of the environment and complies with TVA's environmental expectations. *Tennessee Valley Authority Environmental*

RERP-GE-RAI 2 Response, Attachment 2

Quality Protection Specifications for Transmission Substation or Communications Construction contains provisions that are considered in all TVA and contract construction activities at this site. At all site perimeters, structure, foundation, conduit, grounding, fence, drainage ways, etc., appropriate protective measures to prevent erosion or release of contaminants are taken. Those protective measures are inspected and maintained throughout construction. In addition, the *Tennessee Valley Authority Site Clearing and Grading Specification* is used for projects requiring clearing and/or grading.

Table ENV-1, TVA Specifications for Transmission Substation Construction and/or Site Clearing and Grading, summarizes the TVA specifications to be used for construction, clearing, and grading activities at the substation. Table ENV-2, TVA Best Management Practices, summarizes the TVA BMPs used for construction activities at the substation.

RERP-GE-RAI 2 Response, Attachment 2

Table ENV-1
TVA Specifications for Transmission Substation Construction and/or Site Clearing and Grading

Specifications	Description
Regulations	Compliance with all applicable federal, state, and local environmental and antipollution laws, regulations, and ordinances related to environmental protection and prevention, control, and abatement of all forms of pollution. All applicable federal, state, and local environmental and antipollution laws, regulations, and ordinances are complied with, including without limitation, all air, water, solid and hazardous waste, noise, and nuisance laws, regulations, and ordinances.
Land and Landscape Preservation	Care is exercised to preserve the natural landscape in the entire construction area as well as use areas, in or outside of the ROW, and on or adjacent to access roads. TVA or contract personnel exercises care to preserve the condition of cleared soils by avoiding as much compacting and deep scarring as possible in areas not to be developed for buildings, structures, or foundations. As soon as possible after initial disturbance of the soil and in accordance with any permit(s) or other state or local environmental regulatory requirements, cover material is placed to prevent erosion and sedimentation of water bodies or conveyances to surface water or groundwater.
Sensitive Area Preservation	Certain areas along the access and/or the ROW may be designated by the specifications as environmentally sensitive. These areas include, but are not limited to, areas classified as erodible, geologically sensitive, scenic, historical and archeological, fish and wildlife refuges, endangered species habitat, water supply watersheds, and public recreational areas. Crews take all necessary actions to avoid adverse impacts to these sensitive areas and their adjacent buffer zones. If prehistoric or historic artifacts or features that might be of archaeological or historical significance are discovered during clearing, grading, borrow, or fill operations, the activity immediately ceases within a 100-foot radius, and a TVA project manager, an environmental specialist, and the TVA Cultural Resources program manager is notified. The site is protected and left as found until a determination about the resources, their significance, and site treatment is made by TVA's Cultural Resources Program.

RERP-GE-RAI 2 Response, Attachment 2

Table ENV-1
TVA Specifications for Transmission Substation Construction and/or Site Clearing and Grading

Specifications	Description
Water Quality Control	Activities are performed by methods that prevent entrance or accidental spillage of solid matter, contaminants, debris, and other objectionable pollutants and wastes into flowing caves, sinkholes, streams, dry watercourses, lakes, ponds, and underground water sources. Erosion and/or sedimentation controls are maintained for effectiveness throughout the construction period. Clearing, grading, borrow and fill, and/or disposal activities are performed using BMPs that will prevent erosion and entrance of spillage, contaminants, debris, and other pollutants or objectionable materials into drainage-ways, surface waters, or groundwater. Special care is exercised in refueling equipment to prevent spills. Fueling areas are remote from any sinkhole, crevice, stream, or other water body. BMPs, such as silt fences, on steep slopes and adjacent to any steam, wetland, or other water body will be erected and maintained. BMPs are inspected by the TVA field engineer or other designated personnel routinely and at least as frequently as required by the permit or good management practices and during periods of high runoff; any necessary repairs are made as soon as practicable.
Turbidity and Blocking of Streams	Activities in or near streamside management zones or other bodies of water are controlled to prevent the water turbidity from exceeding state or local water quality standards for that stream. All conditions of a general storm-water permit, aquatic resource alteration permit, or site specific permit are met. If temporary clearing, grading, borrow, or fill activities must interrupt natural drainage, appropriate drainage facilities and erosion/sediment controls are provided to avoid erosion and siltation of streams and other water bodies or water conveyances. Turbidity levels in receiving waters or at storm-water discharge points are monitored, documented, and reported if required by the applicable permit. Erosion and sediment control measures such as silt fences, water bars, and sediment traps are installed as soon as practicable after initial access, site, borrow, fill, or right-of-way disturbance and after sequential disturbance of stabilized areas due to stepwise construction requirement in accordance with applicable permit or regulatory requirements.

RERP-GE-RAI 2 Response, Attachment 2

Table ENV-1
TVA Specifications for Transmission Substation Construction and/or Site Clearing and Grading

Specifications	Description
Streamside Management Zones (SMZs)	Clearing and/or grading activity leaves as many rooted ground cover plants as possible in buffer zones along streams and other bodies of water or wet-weather conveyances thereto. Cutting of trees within SMZs is accomplished by using either hand-held equipment or other appropriate clearing equipment (e.g., a feller-buncher) that would result in minimal soil disturbance and damage to low-lying vegetation. Only approved herbicides are used, and herbicide application is conducted by certified applicators from the Transmission Operations and Maintenance (TOM) organization after initial clearing and construction. Disturbed soils in SMZs are stabilized by appropriate methods immediately after the access or site is cleared. Stabilization occurs within the time frame specified in applicable storm-water permits or regulations.
Wetlands	In forested wetlands, tall trees are cut near the ground, leaving stumps and roots in place. Cutting of trees within wetlands is accomplished by using either hand-held equipment or other appropriate clearing equipment (e.g., a feller-buncher) that would result in minimal soil disturbance and damage to low-lying vegetation. The cambium may be treated with herbicides applied by certified applicators from the TOM organization to prevent regrowth. Understory trees that must be initially cut and removed may be allowed to grow back or may be treated with tree growth regulators selectively to slow growth and increase the reclearing cycle. The decision is situationally made based on existing ground cover, wetland type, and tree species, since tall tree removal may "release" understory species and allow them to quickly grow to "electrical clearance problem" heights. In many circumstances, herbicides labeled for water and wetland use may be used in reclearing.
Floodplain Evaluation	During the planning and design phase, floodplain information is obtained to avoid locating flood damageable facilities in the 100 year floodplain. If the preferred site is located within a floodplain area, alternative sites are evaluated and documentation prepared to support a determination of "no practicable alternative." Steps taken to minimize adverse impacts are documented.
Clearing	No activities may clear additional site or ROW vegetation or disturb remaining vegetation, stumps, or regrowth at locations other than the substation or access thereto. Appropriate erosion or sediment controls for areas disturbed are established as soon as practicable after disturbance.

Table ENV-1
TVA Specifications for Transmission Substation Construction and/or Site Clearing and Grading

Specifications	Description
Brush and Timber Disposal	For initial clearing, trees are commonly part of the contractor's contract to remove as they wish. Trees may be removed from the site for lumber or pulpwood, or they may be chipped or stacked and burned. All such activities are coordinated with the TVA field engineer and the open burning permits; notifications and regulatory requirements are met. On ROWs, trees may be cut and left in place only in areas specified by TVA and approved by appropriate regulatory agencies. These areas may include sensitive wetlands or SMZs where tree removal would cause excessive ground disturbance or in very rugged terrain where windrowed trees are used as sediment barriers along the edge of the ROW, site, or access.
Air Quality Control	Crews take appropriate actions to minimize the amount of air pollution created by construction activities. Appropriate actions are taken to limit the amount of air emissions created by clearing and disposal operations to be well within the limits of clearing or burning permits and/or forestry or local fire department requirements. All operations are conducted in a manner that prevents nuisance conditions or damage to adjacent land, crops, dwellings, highways, or people.
Dust and Mud Control	Activities are conducted to minimize the creation of dust. This may require limitations as to types of equipment, allowable speeds, and routes utilized. Water, straw, wood chips, dust palliative, gravel, combinations of these, or similar controls may be used. Clearing, grading, borrow, fill, or transport activities are conducted in a manner that minimizes the creation of fugitive dust. This may require limitations as to type of equipment, allowable speeds, and routes utilized. Control measures such as water, gravel, etc., or similar measures may be used subject to TVA approval.
Sanitation	Sanitary chemical toilets convenient to all principal points of operation are provided for every working party and at each construction step. The facilities comply with applicable federal, state, or local health laws and regulations. Sanitation facilities are not located closer than 100 feet to any stream or tributary or to any wetland.
Damage Prevention	Movement of construction equipment is conducted in a manner that causes as little intrusion and damage as possible to property features and vegetation.

RERP-GE-RAI 2 Response, Attachment 2

Table ENV-1
TVA Specifications for Transmission Substation Construction and/or Site Clearing and Grading

Specifications	Description
Equipment	All major equipment and proposed methods of operation are subject to the approval of TVA. The use or operation of heavy equipment in areas outside the ROW, access routes, or site will not be permitted without permission from the TVA inspector or field engineer. Steps are taken to limit ground disturbance caused by heavy equipment.
Refuse Disposal	Designated personnel are responsible for daily inspection, cleanup, proper labeling, storage, and disposal of all refuse and debris.
Vehicle Exhaust	Crews maintain and operate equipment to limit vehicle exhaust emissions.
Vehicle Servicing	Routine maintenance of personal vehicles is not performed on the ROW or access route to the site. Heavy equipment is not serviced on site except adjacent to or in designated areas. TVA properly maintains these vehicles with approved spill protection controls and countermeasures.
Smoke and Odors	Combustible and volatile materials that could create objectionable smoke, odor, or fumes are properly stored and handled. Personnel do not burn oil or refuse that includes trash, rags, tires, plastics, or other manufactured debris.
Noise Control	Measures are taken to avoid the creation of noise levels that are considered nuisances, safety, or health hazards for employees, the public, or the site and adjacent property owners. Critical areas including, but not limited to, residential areas, parks, public use areas, and some ranching areas require special considerations. Concentration of individual noisy pieces as well as the hours and locations of operation are considered.
Noise Suppression	All internal combustion engines are properly equipped with mufflers. The equipment and mufflers are maintained at peak operating efficiency. Air compressors and other noisy equipment may require sound reducing enclosures.

RERP-GE-RAI 2 Response, Attachment 2

Table ENV-1
TVA Specifications for Transmission Substation Construction and/or Site Clearing and Grading

Specifications	Description
Burning	Permits are obtained and notification provided as required to state forestry offices and/or local fire departments. Burning complies with requirements of state and local air pollution control and is only allowed in approved locations and during appropriate hours and weather conditions.
Site Restoration	Disturbed areas are stabilized in the following manner unless another method is previously specified. • Subsoil is loosened to minimum depth of six inches and worked to remove unnatural ridges/depressions. • Appropriate soil amendments are added as needed. • Disturbed areas are initially seeded with temporary ground cover. Final restoration and final seeding is performed when construction is completed. • Depending on time of year and weather conditions, the seeding requirement may be delayed or withdrawn until more favorable planting conditions are certain. • Construction sites are protected from species designated by the Federal Invasive Species Council and equipment being transported from location to location is inspected to ensure removal and destruction of live material.
Final Site Cleanup and Inspection	All construction related debris, products, materials, and wastes are properly handled, labeled as required, and removed from the site. Upon completion, the designated TVA person walks down the site and completes an approval inspection.

RERP-GE-RAI 2 Response, Attachment 2

In addition to the *Tennessee Valley Authority Environmental Quality Protection Specifications for Transmission Substation or Communications Construction* described above, the following BMPs from the TVA BMP Manual are employed at the substation. These BMPs may overlap with, or provide more details to, the specifications discussed above. Table ENV-2, Best Management Practices, below summarizes the TVA BMPs for the proposed SVC installation.

Table ENV-2
TVA Best Management Practices

BMP	Description
Sediment and Erosion Control	a. Limit the amount of vegetation disturbed and the exposure of soil to erosive elements. b. Plan clearing, grading and construction to minimize the area and duration of soil exposure. c. Minimize disturbance of natural contours and drains. d. When possible, operate on dry soils when they are least susceptible to structural damage and erosion. e. Divert runoff away from disturbed areas. f. Provide for dispersal of surface flow that carry sediment into undisturbed surface zones that have high infiltration capacity and ground cover conditions. g. Prepare drainage ways and outlets to handle runoff. h. Minimize length and steepness of slopes. Interrupt long slopes frequently. i. Maintain runoff velocities low. j. Trap sediment on-site. k. Inspect and maintain control measures on a regular basis and after significant rainfall events. l. Revegetate and mulch disturbed areas as soon as practical after each disturbance.
Preconstruction Planning	Prior to ground disturbing activity, a plan is developed to address erosion, sediment, and storm-water control issues. A copy of the plan is kept on-site. Field changes to the plan are communicated to the plan preparer.

RERP-GE-RAI 2 Response, Attachment 2

Table ENV-2
TVA Best Management Practices

BMP	Description
Clearing Practices	Clearing operations are conducted in a manner that prevents unnecessary destruction, scarring, or defacing of natural vegetation. In sensitive public or environmental areas, appropriate buffer zones are observed and methods of clearing modified to protect the buffer zone and the sensitive area. The following BMPs use TVA specifications described in Table ENV-1 above to implement the environmental protective element. a. Streamside Management Zones b. Wetlands c. Historic Area Preservation d. Water Quality Control e. Air Quality Control f. Dust Control g. Brush and Timber Disposal
Construction Site Measures	a. When possible, large construction projects are staged/phased to minimize exposure time of cleared soil. b. Grading activities are avoided during months of highly erosive rainfall. c. Initial erosion and sediment control measures are in place and functional prior to earth moving operations. d. Construction debris is kept from entering surface waters, wetlands, wet weather conveyances, or other access points to existing bodies of water. e. Stockpiled soils are located far enough from streams, wetlands, and drainage ways so runoff cannot carry sediment downstream or into adjacent wetlands.
Good House Keeping	Proper application of good housekeeping prevents pollutants and sediment from reaching runoff or floodwaters.

Table ENV-2
TVA Best Management Practices

BMP	Description
Waste Disposal	Solid Waste: Trash and construction debris is hauled to an approved landfill. No solid waste is buried or burned on site. Clearing debris (brush and timber) may be burned on-site in accordance with the TVA specification described in Table ENV-1 above. Hazardous Waste: Hazardous waste generation is not anticipated for these projects. If hazardous waste is generated, all waste is properly collected, managed, and disposed of in accordance with governing regulation. Sanitary Waste: Sanitary waste is handled in accordance with the applicable TVA specification described in Table ENV-1 above. Concrete Waste: Concrete that is delivered to the site but remains unused is transported offsite by the concrete vendor. Concrete trucks use designated washout area to clean the mixer chute. Concrete wash is not permitted to be discharged directly onto the ground in areas within 50 feet of streams, storm drains, or areas with potential for runoff directly into streams and/or storm drains.
Herbicide Use	Herbicide applicators must be trained and licensed; and follow manufacturers' label instructions, EPA guidelines, and respective state/local regulations including NPDES pesticide general permit requirements. Herbicide equipment is properly maintained and adjusted to prevent spillage. Herbicide equipment is never cleaned near streams, water bodies, or infiltration zones.
Storm Water Discharge Management	All potential sources of pollution that could affect storm-water discharge quality are identified and appropriate control measures implemented.
Inspection, Recordkeeping and Reporting	Control measures are routinely checked and repaired as necessary. Inspection are performed during dry periods and after rainfall events. Records are kept on all inspections and repairs to erosion and sediment control measures. Records are maintained on-site or at a nearby office.
Sensitive Resources and Buffer Zones	a. SMZs: In conjunction with the specification described in Table ENV-1 above, establish standard SMZ controls along each intermittent and perennial stream and perennial water body. b. Wetlands: The most desirable BMP pertaining to wetlands is avoidance and leaving natural wetland buffers intact.

RERP-GE-RAI 2 Response, Attachment 2

Table ENV-2
TVA Best Management Practices

BMP	Description
Structural Controls, Standards, and Specifications	Temporary sediment barriers such as straw bales, straw waffles, mulch berms, silt fences, check dams, rock filter dams, diversions, and riprap are used, as appropriate, to capture sediment by slowing and filtering construction storm-water. Temporary stabilization of access roads and parking areas with stone is used to reduce erosion of temporary roadbeds caused by construction traffic. Water turnouts dissipate water energy near roads and ditches. Water bars intercept and divert surface water off the access road to minimize erosion.
Seeding and Stabilization	In conjunction with site restoration specification described in Table ENV-1 above, disturbed areas are seeded and stabilized to minimize soil erosion. Mulch is applied to disturbed land to reduce erosion, maintain soil moisture, moderate soil temperature, and to promote seed germination. Fast growing temporary vegetation is sown on disturbed sites to reduce erosion when it is not possible or appropriate (construction delays or season unsuitable) to establish permanent vegetation.

Response to RERP-GE-RAI 2, Attachment 3

**TVA letter to the Mississippi State Historic Preservation Office -
TVA, Corinth and Holly Springs Substation Expansion Project, Phase 1 Cultural Resources Survey, Alcorn and Marshall Counties, Mississippi**

Tennessee Valley Authority, 400 West Summit Hill Drive, Knoxville, TN 37902

May 20, 2016

Mr. Jim Woodrick, Director
Mississippi Department of Archives and History
Historic Preservation Division
Post Office Box 571
Jackson, Mississippi 39205-0521

Dear Mr. Woodrick:

TENNESSEE VALLEY AUTHORITY (TVA), CORINTH AND HOLLY SPRINGS SUBSTATIONS EXPANSION PROJECT, PHASE I CULTURAL RESOURCES SURVEY, ALCORN AND MARSHALL COUNTIES, MISSISSIPPI

As part of a larger effort to meet increasing demands for bulk power, TVA proposes to request approval of a license amendment from the Nuclear Regulatory Commission (NRC) to increase the electrical output of Units 2 and 3 at Browns Ferry Nuclear Plant. In order to facilitate the Browns Ferry Nuclear (BFN) Extended Power Uprate (EPU) project, TVA proposes to expand the capacity of three substations, including the Corinth Substation in Alcorn County and the Holly Springs Substation in Marshall County. This work would involve adding capacitor banks at each substation, which will require expansion of the existing footprints, and grading. TVA has determined that this proposed substation expansion project is an undertaking (as defined at 36 CFR § 800.16(y)) that has the potential to cause effects on historic properties. We are initiating consultation under Section 106 of the National Historic Preservation Act for this undertaking.

TVA has determined an area of potential effects (APE) for this undertaking that is divided into two parts, one for each of the substations. For the Corinth Substation expansion, TVA has determined the APE for archaeological resources as the circa 6-acre footprint of the proposed substation expansion; the archaeological APE for the Holly Springs substation is the circa 3-acre expansion footprint. TVA has determined the APE for above-ground (historic architectural) resources as areas within a one-half mile radius of each part of the archaeological APE, from which unobstructed views to the new capacitor banks would be possible.

TVA contracted with Tennessee Valley Archaeological Research (TVAR) to perform a Phase I cultural resources survey of the APE. Enclosed are three bound copies of the draft report, titled *A Phase I Cultural Resources Survey of Tennessee Valley Authority's Corinth and Holly Springs Substation Expansions in Alcorn and Marshall Counties*, along with three CDs containing digital copies of the report.

TVAR's background study, conducted prior to the field study, indicated that no properties listed in the National Register of Historic Places (NRHP) and no previously recorded archaeological sites are located in either part of the APE. The archaeological survey identified one archaeological site, 22AL726, located in the Corinth Substation portion of the archaeological APE. TVAR recommends that the site is ineligible for inclusion in the NRHP.

TVAR's background study noted that 14 historic architectural properties have been inventoried previously within the APE for the Corinth Substation Expansion. Of these, TVAR recommends that one is outside the viewshed of the planned substation expansion, and 13 are ineligible for inclusion in the NRHP. The survey recorded eight previously unrecorded properties in this part of the APE, which they have designated IS-1 through IS-8. TVAR recommends all eight of these properties as ineligible for the NRHP, due to a lack of architectural and historic significance.

The architectural survey of the Holly Springs portion of the APE revisited two NRHP-listed historic districts, the Depot-Compress Historic District and the East Holly Springs Historic District, both of which are partially within the half-mile radius. Based on the results of the survey, both of these historic districts are located outside the viewshed to the project area, and neither would be affected by the undertaking. The survey identified 11 previously unrecorded, above-ground properties (IS-9 through IS-19). TVAR recommends all of these properties ineligible for the NRHP due to a lack of architectural and historic significance.

TVA has reviewed the enclosed report and agrees with the findings and recommendations of the authors. Based on the survey, TVA has determined that the Corinth and Holly Springs Substations Expansion project would affect no historic properties.

Pursuant to 36 CFR Part 800.4(d)(1), we are seeking your concurrence with TVA's findings and determinations.

Should you have any questions or comments, please contact Richard Yarnell in Knoxville at wryarnell@tva.gov or (865) 632-3463.

Sincerely,

Clinton E. Jones
Manager, Biological and Cultural Compliance
Safety, River Management and Environment
WT11C-K

SCC:CSD
Enclosures

INTERNAL COPIES:

Amy Henry, WT11D-K
Susan Jacks, WT11C-K
Todd Liskey, MR 4G-C
Emily Willard, MR 4G-C
Richard Yarnell, WT11D-K
ECM, WT CA-K

Phase I Cultural Resources Surveys of Tennessee Valley Authority's Corinth and Holly Springs Substation Expansions in Alcorn and Marshall Counties, Mississippi

Tennessee Valley Archaeological Research

PHASE I CULTURAL RESOURCES SURVEYS OF TENNESSEE VALLEY AUTHORITY'S CORNITH AND HOLLY SPRINGS SUBSTATION EXPANSIONS IN ALCORN AND MARSHALL COUNTIES, MISSISSIPPI

by
Ted Karpynec, Heidi Rosenwinkel, Meghan Weaver, Katherine Wright, and Elin Crook

Prepared for:
Tennessee Valley Authority
400 W. Summit Hill Drive
Knoxville, TN 37902

Prepared by:
Tennessee Valley Archaeological Research
2211 Seminole Drive, Suite 302
Huntsville, Alabama 35805

Hunter B. Johnson
Principal Investigator

May 2016

ABSTRACT

Under contract with the Tennessee Valley Authority (TVA), Tennessee Valley Archaeological Research (TVAR) conducted Phase I cultural resources surveys to document and assess cultural resources with the area of potential effects (APE) associated with the Corinth and Holly Springs substation expansions projects in Alcorn and Marshall Counties, Mississippi. The APE for the archaeological survey consisted of the footprints of the Corinth (2.42 ha [5.98 acres]) and Holly Springs (1.21 ha [2.98 acres]) substation expansions. The architectural APE consisted of a 0.8 km (0.5 mi) radius surrounding the substation footprints. Areas within the architectural survey radii that were determined not to be in view of the substations due to terrain, vegetation, and/or modern built environments were not considered as part of the architectural APE.

TVAR's architectural assessment of the survey radius surrounding the proposed Corinth substation expansion resulted in the revisitation of 14 previously documented architectural resources (003-COR-1249, 1251, 1252, 1253, 1254, 1255, 1256, 1257, 1258, 1259, 1260, 1261, 1262, and 1263). Of the 14 previously documented architectural resources, 13 (003-COR-1249, 1251, 1252, 1253, 1254, 1255, 1256, 1257, 1258, 1259, 1260, 1261, 1262, and 1263) are extant and located within the architectural APE. TVAR recommends these architectural resources not eligible for the National Register of Historic Places (NRHP) due to their lack of architectural distinction and loss of integrity caused by modern alterations and/or damage. TVAR's survey noted previously recorded property 003-COR-1251 is located outside the viewshed of the proposed project area. In addition, TVAR's survey of the APE associated with the Corinth substation identified six resources (IS-1-IS-6) within the survey radius, none of which are recommended as eligible for listing on the NRHP due to their lack of architectural and historic significance. Consequently, TVAR recommends no additional investigation of above-ground resources in connection with the proposed Corinth substation expansion project.

TVAR's architectural assessment of the survey radius surrounding the proposed Holly Springs substation expansion revisited two NRHP-listed historic districts, the Depot-Compress Historic District and the East Holly Springs Historic District, within the survey radius. Based on the results of TVAR's architectural survey, the two historic districts are located outside the viewshed to the project area and will not be affected by the proposed undertaking. In addition, TVAR's survey resulted in the identification of 14 resources (IS-1-IS-14) within the survey radius, none of which are recommended as eligible for listing on the NRHP due to their lack of architectural and historic significance. Consequently, TVAR recommends no additional investigation of above-ground resources in connection with the Holly Springs substation expansion project.

TVAR's archaeological survey resulted in the identification of one site (22AL726) within the APE associated with the Corinth substation expansion, but it lacks the potential to significantly contribute to research concerning the prehistory of the region. Consequently, TVAR recommends that the site is not eligible for listing on the NRHP. No resources were identified during TVAR's survey of the APE associated with the Holly Springs substation expansion. No further archaeological investigations are recommended in connection with either of the proposed projects.

TABLE OF CONTENTS

Chapter 1. Introduction 1
Chapter 2. Environment 5
Chapter 3. Cultural Context 13
Paleoindian 13
Archaic 13
Woodland 15
Mississippian 16
Historic Native American 17
Alcorn County History 17
Marshall County History 24
Chapter 4. Architectural Survey 29
Architectural Survey Methods 29
National Register of Historic Places Eligibility Criteria 33
Architectural Background Literature and Records Search 33
Architectural Survey Results 34
TVA Corinth Substation 34
Previously Recorded Architectural Resources 45
003-COR-1251 45
003-COR-1252 51
003-COR-1253 55
003-COR-1254 58
003-COR-1255 62
003-COR-1256 64
003-COR-1257 67
003-COR-1258 70
003-COR-1259 75
003-COR-1260 78
003-COR-1261 81
003-COR-1262 84
Newly Recorded Architectural Resources 87
IS-1 87
IS-2 89
IS-3 91
IS-4 93
IS-5 95
IS-6 97
IS-7 99
IS-8 101
TVA Holly Springs Substation 104
Newly Recorded Architectural Resources 115
IS-9 115
IS-11 119
IS-12 121
IS-13 124
IS-14 126
IS-15 128
IS-16 131

IS-17 134
IS-18 141
IS-19/ Mississippi Central Railroad 143
Chapter 5. Archaeological Survey 147
Archaeological Background Literature and Records Search 147
Methods of Investigation 152
Results of the Corinth Substation Expansion Survey 152
22AL726 154
Results of the Holly Springs Substation Expansion Survey 156
Chapter 6. Materials Recovered 159
Sherdlet 159
Lithic Debitage 159
Brick 159
Chapter 7. Summary and Recommendations 161
References Cited 163
Appendix A: Architectural Forms 175
Appendix B: Land Patents 215
Appendix C: Curation Letter 219
Appendix D: Shovel Test Roster 223
Appendix E: Site Form 229

LIST OF FIGURES

Figure 1.1. Project location map of Corinth substation expansion. 3
Figure 1.2. Project location map of Holly Springs substation expansion. 4
Figure 2.1. Corinth substation expansion project location within the Blackland Prairie Level IV ecoregion. 6
Figure 2.2. Holly Springs substation expansion project location within the Loess Plains Level IV ecoregion. 8
Figure 2.3. Fallow agricultural field within the APE associated with the Corinth substation expansion (view to the west). 9
Figure 2.4. Wooded area within the APE associated with the Corinth substation expansion (view to the west). 10
Figure 2.5. Existing Corinth substation (view to the west). 10
Figure 2.6. Gravel road traversing the Corinth substation expansion project area (view to the north). 11
Figure 2.7. Manicured grass field comprising the APE associated with the Holly Springs substation expansion (view to the east). 11
Figure 2.8. Existing Holly Springs substation (view to the northwest). 12
Figure 2.9. Residential development across from the Holly Springs substation (view to the southwest). 12
Figure 3.1. 1822 map of Mississippi showing native-held lands and early counties. 18
Figure 3.2. 1835 map of lands ceded by the Chickasaws to the United States. 19
Figure 3.3. 1862 map of Confederate and Union entrenchments in the vicinity of Corinth, from May to June. 22
Figure 3.4. 1876 map of the Battle of Iuka. 23
Figure 3.5. 1897 Rand McNally map of Alcorn County. 24
Figure 4.1. Excerpts of the USGS Corinth and Kendrick, MS quadrangles with viewshed analysis results, roads driven by TVAR historians, and locations of line-of-sight photos in the Corinth survey radius. 31

Figure 4.2. Excerpt of the USGS Holly Springs, MS quadrangle with viewshed analysis results, roads driven by TVAR historians, and locations of line-of-sight photos in the Holly Springs survey radius. 32
Figure 4.3. Map 1 of 2 showing the proposed project area, survey radius, and location of previously and newly recorded architectural resources.. 35
Figure 4.4. Map 2 of 2 showing the proposed project area, survey radius, and location of previously and newly recorded architectural resources.. 36
Figure 4.5. TVA Corinth substation expansion project area; view is north.. 37
Figure 4.6. TVA Corinth substation expansion project area; view is east. 37
Figure 4.7. TVA Corinth substation expansion project area; view is south.. 38
Figure 4.8. TVA Corinth substation expansion project area; view is west. 38
Figure 4.9. LOS-1; view is south.. 39
Figure 4.10. LOS-2; view is southwest.. 39
Figure 4.11. LOS-3; view is southwest.. 40
Figure 4.12. LOS-4; view is northeast. 40
Figure 4.13. Property 003-COR-1249; view is southwest. 41
Figure 4.14. Property 003-COR-1249; view is southwest looking toward the project area. . 41
Figure 4.15. Property 003-COR-1250; view is southeast. 42
Figure 4.16. Property 003-COR-1250; view is southwest looking toward the project area. . 42
Figure 4.17. Property 003-COR-1263; view is southeast. 43
Figure 4.18. Property 003-COR-1263; view is south looking toward the project area. 43
Figure 4.19. Current aerial imagery of the project area illustrating line-of-sight obstructions to architectural resources 003-COR-1249, 003-COR-1250, and 003-COR-1263.. 44
Figure 4.20. Property 003-COR-1251; view is southeast featuring the façade and west elevation.. 46
Figure 4.21. Property 003-COR-1251; view is southwest featuring the carport. 47
Figure 4.22. Property 003-COR-1251; view is west featuring the east elevation.. 47
Figure 4.23. Property 003-COR-1251; view is northeast featuring the south (rear) and west elevations.. 48
Figure 4.24. Property 003-COR-1251; view is northeast featuring the modern addition and chimney attached to the south (rear) elevation.. 48
Figure 4.25. Property 003-COR-1251; modern gazebo; view is southwest. 49
Figure 4.26. Property 003-COR-1251; modern utility building; view is southeast. 49
Figure 4.27. Property 003-COR-1251; ca. 1930 storage shed; view is southwest.. 50
Figure 4.28. Property 003-COR-1252; view is south featuring the façade. 52
Figure 4.29. Property 003-COR-1252; view is southwest featuring the east elevation. 52
Figure 4.30. Property 003-COR-1252; view is northeast featuring the south (rear) and west elevations.. 53
Figure 4.31. Property 003-COR-1252; view is southwest featuring the tornado shelter. . . . 53
Figure 4.32. Property 003-COR-1252; view is east featuring the modern storage shed. . . . 54
Figure 4.33. Property 003-COR-1252; view is southwest featuring the concrete block storage shed.. 54
Figure 4.34. Property 003-COR-1253; view is southwest featuring the façade and east elevation.. 56
Figure 4.35. Property 003-COR-1253; view is southeast featuring the west elevation. 56
Figure 4.36. Property 003-COR-1253; view is northeast featuring the south (rear) and west elevations.. 57
Figure 4.37. Property 003-COR-1253; view is northwest featuring the east and south (rear) elevations. 57
Figure 4.38. Property 003-COR-1254; view is northwest featuring the façade and east elevation.. 59

Figure 4.39. Property 003-COR-1254; view is northeast featuring the façade and west elevation. . . . 59
Figure 4.40. Property 003-COR-1254; view is southwest featuring the east and north (rear) elevations. . . . 60
Figure 4.41. Property 003-COR-1254; view is south featuring the north (rear) elevation. . . 60
Figure 4.42. Property 003-COR-1254; view is north featuring the prefabricated metal storage shed. . . . 61
Figure 4.43. Property 003-COR-1254; view is northeast featuring the ca. 1930 utility building. . . . 61
Figure 4.44. Property 003-COR-1255; view is northwest featuring the façade and east elevation. . . . 62
Figure 4.45. Property 003-COR-1255; view is northeast featuring the façade and west elevation. . . . 63
Figure 4.46. Property 003-COR-1255; view is south featuring the north (rear) elevations. . 63
Figure 4.47. Property 003-COR-1256; view is north featuring the façade. . . . 65
Figure 4.48. Property 003-COR-1256; view is northwest featuring the façade and east elevation. . . . 65
Figure 4.49. Property 003-COR-1256; view is east featuring the west elevation. . . . 66
Figure 4.50. Property 003-COR-1256; view is southeast featuring the north (rear) and west elevations. . . . 66
Figure 4.51. Property 003-COR-1257; view is northwest featuring the façade and east elevation. . . . 68
Figure 4.52. Property 003-COR-1257; view is northeast featuring the façade and west elevation. . . . 68
Figure 4.53. Property 003-COR-1257; view is southeast featuring the north (rear) and west elevations. . . . 69
Figure 4.54. Property 003-COR-1258; view is south featuring the façade. . . . 71
Figure 4.55. Property 003-COR-1258; view is southwest featuring the east elevation. . . . 72
Figure 4.56. Property 003-COR-1258; view is northeast featuring the west and south elevations. . . . 72
Figure 4.57. Property 003-COR-1258; view is northwest featuring the east and south (rear) elevations. . . . 73
Figure 4.58. Property 003-COR-1258; view is southwest featuring the modern garage. . . . 73
Figure 4.59. Property 003-COR-1258; view is south featuring the ca. 1950 garage. . . . 74
Figure 4.60. Property 003-COR-1259; view is east featuring the façade. . . . 76
Figure 4.61. Property 003-COR-1259; view is southeast featuring the façade and north elevation. . . . 76
Figure 4.62. Property 003-COR-1259; view is northwest featuring the south and east (rear) elevations. . . . 77
Figure 4.63. Property 003-COR-1260; view is south featuring the façade. . . . 79
Figure 4.64. Property 003-COR-1260; view is southwest featuring the façade and east elevation. . . . 79
Figure 4.65. Property 003-COR-1260; view is southeast featuring the façade and west elevation. . . . 80
Figure 4.66. Property 003-COR-1260; view is northwest featuring the east and south (rear) elevations. . . . 80
Figure 4.67. Property 003-COR-1261; view is northeast featuring the west (former primary façade) and south elevations. . . . 82
Figure 4.68. Property 003-COR-1261; view is northwest featuring the east and south elevations. . . . 82
Figure 4.69. Property 003-COR-1261; view is southwest featuring the north and west (former primary façade) elevations. . . . 83

Figure 4.70. Property 003-COR-1261; view is southwest featuring the north elevation. . . . 83
Figure 4.71. Property 003-COR-1262; view is southeast featuring the façade and the west elevation garage wing. . . . 85
Figure 4.72. Property 003-COR-1262; view is southwest featuring the façade and east elevation. . . . 85
Figure 4.73. Property 003-COR-1262; view is northwest featuring the east and south (rear) elevations. . . . 86
Figure 4.74. Property 003-COR-1262; view is southwest featuring the modern storage shed. . . . 86
Figure 4.75. Property IS-1; view is southwest featuring the façade and the north elevation garage wing. . . . 88
Figure 4.76. Property IS-1; view is northwest featuring the façade and south elevation. . . 88
Figure 4.77. Property IS-2; view is southwest featuring the façade and the north elevation carport wing. . . . 90
Figure 4.78. Property IS-2; view is northwest featuring the façade and south elevation. . . 90
Figure 4.79. Property IS-3; view is west featuring the façade and the north elevation carport wing. . . . 92
Figure 4.80. Property IS-3; view is northwest featuring the façade and south elevation. . . 92
Figure 4.81. Property IS-4; view is southwest featuring the façade and the north elevation carport wing. . . . 94
Figure 4.82. Property IS-4; view is northwest featuring the façade and south elevation. . . 94
Figure 4.83. Property IS-5; view is southwest featuring the façade and the north elevation carport wing. . . . 96
Figure 4.84. Property IS-5; view is northwest featuring the façade and south elevation. . . 96
Figure 4.85. Property IS-6; view is east featuring the façade and modern carport. 98
Figure 4.86. Property IS-6; view is northwest featuring the east (rear) elevation. 98
Figure 4.87. Property IS-7; view is south featuring the façade. . . . 100
Figure 4.88. Property IS-7; view is northwest featuring the south (rear) elevation and carport wing attached to the east elevation. . . . 100
Figure 4.89. Property IS-8; view is north featuring the façade. . . . 102
Figure 4.90. Property IS-8; view is southwest featuring the modern addition attached to the north (rear) elevation. . . . 102
Figure 4.91. Property IS-8; view is southeast featuring the west elevation of the main block. . . . 103
Figure 4.92. Property IS-8; view is north featuring the ca. 1970 storage shed. 103
Figure 4.93. Excerpt of the USGS Holly Springs, MS topographic quadrangle showing the proposed project area, survey radius, and location of previously and newly recorded architectural resources. . . . 105
Figure 4.94. TVA Holly Springs substation expansion project area; view is north. 106
Figure 4.95. TVA Holly Springs substation expansion project area; view is east. 106
Figure 4.96. TVA Holly Springs substation expansion project area; view is south. 107
Figure 4.97. TVA Holly Springs substation expansion project area; view is west. 107
Figure 4.98. LOS-5; view is northeast. . . . 108
Figure 4.99. LOS-6; view is east. . . . 108
Figure 4.100. LOS-7; view is southeast. . . . 109
Figure 4.101. LOS-8; view is northwest. . . . 109
Figure 4.102. LOS-9; view is southeast. . . . 110
Figure 4.103. LOS-10; view is southeast. . . . 110
Figure 4.104. LOS-11; Depot-Compress Historic District; view is south from the intersection of S. Compress Street and E. Van Dorn Avenue looking toward the project area. . . . 111

Figure 4.105. LOS-12; Depot-Compress Historic District; view is south from the intersection of S. Bethlehem Street and E. Van Dorn Avenue looking toward the project area. 111
Figure 4.106. LOS-13; Depot-Compress Historic District; view is south from E. Van Dorn Avenue looking toward the project area. 112
Figure 4.107. Holly Springs substation project area; view is north looking toward the Depot-Compress Historic District.. 112
Figure 4.108. LOS-14; East Holly Springs Historic District; view is southeast looking toward the project area. 113
Figure 4.109. Holly Springs substation project area; view is northwest looking toward the East Holly Springs Historic District.. 113
Figure 4.110. Current aerial imagery of the project area illustrating line-of-sight obstructions to the NRHP-listed Depot-Compress and East Holly Springs historic districts. 114
Figure 4.111. Property IS-9; view is southwest featuring the façade and east elevation. . . 116
Figure 4.112. Property IS-9; view is northeast featuring the south (rear) and west elevations. 116
Figure 4.113. Property IS-10; view is southeast featuring the façade and west elevation. 118
Figure 4.114. Property IS-10; view is northwest featuring the east and south (rear) elevations. 118
Figure 4.115. Property IS-11; view is southwest featuring the façade and east elevation. 120
Figure 4.116. Property IS-11; view is northeast featuring the south (rear) and west elevations. 120
Figure 4.117. Property IS-12; view is southwest featuring the façade and north elevation. 122
Figure 4.118. Property IS-12; view is northeast featuring the south and west (rear) elevations. 122
Figure 4.119. Property IS-12; view is west featuring the ca. 1950 storage shed. 123
Figure 4.120. Property IS-12; view is north featuring the ca. 1970 carport/garage building. 123
Figure 4.121. Property IS-13; view is northeast featuring the west elevation and the south elevations. 125
Figure 4.122. Property IS-13; view is southwest featuring the east (former primary façade) and north elevations. 125
Figure 4.123. Property IS-14; view is northwest featuring the façade and east elevation. 127
Figure 4.124. Property IS-14; view is southeast featuring the north (rear) and west elevations. 127
Figure 4.125. Property IS-15; view is east featuring the façade. 129
Figure 4.126. Property IS-15; view is southeast featuring the north (rear) and west elevations. 129
Figure 4.127. Property IS-15; view is northwest featuring the east (rear) and south elevations. 130
Figure 4.128. Property IS-15; view is east featuring the storage shed. 130
Figure 4.129. Property IS-16; view is southeast featuring the northern portion of the plaza façade.. 132
Figure 4.130. Property IS-16; view is north featuring the southern portion of the plaza façade.. 132
Figure 4.131. Property IS-16; view is northwest featuring the east (rear) and south elevations. 133

Figure 4.132. Property IS-16; view is southwest featuring the east (rear) and elevation. 133
Figure 4.133. Property IS-17; view is north featuring the main façade of the original plant building. 136
Figure 4.134. Property IS-17; view is northwest featuring the office wing attached to the east elevation of the original manufacturing building. 136
Figure 4.135. Property IS-17; view is northeast featuring the west elevation warehouse. 137
Figure 4.136. Property IS-17; modern concrete block warehouse addition attached to the west elevation; view is east. 137
Figure 4.137. Property IS-17; modern warehouse building; view is west. 138
Figure 4.138. Property IS-17; original water tower; view is northeast. 138
Figure 4.139. Property IS-17; modern pole shed; view is north. 139
Figure 4.140. Property IS-17; modern concrete block garage building; view is southeast. 139
Figure 4.141. Property IS-17; view is northeast featuring the modern storage building and utility shed. 140
Figure 4.142. Property IS-17; view is southeast featuring the manufacturing building. 140
Figure 4.143. Property IS-18; view is northeast and features the façade and south elevation. 142
Figure 4.144. Property IS-18; view is northwest and features the east and south elevations. 142
Figure 4.145. Property IS-19; view is west and features the at-grade crossing at Neely Avenue. 144
Figure 4.146. Property IS-19; view is east and features the at-grade crossing at Neely Avenue. 144
Figure 4.147. Property IS-19; view is northeast from Neely Avenue. 145
Figure 4.148. Property IS-19; view is southwest from Neely Avenue. 145
Figure 5.1. Background study area associated with the Corinth substation expansion. . . . 148
Figure 5.2. Background study area associated with the Holly Springs substation expansion. 149
Figure 5.3. Shovel test locations within the APE associated with the Corinth substation expansion. 153
Figure 5.4. Briars and tall grass at 22AL726. 155
Figure 5.5. Map of 22AL726 155
Figure 5.6. West profile of Shovel Test 27 at 22AL726. 156
Figure 5.7. Shovel test locations within the APE associated with the Holly Springs substation expansion. 157
Figure 5.8. Manicured grass comprising the Holly Springs substation expansion project area (view of the northwest). 158
Figure 5.9. Southwest profile of Shovel Test 13 within the APE associated with the Holly Springs substation expansion. 158

LIST OF TABLES

Table 1.1 Listing of the Previously Recorded Archaeological Sites within a Half-Mile Radius of the APE (ASSF) 7
Table 5.1. Archaeological Sites Within the Background Study Area. 150
Table 5.2. Previous Cultural Resources Surveys Within the Background Study Area. 151

CHAPTER 1. INTRODUCTION

Under contract with the Tennessee Valley Authority (TVA), Tennessee Valley Archaeological Research (TVAR) conducted a Phase I cultural resources survey to document and assess cultural resources located within the area of potential effects (APE) associated with the Corinth and Holly Springs substation expansion projects in Alcorn and Marshall Counties, Mississippi. The project area falls within Township 2 South, Range 7 East, Section 13 and Township 4 South, Range 2 West, Section 5. The APE for the archaeological survey consisted of the footprints of the Corinth (2.42 ha [5.98 acres]) and Holly Springs (1.21 ha [2.98 acres]) substation expansion areas. The architectural APE consisted of a 0.8 km (0.5 mi) radius surrounding the substation footprints. Areas within the architectural survey radii that were determined not to be in view of the substations due to terrain, vegetation, and/or modern built environments were not considered as part of the architectural APE (Figures 1.1 and 1.2).

The purpose of the investigation was to assist TVA in its Section 106 compliance and to provide an inventory of cultural resources within the project area, descriptions of the current conditions at each resource identified, and National Register of Historic Places (NRHP) eligibility recommendations for each resource. The survey was consistent with the Secretary of the Interior's *Standards and Guidelines for Identification* (National Parks Service [NPS] 1983) and met the requirements established by the Mississippi Department of Archives and History (MDAH).

TVAR's architectural assessment of the survey radius surrounding the proposed Corinth substation expansion was conducted on April 7, 2016 and resulted in the revisitation of 14 previously documented architectural resources (003-COR-1249, 1251, 1252, 1253, 1254, 1255, 1256, 1257, 1258, 1259, 1260, 1261, 1262, and 1263). Of the 14 previously documented architectural resources, 13 (003-COR-1249, 1251, 1252, 1253, 1254, 1255, 1256, 1257, 1258, 1259, 1260, 1261, 1262, and 1263) are extant and located within the architectural APE. TVAR recommends these architectural resources not eligible for the National Register of Historic Places (NRHP) due to their lack of architectural distinction and loss of integrity caused by modern alterations and/or damage. TVAR's survey noted previously recorded property 003-COR-1251 is located outside the viewshed of the proposed project area. In addition, TVAR's survey of the APE associated with the Corinth substation identified six resources (IS-1-IS-6) within the survey radius, none of which are recommended as eligible for listing on the NRHP due to their lack of architectural and historic significance. Consequently, TVAR recommends no additional investigation of above-ground resources in connection with the proposed Corinth substation expansion project.

TVAR's architectural assessment of the survey radius surrounding the proposed Holly Springs substation expansion, which was conducted on April 11, 2016, revisited two NRHP-listed historic districts, the Depot-Compress Historic District and the East Holly Springs Historic District, within the survey radius. Based on the results of TVAR's architectural survey, the two historic districts are located outside the viewshed to the project area and will not be affected by the proposed undertaking. In addition, TVAR's survey resulted in the identification of 14 resources (IS-1-IS-14) within the survey radius, none of which are recommended as eligible for listing on the NRHP due to their lack of architectural and historic significance. Consequently, TVAR recommends no additional investigation

of above-ground resources in connection with the Holly Springs substation expansion project.

TVAR's archaeological survey was conducted on April 7, 2016 under the supervision of Monica Warner with the assistance of Nicholas Simpson, Matt Sullivan, and Brady Swilley and resulted in the identification of one site within the APE associated with the Corinth substation expansion, but it lacks the potential to significantly contribute to research concerning the prehistory of the region. Consequently, TVAR recommends that the site is not eligible for listing on the NRHP. No resources were identified during TVAR's survey of the APE associated with the Holly Springs substation expansion. No further archaeological investigations are recommended in connection with the proposed projects.

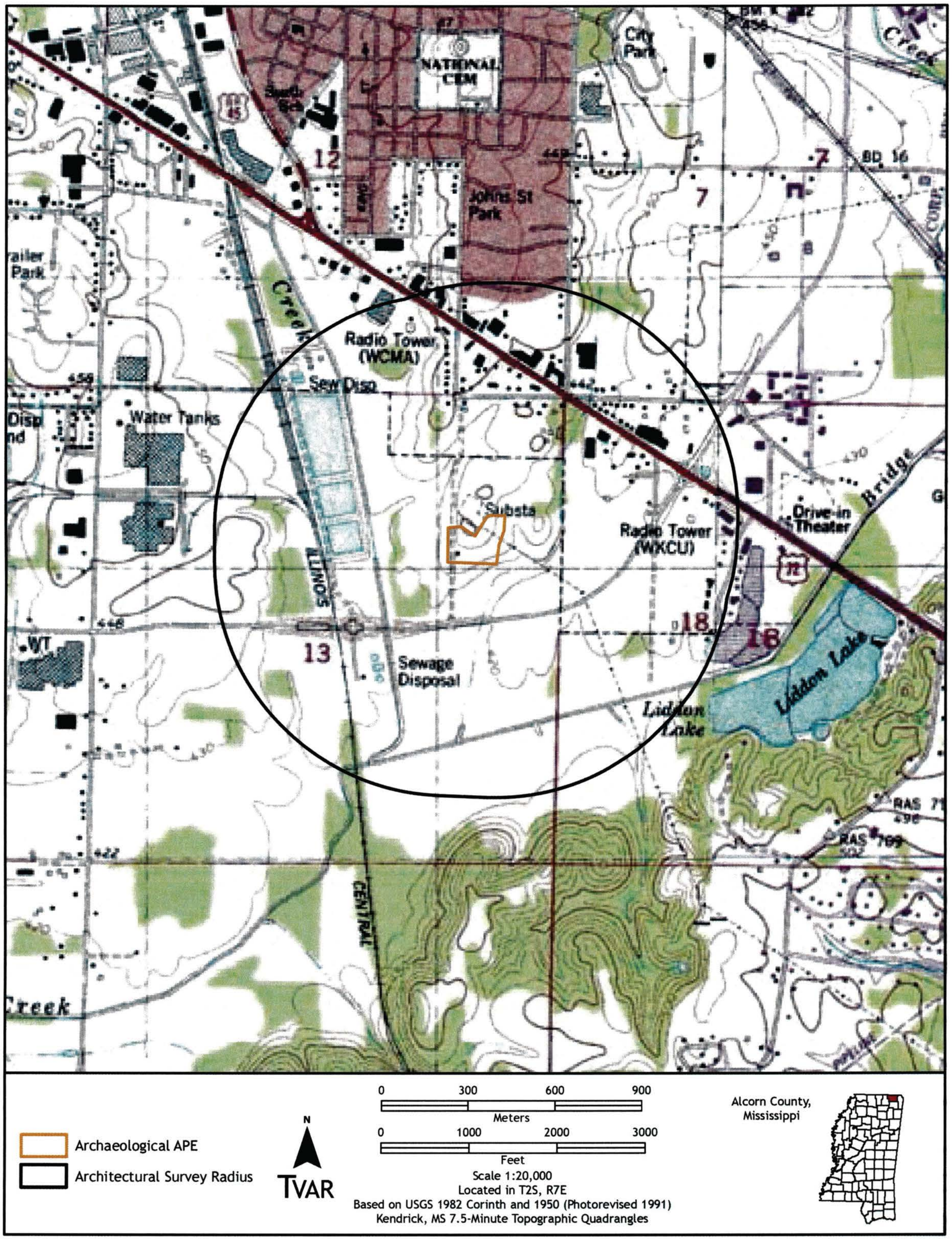


Figure 1.1. Project location map of Corinth substation expansion.

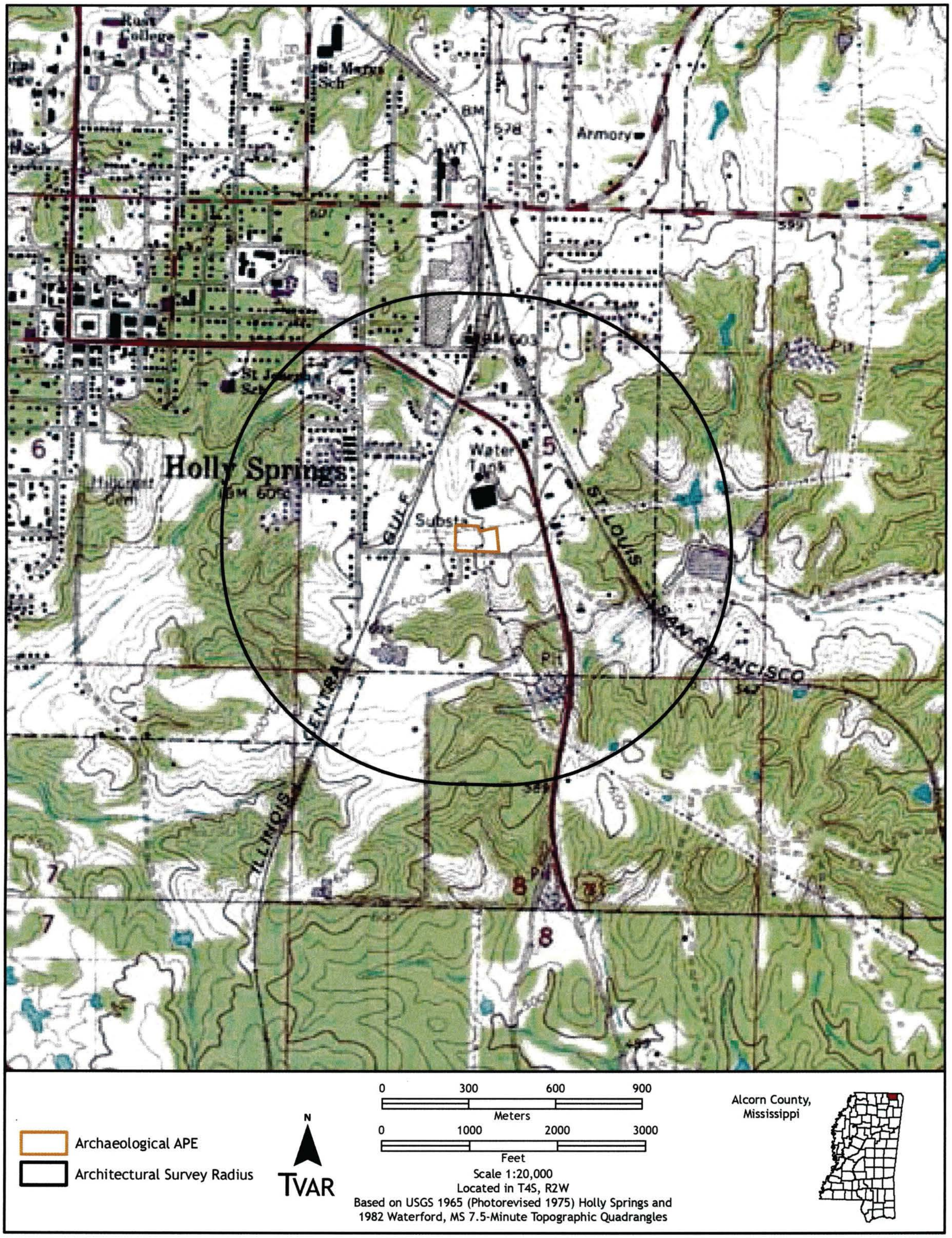


Figure 1.2. Project location map of Holly Springs substation expansion.

CHAPTER 2. ENVIRONMENT

The Corinth substation expansion project area is located in central Alcorn County, within the Upper Hatchie watershed. A canalized portion of Elam Creek associated with nearby sewage disposal and industrial waste facilities is 250 m to the west of the APE. The project area falls within Southeastern Plains Level III ecoregion. The Southeastern Plains is characterized by irregular plains predominantly covered by longleaf pine forests (Chapman et al. 2004). Within the Southeastern Plains, the project area is encompassed by the Blackland Prairie Level IV ecoregion (Figure 2.1).

The Blackland Prairie is comprised of undulating irregular plains that are dissected by low gradient streams. Vegetation native to the ecoregion includes blackbelt oak-cedar forests of chinkapin, blackjack, and post oaks; eastern redcedar; sweetgum; and hackberry. Additionally, patches of bluestem prairies of little bluestem, yellow Indiangrass, prairie rosinweed, and prairie coneflower are found throughout. The land is currently used for pasture, pond-raised catfish production, and cropland associated with the cultivation of hay, soybeans, corn, and cotton (Chapman et al. 2004).

The soil series mapped within the APE include Paden (PaB) and Providence (PdB3 and PdC3). Paden soils are well drained and formed in silty material and underlying alluvium. Paden silt loam (PaB) is found on stream terraces slopes between 2 and 5 percent. Providence soils are well drained and formed in a mantle of silty materials and underlying sandy and loamy sediments. Providence silt loam, severely eroded (PdB3) is found on terrace slopes between 2 and 5 percent, and Providence silt loam, severely eroded (PdC3) is found on terrace slopes ranging between 5 and 8 percent (NRCS 2016; SSURGO 2016). The underlying geology of the project area primarily consists of Cretaceous materials from the Demopolis chalk and Coffee sand units, and knappable chert gravel is produced by the nearby Tuscaloosa unit. (Futato 1999:47; O'Hear et al. 1985:7-8; Pettry 1983:3.1; USGS2014a). In addition, Fort Payne chert from the Fort Payne formation, which outcrops in neighboring northwestern Alabama, was accessible to prehistoric populations for tool manufacture (Johnson and Meeks 1994:67; O'Hear et al. 1985:7; Randall 2000:60).

Tuscaloosa gravel is readily available for collection in exposed gravel bars throughout the region (Bense 1983a:23; Ensor 1981:7-8; O'Hear et al. 1985:8). The chert is derived from Devonian and Mississippian geologic units, and after eroding from its parent formations, was fluvially transported and redeposited to form the Tuscaloosa formation (Bense 1983b:IIIF.1; Ensor 1981:8). The material ranges in color between yellow, white, and tan, and research has demonstrated that the gravel takes on a pinkish or red hue with heat treatment(Bense 1983a:23; Ensor 1981:8; Futato 1999:47). Fort Payne chert is formed in nodules or beds within the Fort Payne limestone, and some research indicates that it occurred in gravel bars in antiquity (Bense 1983a:23; 1983b:IIIF.1; Johnson and Meeks 1994:67; Randall 2000:58, 60). Fort Payne chert is generally gray to white with bluish mottling, and the texture distinctively granular, but the material varies widely from region to region (Ensor 1981:10; Futato 1999:47; Johnson and Meeks 1994:67).

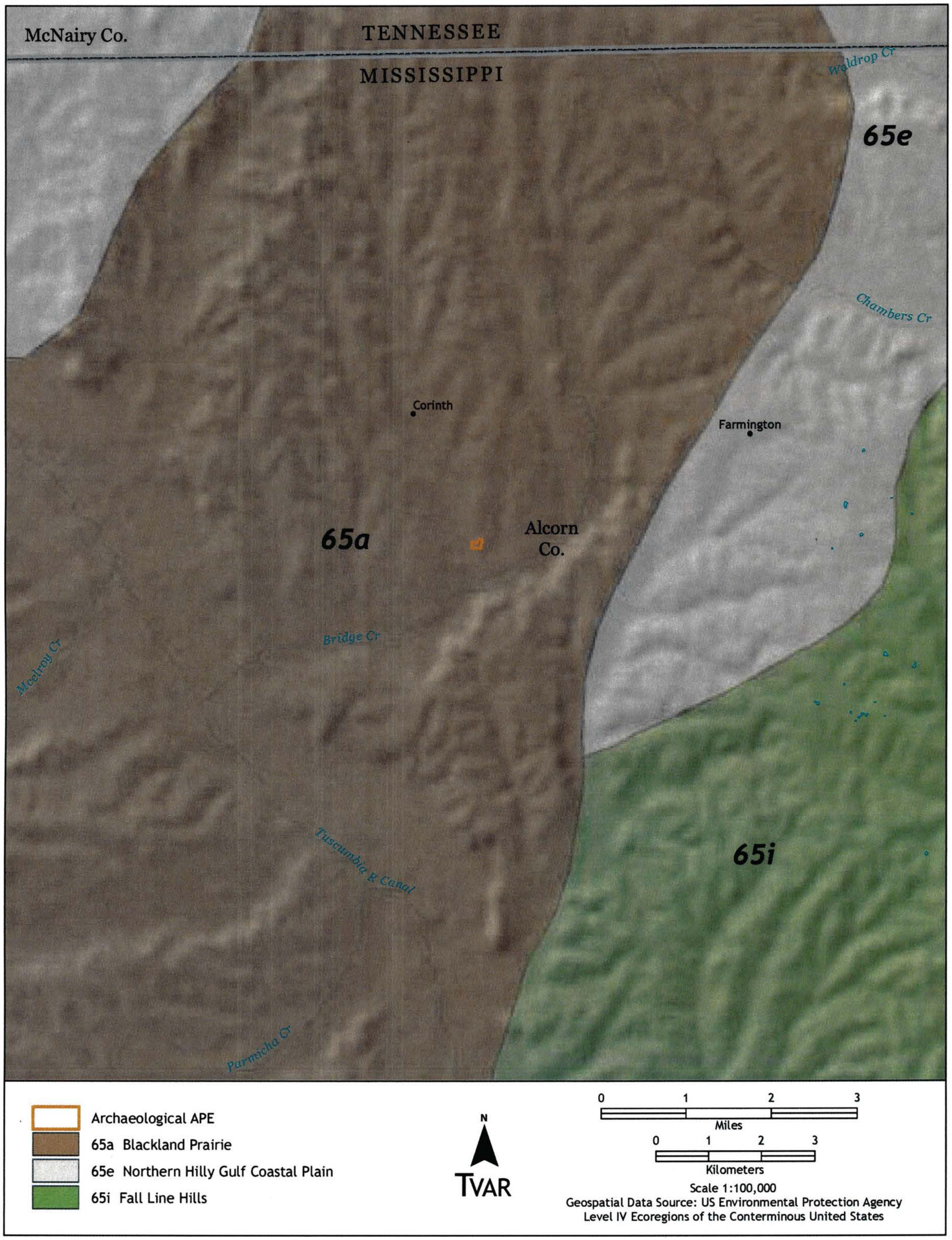


Figure 2.1. Corinth substation expansion project location within the Blackland Prairie Level IV ecoregion.

The Holly Springs substation expansion project area is located in central Marshall County, within the Coldwater watershed. Although no major natural water sources are located in proximity to the project area, numerous unnamed, spring-fed streams have been impounded throughout the region. The project area is located in the Loess Plains Level IV ecoregion, part of the larger Mississippi Valley Loess Plains Level III ecoregion (Figure 2.2). The Mississippi Valley Loess Plains extend from the Ohio River in western Kentucky to Louisiana and are comprised of irregular plains, hills, and river bluffs along the Mississippi River. The landscape is formed by thick layers of loess, and vegetation native to the ecoregion consists of primarily of hickory and oak-hickory-pine forests (Chapman et al. 2004).

The Loess Plains Level IV ecoregion is comprised of gently rolling to irregular plains with thinning layers of loess. Erosional activity throughout the region has resulted in wide, flat floodplains and increased silty and sandy substrates in stream bottoms. Vegetation native to the Loess Plains includes oak-hickory and oak-hickory-pine forests of white, post, southern red, blackjack oaks, mockernut and pignut hickory, shortleaf and loblolly pine, beech, and blackgum; southern floodplain forests of bald cypress and water tupelo; and bottomland hardwood forests of overcup, swamp chestnut, and water oak; water hickory, red maple, and green ash. The landwithin the Loess Plains is used primarily for agriculture and tree farming. Croplands are used to cultivate soybeans, cotton and corn (Chapman et al. 2004).

The soils mapped within the APE associated with the Holly Springs substation expansion include Lexington silt loam, severely eroded (LeC3) and Memphis silt loam, eroded (MeB2). Lexington soils are well drained and formed in mantles of loess. Lexington silt loam, severely eroded (LeC3) is found on hillslopes ranging between 5 and 8 percent. Memphis soils are well drained and formed in loess deposits over 122 cm thick. Memphis silt loam, eroded (MeB2) is found on summit slopes ranging between 2 and 5 percent (NRCS 2016; SSURGO 2016).

The underlying geology of the Holly Springs substation project area is comprised of materials from the Kosciusko and Tallahatta formations and Neshoba sand, all of the Claiborne group. The Kosciusko formation consists of irregularly bedded sand, clay, and quartzite, and the Tallahatta formation includes clay, claystone, and lenses of sand with some sandstone (USGS 2014b). The Kosciusko formation outcrops in an irregular belt through Mississippi's central and eastern counties, and the quartzite contained in the formation's distinctive ledges and boulders is sporadically found in prehistoric assemblages from counties along the state's northern border. Kosciusko quartzite is usually gray or brown in color, and is quite brittle, making it an excellent material for tool manufacture. Heat treatment improves the quartzite's knappability, although it does not generally change its color. In Mississippi, the material predominately appears in assemblages associated with the Early Archaic and transitional Woodland-Mississippian periods (Lehman 1982:15; McGahey 1999:2). Siliceous stone materials from the Tallahatta formation, which comprises the bulk of the area surrounding the APE, include chalcedony and orthoquartzite (USGS 2014b). Tallahatta orthoquartzite, also called buhrstone, occurs near the base of the formation. It varies in appearance, depending on the degree to which the material is weathered, beginning as a translucent bluish or greenish gray and weathering to a more opaque tan or brown (Adams et al. 1926:269; Lloyd 1983:126).

Figure 2.2. Holly Springs substation expansion project location within the Loess Plains Level IV ecoregion.

At the time of TVAR's survey, much of the project area associated with the expansion of the Corinth substation fell within fallow agricultural fields, and some wooded patches of secondary growth were found near the APE's northeastern corner (Figures 2.3 and 2.4). The existing substation was located to the north of the APE, and a maintained gravel road was also observed across the project area (Figures 2.5 and 2.6). The project area associated with the Holly Springs substation expansion primarily fell within a manicured grass field (Figure 2.7). The existing substation was located to the APE's west, and residential development was observed to the south of the project area across Neely Road (Figures 2.8 and 2.9).

Figure 2.3. Fallow agricultural field within the APE associated with the Corinth substation expansion (view to the west).

Figure 2.4. Wooded area within the APE associated with the Corinth substation expansion (view to the west).

Figure 2.5. Existing Corinth substation (view to the west).

Figure 2.6. Gravel road traversing the Corinth substation expansion project area (view to the north).

Figure 2.7. Manicured grass field comprising the APE associated with the Holly Springs substation expansion (view to the east).

Figure 2.8. Existing Holly Springs substation (view to the northwest).

Figure 2.9. Residential development across from the Holly Springs substation (view to the southwest).

CHAPTER 3. CULTURAL CONTEXT

Context for this study is provided in part by the following overview.[1] These summary sketches are simplified and not meant to replace more thorough research. Additional details are provided in the following Architecture and Archaeology chapters.

Paleoindian

Although there is some debate regarding the possible presence of earlier occupations (see Goodyear 2005), archaeologists generally agree that by ca. 11,500 B.C. southeastern North America was inhabited by nomadic hunter-gatherers that manufactured distinctive lanceolate-shaped hafted bifaces. The earliest of these Paleoindian populations hunted Pleistocene megafauna species such as mammoth and giant bison.

Walthall (1998) noted a dramatic increase in the use of caves and rockshelters in Late Paleoindian times. He attributed the shifting settlement pattern to increased populations and changes in mobility ranges and subsistence activities linked to broad environmental changes accompanied by extinctions of several Pleistocene faunal species hunted by earlier Paleoindian groups. Meeks and Anderson (2012) further advanced these arguments with hafted biface data indicative of a population increase during Late Paleoindian times.

Chronologically diagnostic hafted biface types provide a basis for a tripartite Paleoindian sequence dating between 11,500 and 9200 cal B.C. (Anderson et al. 1996; Sherwood et al. 2004). Early Paleoindian (ca, 11,500-10,900 cal B.C.) contexts are recognized by the presence of fluted and unfluted Clovis hafted bifaces. Fluted and unfluted lanceolate bifaces with broad blades and constricted hafts, such as Beaver Lake, Cumberland, and Quad, are considered Middle Paleoindian (10,900-10,000 cal B.C.) diagnostics. Late Paleoindian (10,000-9200 cal B.C.) assemblages are distinguished by the presence of lanceolate forms with side-notched hafts such as Dalton and Hardaway Side Notched. Clovis and Cumberland fluted points, primarily knapped from Fort Payne chert, have been recovered in northeast Mississippi. The Hester site, located in Monroe County, is a multicomponent site with Late Paleoindian Quad and Dalton components underlying a distinct Early Archaic deposit (Little et al. 2016:367).

Archaic

Archaic manifestations in the Southeast are represented by preceramic and early ceramic assemblages dating from approximately 9500 to 800 cal B.C. Based on temporally diagnostic hafted bifaces, stratigraphic contexts, and radiocarbon dates, fairly well-documented Archaic sequences have been developed throughout the region: Early Archaic (9200-6900 cal B.C.), Middle Archaic (6900-3700 cal B.C.), and Late Archaic (3700-800 cal B.C.).[2]

---

[1] Portions of the summaries are extracted verbatim, or nearly so, from previous TVAR reports without further citation (e.g., Little et al. 2012; Little et al. 2016).
[2] These generalized date ranges vary somewhat from one locality to another.

The settlement system of Early Archaic groups appears to represent a continuum of that employed in earlier Late Paleoindian times with occupations of caves, rockshelters, and open-air sites. Walthall (1980) suggested that population size continued to increase during this period. Early Archaic is chronologically ordered by diagnostic hafted biface types (Anderson et al. 1994; Sherwood et al. 2004). The sequence begins with side-notched types such as Big Sandy, Bolen, and Taylor. The Edgefield scraper is another likely constituent of the earliest Early Archaic assemblages. These assemblages date from about 9200 to 8500 cal B.C. Corner-notched types, such as Kirk Corner Notched and Palmer Corner Notched, were manufactured from approximately 8500 to 7800 cal B.C., while bifurcated types, including Lecroy, MacCorkle, and St. Albans, were made from about 7800 to 6600 cal B.C.

The Middle Archaic period coincides closely with the Hypsithermal climate interval during the Middle Holocene. As McNutt (2008:54-56) indicated, Hypsithermal climate conditions varied significantly across the landscapes of the Southeast, and Sassaman (2001) argued that there were marked sociocultural differences, as well. Along the South Atlantic Slopes settlements were concentrated in upland environments, while west of the Appalachians riverine settings were important to Middle Archaic populations (Dye 1996; Sassaman 2001). Sites marked by large accumulations of freshwater mollusk shells begin to appear in the archaeological record in the Tennessee Valley (Lewis and Lewis 1961; Walthall 1980:62). Middle Archaic populations also occupied caves and rockshelters in the Tennessee Valley (e.g., Cambron and Waters 1961; DeJarnette et al. 1962; Hollingsworth 1991; Ingmanson and Griffin 1994; Little et al. 2013; Sherwood et al. 2004). Bense (1994:78) pointed out that human burials are sparsely represented in the archaeological record prior to the Middle Archaic. However, there is ample evidence of Middle Archaic burials (DeJarnette et al. 1962:80; Dowd 1989; Lewis and Lewis 1961; Walthall 1980:61-65). There is also evidence of interpersonal conflict during the Middle Archaic (Walthall 1980:64). Near the end of the period, extensive exchange networks developed in the region (Jefferies 1996; Johnson and Brookes 1989), and construction possibly began on some of the earliest mounds in the Southeast (Russo 1996; Saunders 1994).

A Middle Archaic hafted biface chronology has been established for a broad region across the Southeast. The earliest Middle Archaic manifestations are marked by the presence of Kirk Stemmed, Kirk Serrated, and Stanley Stemmed bifaces between 6900 and 6300 cal B.C. Later in the sequence, from approximately 6300 to 5400 cal B.C., Eva and Morrow Mountain hafted bifaces were constituents of Middle Archaic lithic toolkits. Middle Archaic assemblages dating to 5400-4300 cal B.C. are marked by the presence of Sykes/White Springs and Guilford hafted bifaces. Benton bifaces are diagnostic of terminal Middle Archaic (4500-3700 cal B.C.) occupations in the Tennessee-Tombigbee region of Alabama, Mississippi, and Tennessee (McNutt 2008; Meeks 1999). Middle Archaic sites in northeast Mississippi are represented mostly from midden mounds, sites such as Moore's Creek (22AL521) and Mann (22TS565) (Penman 1975; Meeks 1999).

The Late Archaic is marked by several technological developments. Perhaps foremost of these was the domestication of several plant species in eastern North America around 5000-3800 B.P. (Smith 2011; Smith and Yarnell 2009). These domesticates are sometimes referred to collectively as the "eastern agricultural complex," which consisted of squash, sunflower, marshelder, and chenopod. Other plants such as erect knotweed, little barley, and maygrass do not appear to have been domesticated but were in all probability deliberately planted.

In addition, fiber-tempered pottery and steatite vessels first appeared in the Coastal Plain of the Southeast during the Late Archaic (Sassaman 1993; Walthall and Jenkins 1976). Jenkins and Krause (1986:36-37) suggested that soapstone vessels are horizon markers for terminal Late Archaic assemblages. Truncer's (2004:507) study of steatite vessel chronology concluded that steatite vessels were produced for almost 2000 years before they peaked "clearly and strongly around 1500 cal B.C., a peak that accounts for the general success of the horizon-marker use." Sassaman (2006:151) disputed Truncer's chronology and alternatively argued that there is insufficient evidence for presuming that steatite vessels predate 3700 radiocarbon years B.P.

During the ending centuries of the Late Archaic, the well-known Poverty Point earthworks also were constructed (Kidder 2002; Gibson 2000, 2007, 2010; Ortmann 2010). The Poverty Point site has yielded large inventories of artifacts made of exotic stones such as soapstone, greenstone, galena, copper, hematite, magnetite, crystal quartz, novaculite, fluorite, obsidian, Fort Payne chert, Dover chert, and Pickwick chert (Gibson 2000:172-173). These nonlocal materials constitute good evidence for panregional exchange. The site has been widely recognized as a material manifestation of a conspicuous development in sociopolitical complexity, although the composition and inner workings of the Late Archaic society is a subject of supposition and debate (e.g., Gibson 2007; Sassaman 2005).

By Late Archaic times, the regionalized hafted biface sequences that characterized the Early and Middle Archaic periods were replaced by more localized temporal trajectories of mostly stemmed bifaces. For instance, Savannah River Stemmed was widely distributed along the South Atlantic Slopes, while early in the sequence, Ledbetter and Pickwick were disbursed in an area extending from the southwestern slopes of the Appalachians into the Coastal Plain of Tennessee, Mississippi, and Alabama. Near the end of the Late Archaic in the westerly region, a multitude of other stemmed types were manufactured including Cotaco Creek, Flint Creek, Little Bear Creek, McIntire, Motley, and Wade. Diagnostics including Pickwick, Ledbetter, Gary, Elora and Little Bear Creek points, were used to identify the Late Archaic component at the Kellogg Village Site (22CL527) in northeast Mississippi (Atkinson et al. 1980).

Woodland

The Woodland stage is perhaps best known for the Adena and Hopewell earthworks and mortuary practices in the Ohio Valley and widespread exchange networks in which exotic artifacts and raw materials were distributed across much of eastern North America during the Early and Middle periods of the stage. There is evidence that cultivation of some of the plants domesticated in eastern North America became an important subsistence pursuit in the Ohio Valley (Wymer 1996) and other areas of the East (Yarnell 1993). While less numerous and spectacular than those of the Ohio Valley, Middle Woodland platform mounds and linear earthen embankments (Keith 2010; Knight 2001; Mainfort 1989), piled-stone structures (i.e., mounds, effigies, and linear "wall-like" structures) (Faulkner 1996; Holstein et al. 1995; Jefferies and Fish 1978; Keith 2010), and burial mounds (Cole 1981; Jefferies 1976; Jenkins and Krause 1986; Walthall 1980; Waring 1945; Wimberly and Tourtelot 1941) are fairly widespread across various landscapes in the Southeast. Woodland mound burials sometimes were accompanied by nonlocal materials such as marine shell, copper, galena, and mica, to name but a few. During the Late Woodland, there was an obvious reduction in both earthworks and distributions of exotic materials in some areas of the Southeast, though this pattern

does not hold throughout the region (Anderson and Mainfort 2002:15-19). A major technological change is signaled by the introduction of bow-and-arrow technology into the region during the Late Woodland (Blitz 1988).

The Middle Woodland Stage in northeast Mississippi is generally defined by the Miller I and II sequences from archaeological work primarily conducted in the Tombigbee River drainage for the Tenn-Tom Waterway (Jenkins 1979). Miller sequences are defined by ceramic diagnostics, sand-tempered forms representing the earlier Miller I phase and grog-tempered defining the later division III (Johnson 1988). Miller I is characterized by the presence of sand tempered fabric marked (Saltillo Fabric Marked), cordmarked (Furrs Cordmarked), and plain (Baldwin Plain) ceramics. Furrs Cord marked pottery generally increases and Saltillo Fabric Marked pottery decreases to almost absence in the Miller II phase. Sedentary settlement patterns become more dominant in the Middle Woodland, which is evident by large round-to-oval postmold patterns excavated at the Bynum site (Bohannon 1972). The Bynum site also yielded non-local materials, including copper spools, some of which were filled with galena, rolled sheet copper objects, galena, greenstone celts, and Busycon shell fragments.

The Late Woodland Stage corresponds to Miller III in northeast Mississippi. Grog tempered ceramics dominate with Baytown Plain and Mulberry Creek Cordmarked varieties, and Fabric Marked, Wheeler Check Stamped, and Alligator Incised occurring in smaller quantities. Lithic technologies are primarily represented by locally available chert sources that were commonly heat treated. Small triangular projectile or arrow points, such as Madison and Hamilton, have been recovered from Miller III contexts. These triangular diagnostics have been attributed to large fauna subsistence, such as deer (Jackson and Scott 2002). All three Miller phases were represented by that sites that were excavated by TVAR along Chickasawhay Creek between 2012 and 2013 (Little et al. 2016:385).

Mississippian

Many, if not most, current researchers concur that populations associated with Mississippian stage manifestations throughout southeastern North America were set aside from earlier ones by the development of institutionalized social inequality (Smith 1990). Maize agriculture appears to have been an important subsistence component for most Mississippian societies (Scarry 1993). Pole-framed public and domestic structures were often rectangular (sometimes circular) and sometimes employed wattle-and-daub wall construction. A central plaza surrounded by mounds and public and domestic structures characterized some of the larger Mississippian communities (Lewis and Stout 1998). Some Mississippian sites also were fortified with palisade walls and bastions and sometimes defensive ditches or moats, as well (e.g., Knight and Steponaitis 1998; Larson 1972; Schroedl 1998). Regional settlement studies typically reflect a site hierarchy consisting of mound centers and outlying nonmound sites (e.g., Anderson 1994; Blitz and Lorenz 2006; Hally 1993; Steponaitis 1978). Specially crafted artifacts often made of extralocal materials furnish evidence of widespread interregional exchange (Brown 2004). The existence of far-reaching Mississippian alliances in the interior Southeast was documented at the time of initial European contact. The Lyon's bluff site located in northeast Mississippi is characteristic of the Mississippian stage manifestations identified at Moundville in western Alabama. Moundville ceramics, such as Mississippi Plain, Bell Plain, Moundville Incised, Cartage Incised, and Moundville Engraved, have been found at Lyon's Bluff (Atkinson 1986).

Historic Native American

Although earlier there were sporadic European contacts with Native Americans along the Gulf and Atlantic coasts and failed colonial attempts by both the Spanish and French, the Spanish expedition of Hernando de Soto (1539-1543) represents the earliest recorded European contact with native populations in the interior of southeastern North America. In the 1560s, the Tristan de Luna and Juan Pardo expeditions revisited some of the areas in the interior traversed by the earlier Soto entrada. By almost all archaeological accounts, widespread and extensive depopulation followed in the wake of the sixteenth-century Spanish incursions into the Southeast, and there was a concomitant disintegration of Mississippian polities accompanied by migrations and coalescence of native groups throughout much of the region (Hoffman 1993; Jeter 2002; Knight 1994; Little 2008; Morse and Morse 1983:313-315; Regnier 2014; Smith 1987, 2006). Hudson and Tesser (1994) pointed out that these years have been largely neglected by historians and referred to them as the forgotten centuries. Robbie Ethridge (2009) has subsequently illuminated some of these shadowy times with her conception of the Mississippian shatter zone, i.e., a region of widespread social and political transformations of native groups, presumably related to internecine warfare and slave trade with Europeans.

In the late seventeenth and early eighteenth centuries, the British, French, and Spaniards competed for control over broad regions of the Southeast. Increasing participation in nascent European capitalist markets through deerskin and peltry trade contributed to extensive transformations of native groups during the colonial era (Braund 1993; Waselkov 1988; White 1983), and by the mid-1800s, the United States government had exiled most of the remaining Southeastern groups to Oklahoma.

Alcorn County History

Located in northeastern Mississippi, Alcorn County is bordered by the state of Tennessee to the north, Tishomingo County to the east, Prentiss County to the south, and Tippah County to the west. Named for Governor James L. Alcorn, Alcorn County was established on April 15, 1870, and formed from portions of Tippah and Tishomingo Counties. The county encompasses 402 square miles. Corinth was established as the county seat in 1853 and remains so today (MSGenWeb 2015). From 1798 to 1812, the population of the Mississippi Territory grew at a steady, yet moderate pace, however in the years following the War of 1812, as historian Robert V. Haynes explains, "[the] Territory experienced a population explosion or 'fever' as the phenomenon was then called. The period from 1800 to 1819 became known as the 'The Great Migration,' when thousands of pioneers crossed the mountains and settled the Old Southwest and Northwest" (Haynes 2010:133). Despite laws that prohibited the settlement of Chickasaw and Choctaw lands, the westward progression of Euro-American migration led to the taking of land by squatters and the establishment of businesses along the Natchez Trace (Figures 3.1-3.2) (Haynes 2010:203).

The Mississippi Territory was established by Congress on April 7, 1798, and on December 10, 1817, Mississippi became the twentieth state admitted to the Union (Hoseman 2012:743). At that time, immigrants to Mississippi could only legally settle in three areas: on a strip of land in the southern part of the state, east of the Tombigbee along the Alabama line, or in the Natchez District (Clark and

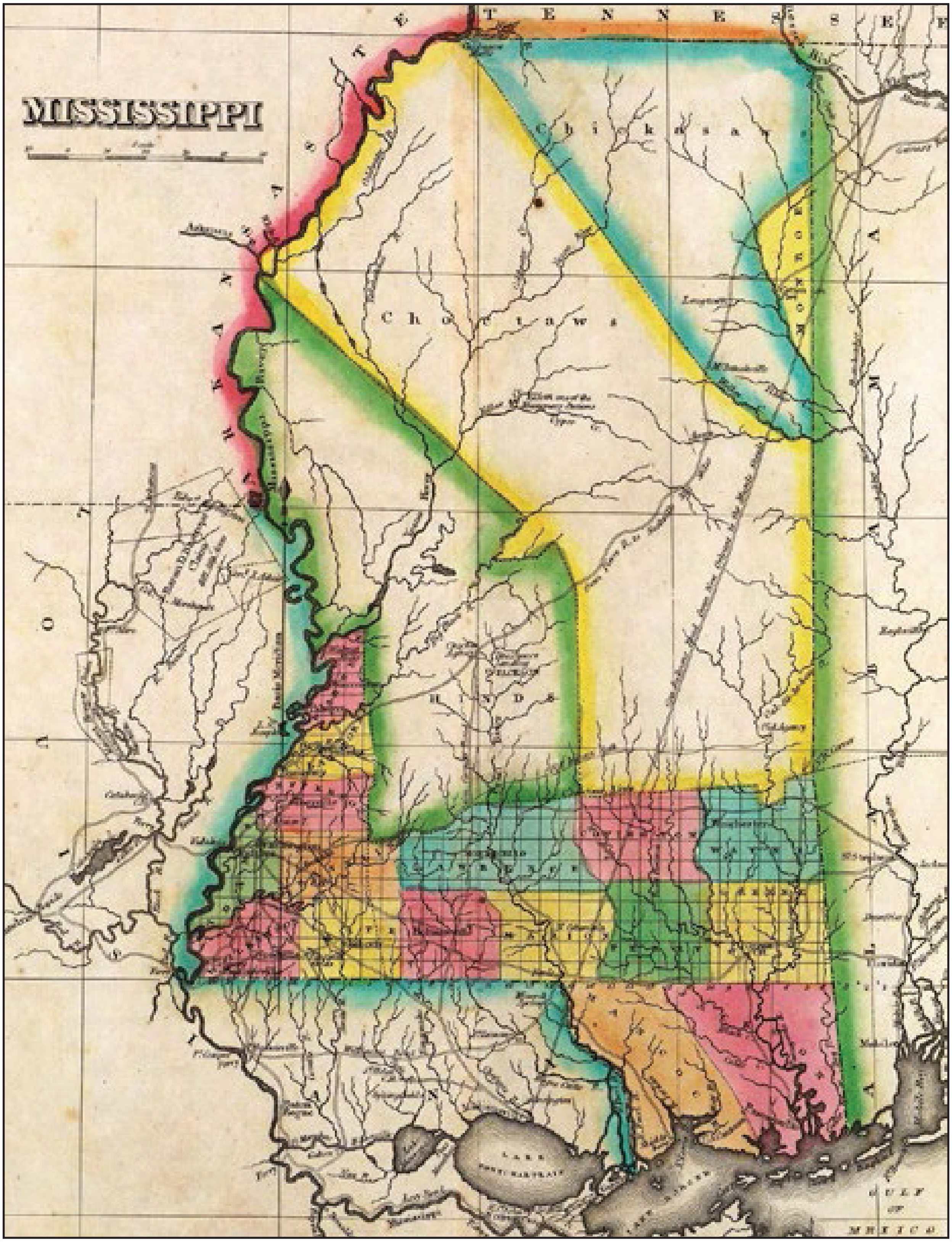


Figure 3.1. 1822 map of Mississippi showing native-held lands and early counties.

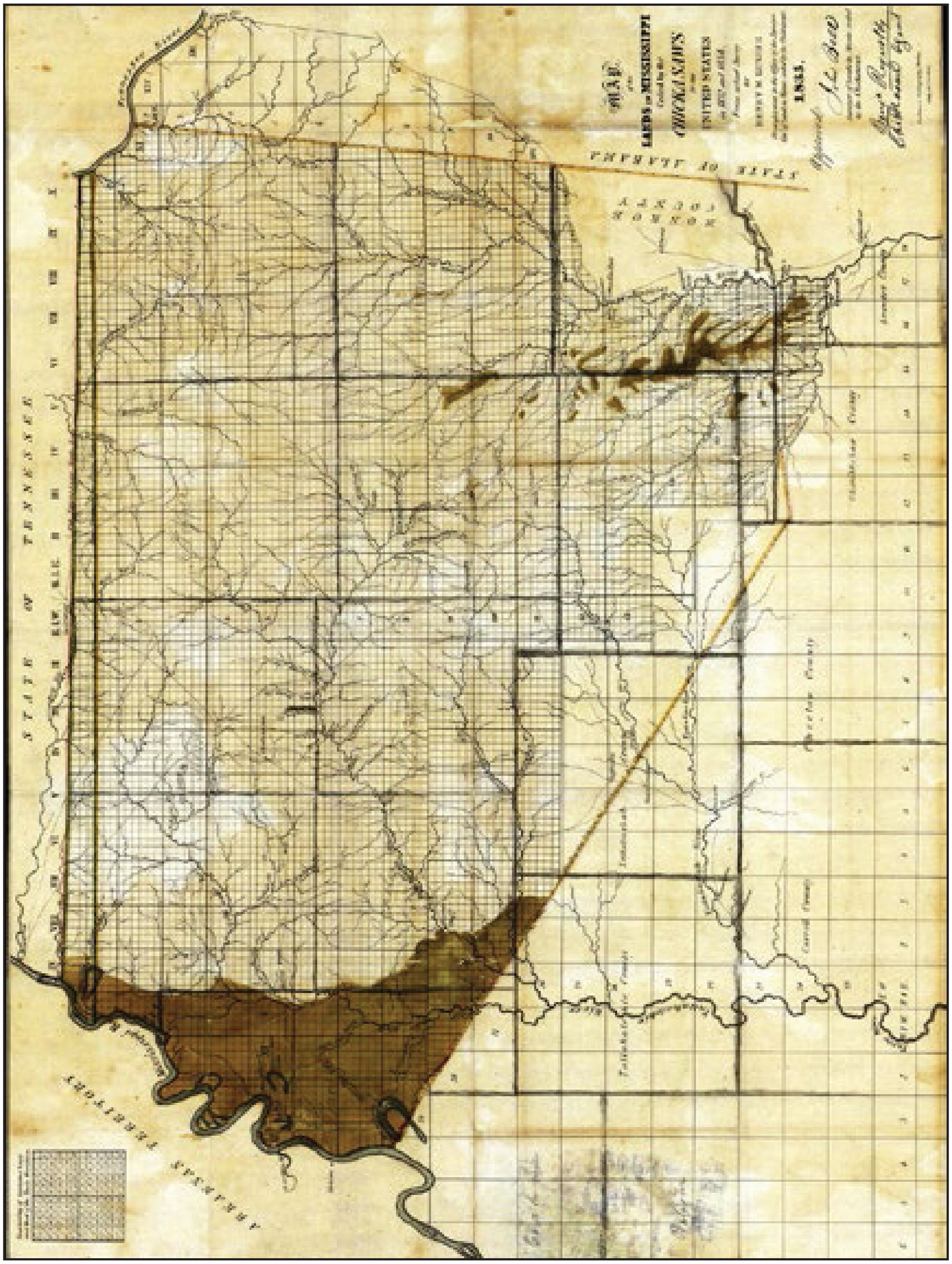


Figure 3.2. 1835 map of lands ceded by the Chickasaws to the United States.

Guice 1989:165). Approximately 75,500 people lived in Mississippi by 1820, and 44 percent of the population was enslaved (Westley 2005:67). In northeastern Mississippi, an influx of traders and settlers increased the white population in the area to between 4,000 and 5,000 people. Tensions escalated between the Chickasaws and the settlers, primarily due to land disputes caused by the setters' use of Chickasaw land for cultivation and livestock pasturing. The federal government cited these tensions during treaty negotiations with the Chickasaw, and declared immediate removal to be in their best interest (Franks 2009). One of Andrew Jackson's campaign promises from the presidential election of 1828 was the removal of the Southeastern tribes to lands west of the Mississippi River. True to his word, following his election, President Jackson appointed two commissioners to expedite the process and provided them with the simple instructions that they "fail not to make a treaty" for the remaining Choctaw lands in Mississippi (Elliott and Barnes 1996:13; Halbert 1902:375).

The majority of the area's early settlers arrived from the Carolinas, Georgia, and Alabama. Early settlements in the county included Corinth, Danville, Glendale, Kossuth, and Rienzi (Lowry and McCardle 1891:439). By 1840, the population of Tippah and Tishomingo Counties included 16,125 residents (U.S. Census Bureau 1872:42-43). The Hatchie and Tuscumbia rivers and their tributaries allowed for the early movement of goods to market. Corinth, located at the intersection of the Memphis & Charleston and Mobile & Ohio railroads, was founded in 1853 and grew into a major commercial hub due to ready rail access to Memphis (Rowland 1907:61; 565-566).

Lying within the Northeastern Prairie and Limestone Formation regions, the area features timbered, gently rolling topography with river and creek bottom lands that provided an excellent environment for agriculture and the raising of livestock (Rowland 1907:61). The typical antebellum Tishomingo or Tippah County farmer raised cattle, horses, sheep, and swine, as well as corn, oats, potatoes, tobacco, and cotton (DeBow 1853:456-460). Market products such as wool, flax, butter, and cheese supplemented a farmer's income. The county's location within the soil-rich region of north Mississippi lent itself to large plantations commonly found in the Lower South. As a result, farms were generally large-sized operations. In 1850, the counties contained 162,220 improved acres of farmland (DeBow 1853:456). By 1860, improved acreage had surged to 248,805 acres (Kennedy 1864:84).

The surge of tobacco and cotton as major cash crops drove the establishment of larger plantations throughout the region, often depending on enslaved Africans and African-descended peoples to provide labor for the county's farmers. Although a number of white families in the county did not own slaves, slavery was seen as part of the accepted social order and as the necessary means for producing wealth and marking social achievement. Slaves comprised approximately 19 percent (or 6,889 individuals) of Tippah and Tishomingo Counties' total population of 36,231 in 1850. By 1860, slaves constituted 24.1 percent of the counties' total population. During the same period, the number of 'free colored' individuals in the area was low; only seven persons were counted in 1850 and 22 in 1860 (United States Census Bureau 1872:41-43).

The onset of the Civil War brought great upheaval and loss to the region and county residents. On January 9, 1861, Mississippi became the second Southern state to secede from the Union, and Tippah and Tishomingo Counties raised 15 Confederate regiments for the Mississippi Infantry, Mississippi Cavalry, and Mississippi Partisans (FamilySearch.org 2016a; 2016b). Major battles in Tishomingo

County took place in Corinth (April 29-June 10, 1862 and October 3, 1862) and Iuka (September 19, 1862) (Figures 3.3-3.4). Corinth's pivotal location at the rail junction made it an important supply center for the Confederacy. The Siege of Corinth began following the Union victory at Shiloh. Under the command of Major General Henry Halleck, Union forces began their advance on the city and by May 25, 1862, were close enough to begin their bombardment. The Confederate troops, led by General Pierre G. T. Beauregard, fled Corinth for Tupelo (Rowland 1907:153-154). The Union forces occupied Corinth through July of that year, until a large contingency marched toward Chattanooga. Troops remaining behind in Corinth were commanded by General William S. Rosecrans (Rowland 1907:153-154).

In an attempt to prevent Rosecrans from encroaching into Middle Tennessee, the Confederate Army of the West, led by General Sterling Price, marched into Iuka on September 14, 1862. The battle resulted in the deaths of 86 Confederate and 790 Union men (Rowland 1907:949-950). Remaining soldiers with the Army of the West retreated and rejoined General Earl Van Dorn for an assault on Corinth. The second battle in Corinth took place on October 3, 1862, when General Van Dorn led the Army of West Tennessee in an attack on General Rosecrans' Union troops. After three separate assaults, the Union drove back the Confederates, and in the process, captured 2,268 rebel prisoners. The battle ultimately resulted in 505 casualties, 2,150 wounded, and 2,183 missing for the Confederacy and 355 casualties, 1,841 wounded, and 324 missing for the Union (Rowland 1907:567-570).

As with most of the rural South, northeastern Mississippi had grown as an agricultural region, suffered during the Civil War and Reconstruction, and reclaimed its agrarian economy after the war. A sharecropping economy arose in the postbellum period, lasting from about 1870 to the 1930s. The end of the war also brought about the reorganization of northern Mississippi counties, resulting in the formation of Alcorn County in April 1870. At that time, the county's population included 10,431 individuals, 26.5 percent of whom were described as 'free colored' (U.S. Census Bureau 1872:42). Corinth was quickly established as the county seat and was originally named Cross City. Large plantations in the region dwindled, and the amount of improved acreage in Alcorn County included only 41,300 acres in 1870 (U.S. Census Bureau 1872:184). Farmers primarily raised swine, sheep, and cattle, and cultivated corn, wheat, and potatoes. Butter, milk, wool, and cane molasses were staple farm-to-market products for the Alcorn County farmer (U.S. Census Bureau 1872:184-187).

In the late nineteenth century, Alcorn County's economy expanded to include large-scale commercial and industrial enterprises, which were primarily centered around Corinth (Figure 3.5). As one of the most important manufacturing centers in Mississippi, Corinth housed clothing, iron, and lumber mills, as well as a number of cotton gins. The city became a center for finance, with the opening of the Tishomingo Savings Institution, the Bank of Corinth, and the Citizens Savings Bank (Rowland 1907:566). The early twentieth century saw the construction of an improved road network and the development of municipal infrastructure, particularly in Corinth. By the early 1900s, the city was equipped with a sewage system, electric lighting, and a water works system (Rowland 1907:566).

While Alcorn County has remained largely agricultural throughout its history, the twentieth and early twenty-first centuries saw an increase in large-scale manufacturers. Alcorn County's workforce is largely employed within the manufacture of paper and fiber products, industrial equipment, and vinyl products, as well as construction, health-care services, and machining. Major corporations including

Figure 3.3. 1862 map of Confederate and Union entrenchments in the vicinty of Corinth, from May to June.

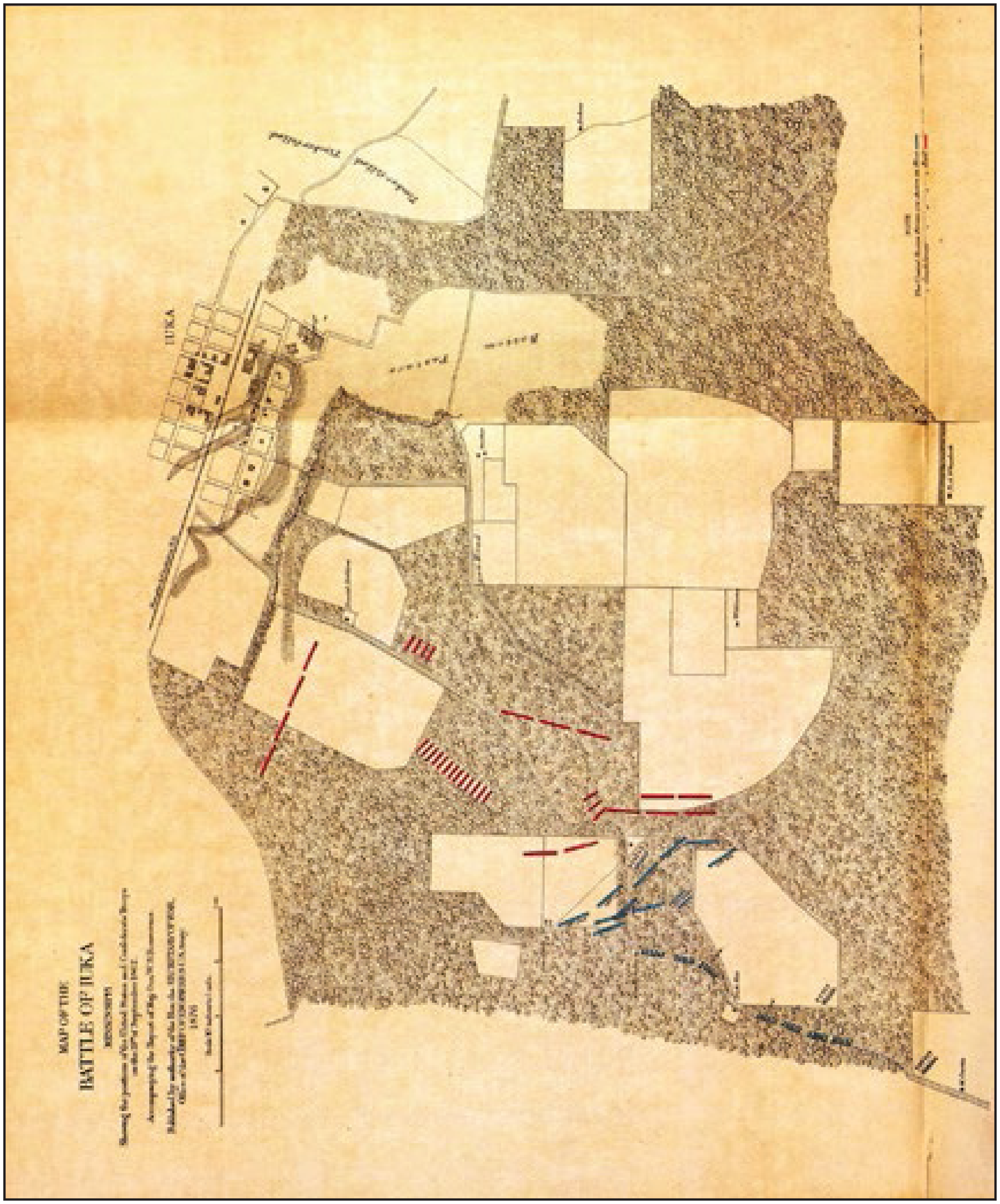


Figure 3.4. 1876 map of the Battle of Iuka.

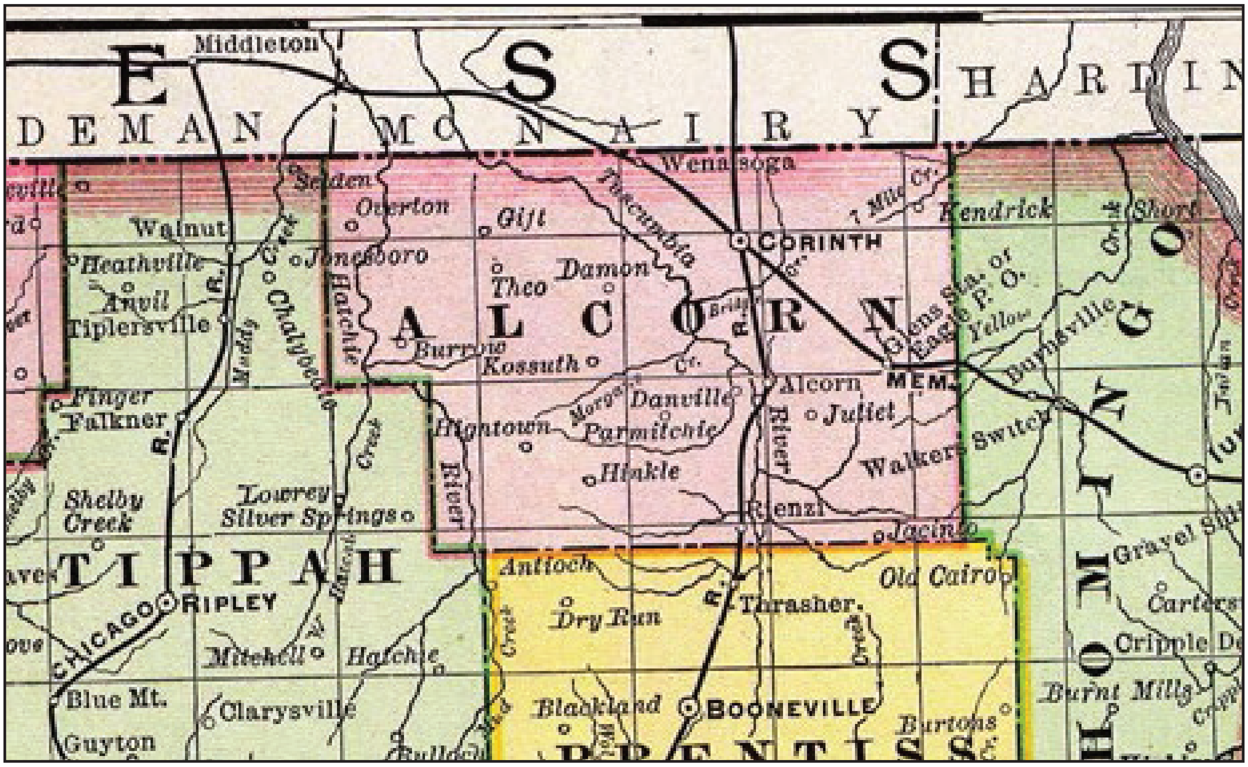


Figure 3.5. 1897 Rand McNally map of Alcorn County.

Caterpillar, Inc., Avectus Healthcare Solutions, Kimberly-Clark Corporation, and Corinthian, Inc. currently maintain office, manufacturing, or distribution centers in Alcorn County. The Magnolia Regional Health Center and Northeast Mississippi Community College are also major employers (The Alliance 2016). As of 2012, 505 farms remained in Alcorn County, encompassing 93,578 acres. The average farm size is 185 acres. Alcorn County farms primarily derive their income from soybeans, hay, corn, and cattle (United States Census Bureau 2012a). The county's population in 2010 consisted of 37,057 persons (U.S. Census Bureau 2016a).

Marshall County History

Located in northern Mississippi, Marshall County is bordered by the state of Tennessee to the north, Benton County to the east, Lafayette to the south, and Desoto and Tate Counties to the west. Marshall County comprises 706 square miles with a total population of 37,144 (United States Census Bureau 2015). Named for Supreme Court Chief Justice John Marshall, Marshall County was established on February 9, 1836 from the Chickasaw cession of 1832 (see Figures 3.1-3.2). At the time of its formation, Marshall County encompassed 828 square miles, including portions of present-day Benton and Tate Counties (Rowland 1907:172). Holly Springs was established as the county seat in 1837 and remains so today.

From 1798 to 1812, the population of the Mississippi Territory grew at a steady, yet moderate pace, however in the years following the War of 1812, as historian Robert V. Haynes explains, "[the] Territory experienced a population explosion or 'fever' as the phenomenon was then called. The period from 1800 to 1819 became known as the 'The Great Migration,' when thousands of pioneers crossed the mountains and settled the Old Southwest and Northwest" (Haynes 2010:133). Despite laws that prohibited the settlement of Chickasaw and Choctaw lands, the westward progression of Euro-American migration led to the taking of land by squatters and the establishment of businesses along the Natchez Trace (Haynes 2010:203).

The Mississippi Territory was established by Congress on April 7, 1798, and on December 10, 1817, Mississippi became the twentieth state admitted to the Union (Hoseman 2012:743). At that time, immigrants to Mississippi could only legally settle in three areas: on a strip of land in the southern part of the state, east of the Tombigbee along the Alabama line, or in the Natchez District (Clark and Guice 1989:165). Approximately 75,500 people lived in Mississippi by 1820, and 44 percent of the population was enslaved (Westley 2005:67). In northeastern Mississippi, an influx of traders and settlers increased the white population in the area to between 4,000 and 5,000 people. Tensions escalated between the Chickasaws and the settlers, primarily due to land disputes caused by the setters' use of Chickasaw land for cultivation and livestock pasturing. The federal government cited these tensions during treaty negotiations with the Chickasaw, and declared immediate removal to be in their best interest (Franks 2009). One of Andrew Jackson's campaign promises from the presidential election of 1828 was the removal of the southeastern tribes to lands west of the Mississippi River. True to his word, following his election, President Jackson appointed two commissioners to expedite the process and provided them with the simple instructions that they "fail not to make a treaty" for the remaining Choctaw lands in Mississippi (Elliott and Barnes 1996:13; Halbert 1902:375).

The majority of Marshall County's early settlers arrived from the Carolinas, Georgia, and Alabama. By 1840, the county's population included 17,500 residents and four early settlements: Holly Springs, Hudsonville, Tallaloosa, and Waterford (Rowland 1907:173). Holly Springs, located at the intersection of the Illinois Central and the Kansas City, Memphis, and Birmingham rail lines, grew into the county's major commercial hub due to ready rail access and proximity to markets in Memphis. The community was home to a dairy, several factories, and numerous pottery works. In addition, local residents engaged in market gardening (Rowland 1907:173). An early center for education in the region, Holly Springs was the home of the Holly Springs Female Institute, Holly Springs Literary Institution (later the University of Holly Springs), Mississippi Synodical College, North Mississippi Experiment Station, and Rust University. The town's reputation for high-quality education attracted wealthy families from around the region (Rowland 1907:874).

The typical antebellum Marshall County farmer raised corn, cotton, rice, tobacco, sheep, cattle, horses, and hogs (DeBow 1853:456-458). In 1850, Marshall County was the highest producer of cotton and butter, and was the third-highest producer of tobacco in the state. The county's location within the soil-rich region of north Mississippi lent itself to large plantations commonly found in the Lower South. As a result, farms were generally large-sized operations. In 1850, the county contained 180,980 improved acres of farmland, ranking it first in the state.

The surge of tobacco and cotton as major cash crops drove the establishment of larger plantations throughout the region, often depending on enslaved Africans and African-descended peoples to provide labor for the county's farmers. Although a number of white families in the county did not own slaves, slavery was seen as part of the accepted social order and as the necessary means for producing wealth and marking social achievement. Enslaved individuals comprised approximately 51.9 percent of Marshall County's population in 1850. By 1860, slaves constituted 60.5 percent of the county's total population (United States Census Bureau 1872:41-42). During the same period, the number of free colored individuals in the county was extremely low; only a single person was counted in 1850 and eight individuals in 1860.

The onset of the Civil War brought great upheaval and loss to the region and county residents. On January 9, 1861, Mississippi became the second Southern state to secede from the Union, and Marshall County raised 11 companies for the Confederate army and cavalry (FamilySearch.org 2015). Holly Springs became occupied by General Ulysses S. Grant and his army during their 1861-1862 campaign towards Vicksburg, when Union forces established an important supply and munitions depot in the community. During this time, Grant and his wife resided at Walter Place (also known as Airliewood), in Holly Springs (Semmes and Nolen 2013:2). As described by historians Ryan Semmes and David Nolen, "Because of the supplies for Grant's advancing forces stored at Holly Springs, the town became a perfect target for Confederate troops intent on stopping –or at least slowing down – the Union campaign against Vicksburg" (2013:3). A December 1862 raid on the city by Confederate General Earl Van Dorn, resulted in the seizure of Union supplies and the burning of much of Holly Springs. Subsequent battles took place in the city on May 24 and August 27-28 of 1864 (Rowland 1907; Semmes and Nolen 2013).

Following the Civil War, large plantations dwindled, and the amount of improved acreage in Marshall County fell by 12 percent by 1870 (Kennedy 1864; U.S. Census Bureau 1872). Animal husbandry in the region continued to focus on cattle, hogs, and sheep. Tobacco production in Marshall County increased by 366 percent, and the county was the fourth-highest producer of tobacco in the state in 1870. At the same time, cotton production fell by 62.8 percent (U.S. Census Bureau 1872:184-186). As with most of the rural South, Marshall County had grown as an agricultural region, suffered during the Civil War and Reconstruction, and later reclaimed its agrarian economy, particularly through cotton, corn, oats, sweet potatoes and wheat (U.S. Census Bureau 1872:184-186).

A sharecropping economy arose during the postbellum period, lasting from about 1870 to the 1930s. The early twentieth century saw the construction of an improved road network and the development of municipal infrastructure, particularly in Holly Springs. By the turn of the century, the city was equipped with a sewage system, electric lighting, and a water works system (Rowland 1907:874). The early twentieth century also saw a diversification of economic activities in Marshall County including "two potteries, a large cotton-seed oil mill, a cotton compress, two gins and grist mills, and ice factory and bottling works, a steam laundry, extensive marble works, a brick plant, four hotels and three livery barns (Rowland 1907:876). Three banking institutions managed the county's finances: the Bank of Holly Springs, the Merchants and Farmers Bank, and the Peoples Bank.

As of 2012, 573 farms remained in Marshall County focusing on soybean, hay, corn, and cattle production. The average farm size is 355 acres (United States Census Bureau 2012b). While Marshall

County remained largely agricultural throughout history, the twentieth and early twenty-first centuries saw an increase in large-scale manufacturers such as Ashley Furniture Industries, Thomas and Betts Corporation, and Volvo Group (NMIDA 2015). The county's population in 2010 consisted of 37,144 persons (U.S. Census Bureau 2016b).

CHAPTER 4. ARCHITECTURAL SURVEY

In April and May 2016, TVAR conducted a survey of the architectural APEs of the proposed Corinth and Holly Springs substation expansion projects. As part of the architectural survey, TVAR revisited 17 previously recorded architectural resources and documented 19 newly recorded architectural resources within the architectural APEs. Based on the results of its architectural survey, it is the opinion of TVAR that the proposed undertaking will have no effect on historic architectural resources. TVAR recommends no additional investigation of above-ground resources in connection with the proposed project. The following chapter provides a background literature and records review of information relevant to the project area, a discussion of the field methods employed during the survey, descriptions of the architectural resources identified, and recommendations regarding their NRHP eligibility.

Architectural Survey Methods

The architectural survey was completed using the guidelines contained in National Register Bulletin 24, *Guidelines for Local Surveys: A Basis for Preservation Planning* (Derry et al. 1985) and the requirements provided by MDAH's *Survey Inclusion Guidelines and Survey Standards* (MDAH 2008 and 2011). The purpose of the architectural survey was to identify properties within the project APEs that are listed, or eligible for listing, in the NRHP. Federal regulations define an APE as "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist" (CFR 2013a). The architectural APEs for this study consisted of each subject parcel, in addition to any areas visually connected to them via viewsheds to and from the project areas, located within a 0.8 km (0.5 mi) survey radius. Areas within the survey radius that were not within view of the subject parcel due to obstructed lines-of-sight (e.g., terrain, vegetation, and/or modern built environments) were not considered part of the architectural APE.

TVAR's architectural survey consisted of driving all accessible roads within the architectural APEs in order to identify architectural resources that appear to be 50 years old or older and visually connected to the project area. All architectural resources that met the age criterion and that fell within visual line of sight to the project area were plotted on the applicable USGS quadrangle map and photographed with a digital camera. The construction dates of the buildings discussed in this study were derived from reviewing United States Geological Survey (USGS) topographical maps of the survey radius found online at the USGS Historical Topographical Map Explorer, and through stylistic evidence displayed by each documented architectural resource. Survey information maintained throughout the course of the inventory included field notes, sketch maps, and photographs. For the purposes of this report, TVAR has identified newly recorded properties with the prefix "IS" to denote an "Inventoried Structure." For properties that had not been previously documented, a Mississippi Historic Resources Inventory form was completed (Appendix A).

To aid in the architectural field assessment, TVAR performed a viewshed analysis of the 0.8 km (0.5 mi) survey radius surrounding the proposed project areas using the Viewshed tool in the Spatial

Analyst extension in ArcGIS 10.3. The assessment used the USGS National Elevation Dataset 10 m (NED10) digital elevation model (DEM), land use classification data from the USDA Cropland Data Layer (CDL), and an estimation of the average forest canopy height for the area from the NASA Forest Canopy Height dataset. TVAR processed the CDL land use classification data to reassign all forested classes to the average forest canopy height of 19 m (62 ft) and all other land use classes to a height of zero. This dataset was then added to the DEM to produce a digital surface model (DSM), accounting for both elevation and forest canopy height. Finally, points along the proposed substation boundary served as the observer points and were assigned a height of 30.5 m (100 ft) to account for the height of the substation. Using these inputs, the Viewshed tool analyzed each cell of the elevation model to assess its visibility from the observer points (Figure 4.1-4.2).

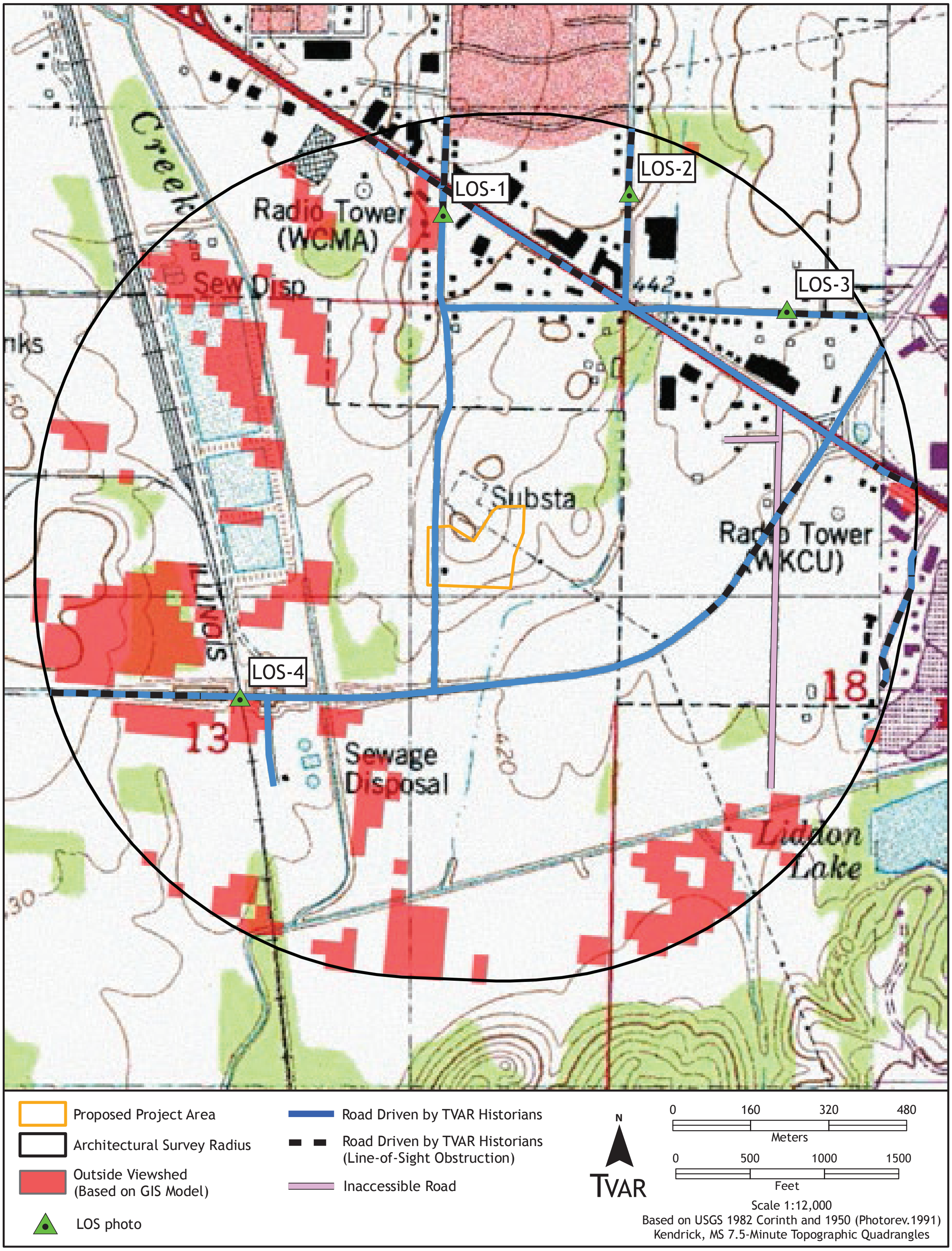


Figure 4.1. Excerpts of the USGS Corinth and Kendrick, MS quadrangles with viewshed analysis results, roads driven by TVAR historians, and locations of line-of-sight photos in the Corinth survey radius.

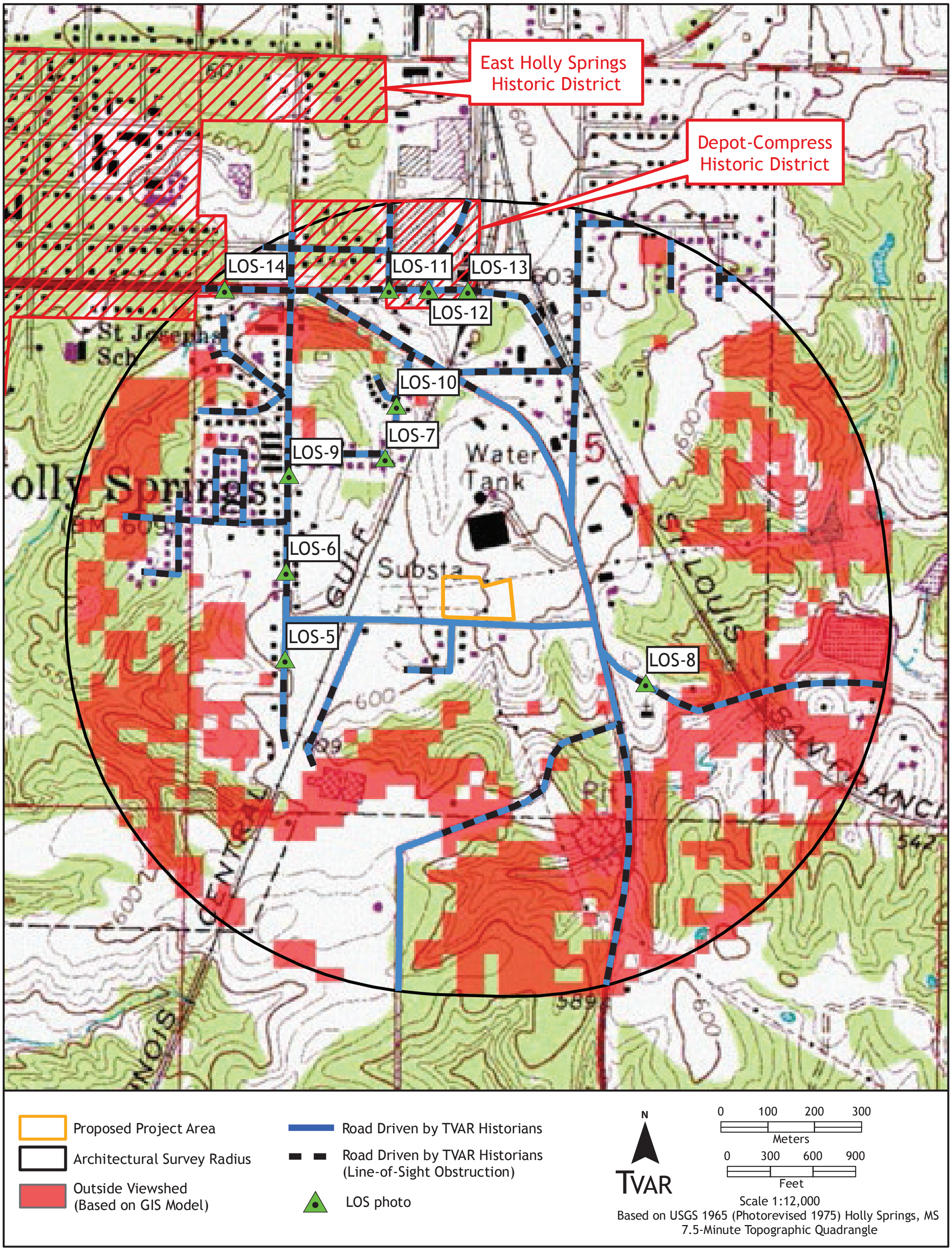


Figure 4.2. Excerpt of the USGS Holly Springs, MS quadrangle with viewshed analysis results, roads driven by TVAR historians, and locations of line-of-sight photos in the Holly Springs survey radius.

National Register of Historic Places Eligibility Criteria

Sufficient data were compiled to make recommendations regarding eligibility for listing on the NRHP for each architectural resource addressed during this study. According to 36 CFR §60.4, cultural resources eligible for listing on the NRHP are defined as buildings, structures, objects, sites, and districts that have "integrity," and that meet one or more of the criteria outlined below (CFR 2013b; NRHP 2002).

- Criterion A (Event). Association with one or more events that have made a significant contribution to the broad patterns of national, state, or local history.

- Criterion B (Person). Association with the lives of persons significant in the past.

- Criterion C (Design/Construction). Embodiment of distinctive characteristics of a type, period, or method of construction; or representation of the work of a master; or possession of high artistic values; or representation of a significant and distinguishable entity whose components may lack individual distinction.

- Criterion D (Information Potential). Properties that yield, or are likely to yield, information important in prehistory or history. Criterion D is most often (but not exclusively) associated with archaeological resources. To be considered eligible under Criterion D, sites must be associated with specific or general patterns in the development of the region. Therefore, sites become significant when they are seen within the larger framework of local or regional development.

As a general rule, the criteria exclude birthplaces and graves of historical figures, cemeteries, religious properties, moved buildings, reconstructions, commemorative properties, and properties less than 50 years old. However, per the regulations set forth in 36 CFR §60.4 and addressed in National Register Bulletin 15, *How to Apply the National Register Criteria for Evaluation*, resources that fall under these categories may be eligible for the NRHP if they meet Criteria Considerations A-F (NRHP 2002). "Integrity" is perhaps the paramount qualification of NRHP eligibility and can be related to location, design, setting, materials, workmanship, feeling, and/or association (NRHP 2002).

Architectural Background Literature and Records Search

Prior to initiating fieldwork, TVAR reviewed the MDAH's online Historic Resources Inventory Database (HRID) for an inventory of Alcorn and Marshall County architectural resources that have been previously recorded and those resources that are listed on or that have been determined eligible for inclusion in the NRHP. Based on the information provided in the HRID, 15 previously recorded architectural resources (003-COR-1249, 003-COR-1250, 003-COR-1251, 003-COR-1252, 003-COR-1253, 003-COR-1254, 003-COR-1255, 003-COR-1256, 003-COR-1257, 003-COR-1258, 003-COR-

1259, 003-COR-1260, 003-COR-1261, 003-COR-1262, and 003-COR-1263) are located within the architectural survey radius of the proposed TVA Corinth substation expansion project area. According to HRID records, none of these properties have been officially evaluated for inclusion on the NRHP by either the MDAH or a federal agency.

For the proposed TVA Holly Springs substation project, HRID records indicate that portions of two previously documented architectural resources, the NRHP-listed Depot-Compress Historic District and the NRHP-listed East Holly Springs Historic District, are located within the architectural survey radius.

Architectural Survey Results

The architectural survey of the APEs was conducted by TVAR personnel on April 7 and May 4 and 6, 2016 under the direction of Sr. Preservation Planner Ted Karpynec and Preservation Planner Meghan Weaver. As this report addresses the planned expansion of two separate substations, the results of the architectural survey are presented accordingly.

TVA Corinth Substation

TVAR's architectural survey of the proposed expansion of the TVA Corinth substation revisited 15 previously documented architectural resources (003-COR-1249, 003-COR-1250, 003-COR-1251, 003-COR-1252, 003-COR-1253, 003-COR-1254, 003-COR-1255, 003-COR-1256, 003-COR-1257, 003-COR-1258, 003-COR-1259, 003-COR-1260, 003-COR-1261, 003-COR-1262, and 003-COR-1263) that are located within the architectural survey radius. Based on the results of its survey, it is the opinion of TVAR that previously recorded properties 003-COR-1251, 003-COR-1252, 003-COR-1253, 003-COR-1254, 003-COR-1255, 003-COR-1256, 003-COR-1257, 003-COR-1258, 003-COR-1259, 003-COR-1260, 003-COR-1261, and 003-COR-1262 are not eligible for the NRHP due to their lack of architectural distinction and loss of integrity caused by modern alterations and/or damage resulting from neglect. TVAR's survey found that previously recorded architectural resources 003-COR-1249, 003-COR-1250, and 003-COR-1263 are located outside the viewshed to the project area (see Figure 4.1; Figures 4.3-4.19).

Additionally, TVAR's architectural survey resulted in the identification of eight previously undocumented architectural resources, IS-1-IS-8, which fall within the architectural APE of the proposed project area. Based on the results of its survey, it is the opinion of TVAR that properties IS-1-IS-8 are not eligible for the NRHP due to their lack of architectural distinction and loss of integrity caused by modern alterations. Based on the results of the architectural survey, it is the opinion of TVAR that no historic properties will be affected by the proposed expansion of the TVA Corinth substation. TVAR recommends no additional investigation of above-ground resources in connection with the proposed project.

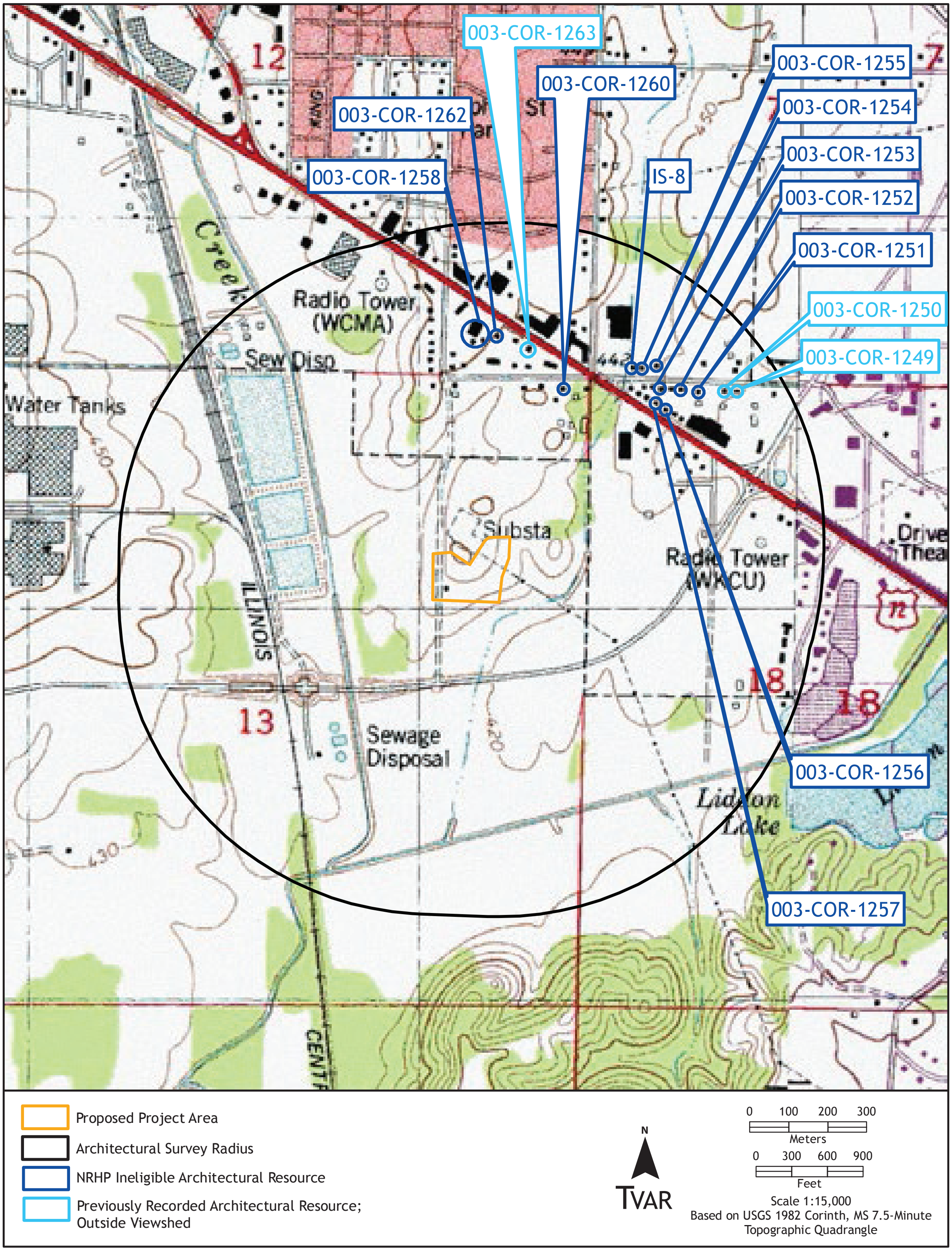


Figure 4.3. Map 1 of 2 showing the proposed project area, survey radius, and location of previously and newly recorded architectural resources.

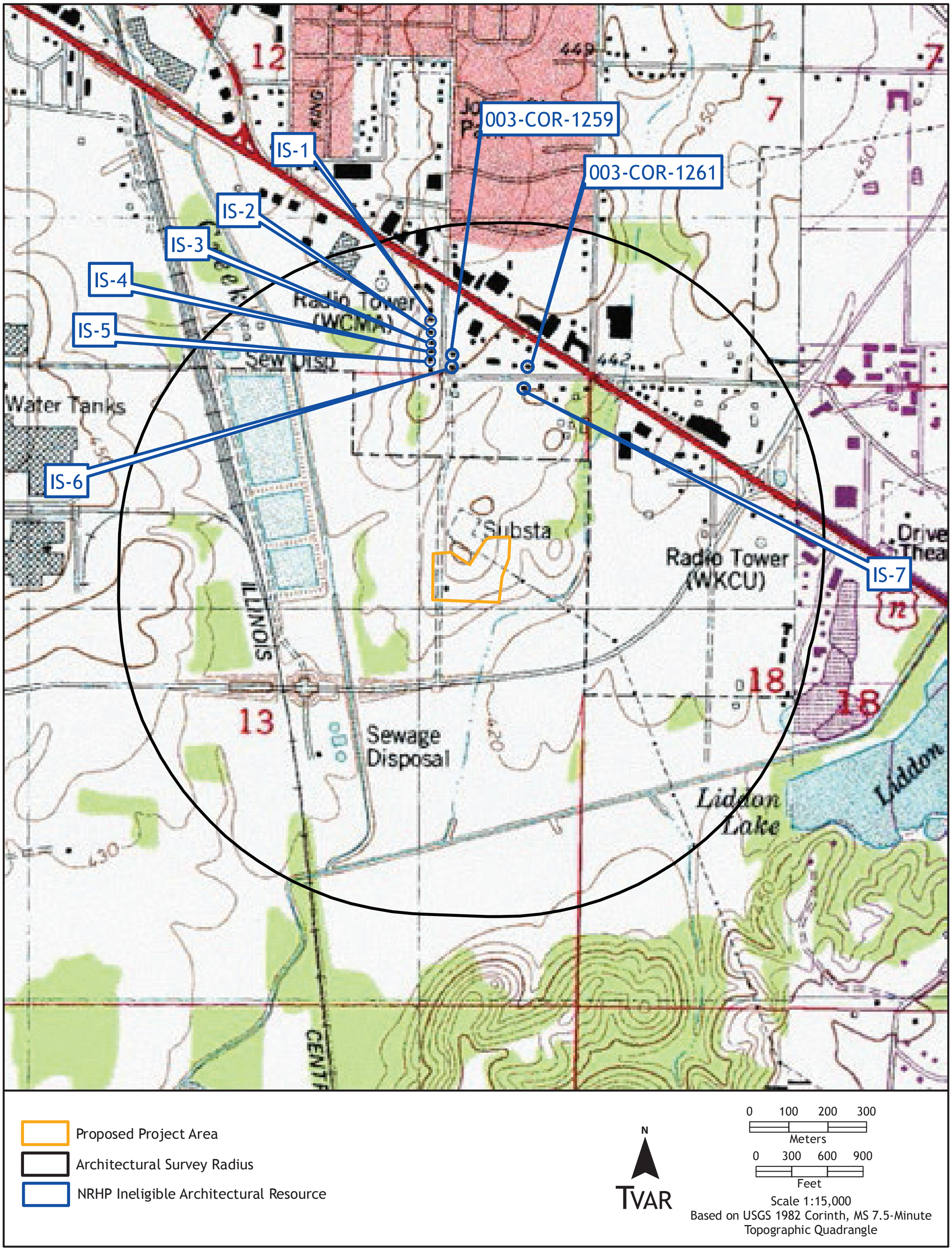


Figure 4.4. Map 2 of 2 showing the proposed project area, survey radius, and location of previously and newly recorded architectural resources.

Figure 4.5. TVA Corinth substation expansion project area; view is north.

Figure 4.6. TVA Corinth substation expansion project area; view is east.

Figure 4.7. TVA Corinth substation expansion project area; view is south.

Figure 4.8. TVA Corinth substation expansion project area; view is west.

Figure 4.9. LOS-1; view is south.

Figure 4.10. LOS-2; view is southwest.

Figure 4.11. LOS-3; view is southwest.

Figure 4.12. LOS-4; view is northeast.

Figure 4.13. Property 003-COR-1249; view is southwest.

Figure 4.14. Property 003-COR-1249; view is southwest looking toward the project area.

Figure 4.15. Property 003-COR-1250; view is southeast.

Figure 4.16. Property 003-COR-1250; view is southwest looking toward the project area.

Figure 4.17. Property 003-COR-1263; view is southeast.

Figure 4.18. Property 003-COR-1263; view is south looking toward the project area.

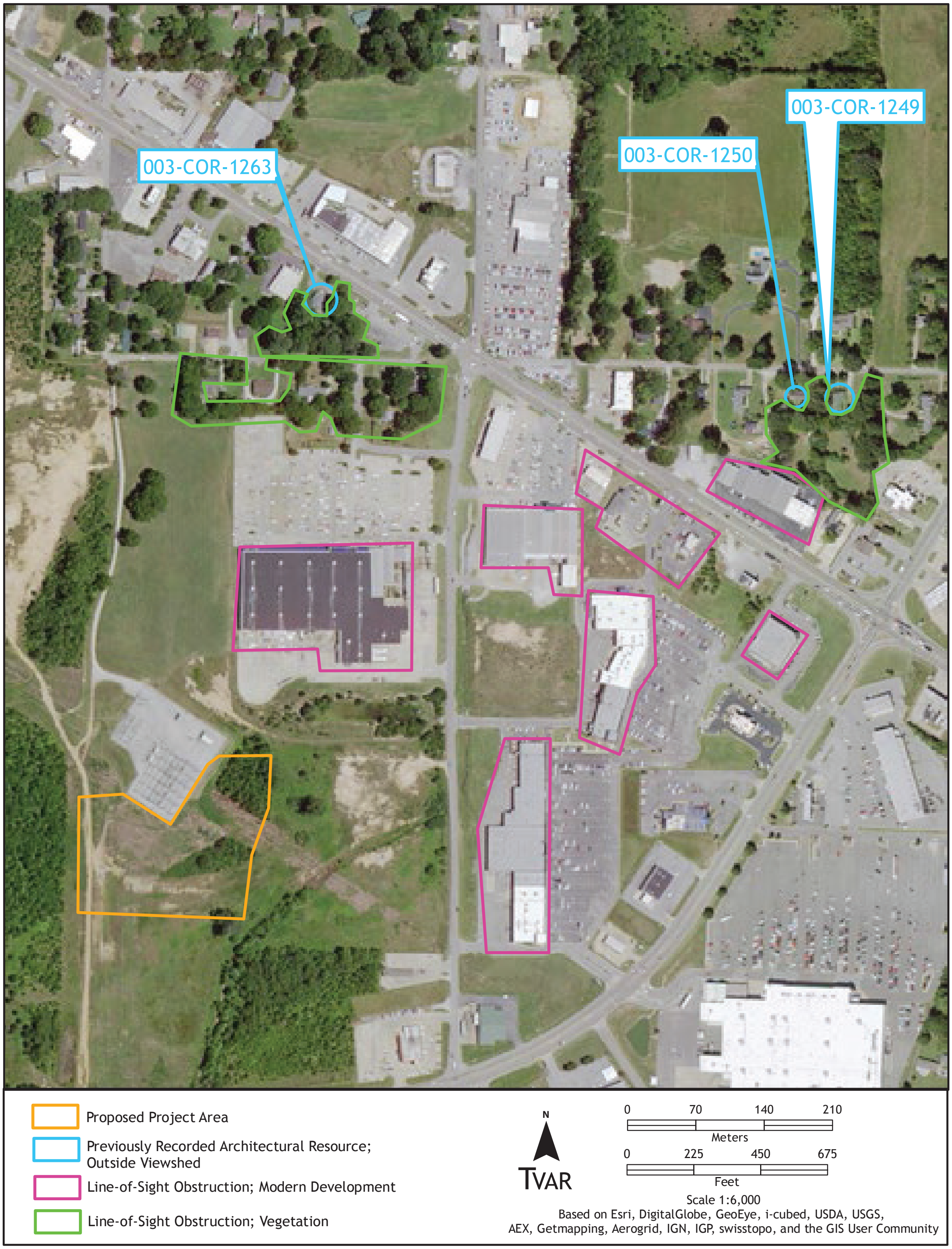


Figure 4.19. Current aerial imagery of the project area illustrating line-of-sight obstructions to architectural resources 003-COR-1249, 003-COR-1250, and 003-COR-1263.

Previously Recorded Architectural Resources

003-COR-1251

Located approximately 0.38 miles northeast of the project area at 2014 Liddon Lake Road, property 003-COR-1251 is an irregularly-shaped, one-story bungalow style house that appears to have been constructed ca. 1930 (see Figure 4.3; Figures 4.20-4.27). The frame building features a hipped roof covered with asphalt shingles, an exterior clad with a brick veneer, and a continuous brick foundation. Additionally, the gable ends of the house each feature a square-shaped attic vent that is boarded over with wood and is centrally positioned within a gable field clad with stucco and half-timbered detailing. Facing north, the façade reveals a centrally placed door that is flanked on either side by a pair of one-over-one, double-hung vinyl sash windows. Access to the façade door is achieved via a full-width porch that extends to the east beyond the main block to form a double-bay porte cochere. The porch features a concrete slab deck and a series of brick columns that support a side-gabled roof which is connected to the house. Modern alterations to the porch include the application of vinyl siding along the frieze and soffits, and the enclosure of the porch openings with wood lattice work and metal screens.

The east elevation of the house is marked by a projecting gabled bay that contains an exterior end brick chimney which has been terminated below the roof line. Flanking the chimney are two window openings containing one-over-one, double-hung vinyl sashes. Positioned south of the projecting gabled bay are two pairs of windows containing one-over-one, double-hung vinyl sashes. Additional fenestration consists of a single window opening containing a four-light wood casement sash located near the southeast corner of the main block. Attached to the east elevation near the southeast corner is a modern, single-bay addition capped with a gabled roof, which projects from the main block. The addition contains a door and two one-over-one, double-hung vinyl sash windows on its south elevation. A similar window is located on the north elevation of the projecting bay. Additionally, the projecting bay is highlighted by a modern exterior brick chimney which is positioned in the ell created by the projecting gabled bay and a rear addition.

The west elevation of the house features a centrally placed projecting gabled bay that is pierced by a pair of one-over-one, double-hung vinyl sash windows. In addition, single one-over-one, double-hung vinyl sash windows are located on the north and south elevations of the projecting bay. Flanking the central bay to the north is a pair of one-over-one, double-hung vinyl sash windows. This sash type is repeated on a single window and a paired window positioned south of the projecting bay. Attached to the south (rear) elevation is a modern one-story, gabled-roof addition. The addition features a roof covered with asphalt shingles, an exterior clad with vinyl siding, and a continuous brick foundation. The addition includes a door on the south elevation and a pair of six-over-six, double-hung vinyl sash windows on the west elevation.

Associated outbuildings include:

- A modern gazebo. The frame structure rests on a concrete slab foundation and is composed of a series of wood posts that support a pyramidal roof covered with asphalt shingles (see Figure 4.25);

- A modern utility shed. The frame structure features a side-gabled roof covered with asphalt shingles, an exterior clad with wood panel siding, and a concrete slab foundation. Facing north, the shed includes two pairs of metal panel doors and two windows containing four-over-four, double-hung vinyl sashes (see Figure 4.26);

- A ca. 1930 storage shed. Resting a concrete slab foundation, the wood frame structure features a front-gabled roof covered with asphalt shingles and an exterior clad with a brick veneer. A door is positioned on the north elevation (see Figure 4.27).

NRHP Assessment

Property 003-COR-1251 is a typical example of a ca. 1930 bungalow style house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the application of vinyl siding on the porch, the enclosure of the façade porch with metal screening and wood lattice, the replacement of the original window sashes, the truncation of the east elevation chimney, and the construction of the one-story addition to the rear elevation. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that 003-COR-1251 is not eligible for the NRHP.

Figure 4.20. Property 003-COR-1251; view is southeast featuring the façade and west elevation.

Figure 4.21. Property 003-COR-1251; view is southwest featuring the carport.

Figure 4.22. Property 003-COR-1251; view is west featuring the east elevation.

Figure 4.23. Property 003-COR-1251; view is northeast featuring the south (rear) and west elevations.

Figure 4.24. Property 003-COR-1251; view is northeast featuring the modern addition and chimney attached to the south (rear) elevation.

Figure 4.25. Property 003-COR-1251; modern gazebo; view is southwest.

Figure 4.26. Property 003-COR-1251; modern utility building; view is southeast.

Figure 4.27. Property 003-COR-1251; ca. 1930 storage shed; view is southwest.

003-COR-1252

Located approximately 0.36 miles northeast of the project area at 2010 Liddon Lake Road, property 003-COR-1252 is a one-and-one-half-story bungalow style house that appears to have been constructed ca. 1930 (see Figure 4.3; Figures 4.28-4.33). The frame building features a side-gabled roof covered with asphalt shingles, an exterior clad with weatherboard siding, and a continuous brick foundation. Facing north, the façade reveals a centrally placed door that is flanked on either side by a pair of one-over-one, double-hung vinyl sashes. Access to the façade door is achieved via a partial-width porch that extends beyond the main block to the east, forming a porte cochere. The porch features a concrete slab deck on a brick foundation and a pair of tapered wood columns that support a projecting gabled entry roof. Connected to the west slope of the entry roof is a side-gabled roof that forms the porte cochere. This section of the porch roof is highlighted by exposed rafter ends and is supported by three tapered wood columns, two of which rest on brick plinth blocks.

Both the east and west elevations of the house are pierced by a single window and a paired window on the first story that contain one-over-one, double-hung vinyl sashes. Situated in the half story is a rectangular-shaped window containing a single-pane vinyl sash. The south (rear) elevation includes a shed-roof addition that appears to have been constructed ca. 2000. The addition is clad with modern wood drop siding and rests on a concrete block foundation. Connected to the addition is a wood deck that provides access to a centrally placed door. Flanking the door to the east is a pair of one-over-one, double-hung vinyl sash windows. In addition, a window containing a pair of two-light, sliding vinyl sash windows are positioned west of the door.

Associated outbuildings and structures include:

- An underground tornado shelter that appears to date to the mid-twentieth century. Located northwest of the house, the shelter is cast in concrete and includes a vent pipe and bulkhead entrance covered with sheets of corrugated metal (see Figure 4.31);

- A modern prefabricated storage shed. The frame structure is capped with a front-gabled roof covered with metal sheeting and features an exterior clad with wood panel siding. A pair of swinging wood doors are located on the west elevation (see Figure 4.32);

- A concrete block storage shed that appears to date to ca. 1960. The structure is capped with a pyramidal roof covered with asphalt shingles and includes a door on the east elevation (see Figure 4.33).

NRHP Assessment

Property 003-COR-1252 is a typical example of a ca. 1930 bungalow style house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the replacement of the original window sashes and the construction of the one-story shed-roof addition and wood deck to the rear elevation. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that 003-COR-1252 is not eligible for the NRHP.

Figure 4.28. Property 003-COR-1252; view is south featuring the façade.

Figure 4.29. Property 003-COR-1252; view is southwest featuring the east elevation.

Figure 4.30. Property 003-COR-1252; view is northeast featuring the south (rear) and west elevations.

Figure 4.31. Property 003-COR-1252; view is southwest featuring the tornado shelter.

Figure 4.32. Property 003-COR-1252; view is east featuring the modern storage shed.

Figure 4.33. Property 003-COR-1252; view is southwest featuring the concrete block storage shed.

003-COR-1253

Located approximately 0.34 miles northeast of the project area at 2006 Liddon Lake Road, property 003-COR-1253 is a ca. 1930, one-story Craftsman/bungalow style house with an original gabled roof rear extension (see Figure 4.3; Figures 4.34-4.37). The frame building features a side-gabled roof covered with asphalt shingles, an exterior clad with a brick veneer, and a continuous brick foundation. Facing north, the façade reveals a centrally placed door that is flanked on either side by a pair of one-over-one, double-hung vinyl sash windows. Access to the façade door is achieved via a central-bay porch. The porch features a concrete slab deck on a brick foundation and two tapered wood posts atop brick plinth blocks that support a projecting gabled roof. The gable field of the porch roof is clad with stucco and is pierced by a wood louvered vent.

The east elevation of the house is marked by an exterior end brick chimney that has been truncated at the roof line. Flanking the chimney to the north is a single window containing one-over-one, double-hung vinyl sashes. This sash type is repeated in a paired window positioned south of the chimney. Located at the attic level are two wood louvered vents that flank the chimney. Located south on the gabled-roof extension is a door and a band of five windows containing one-over-one, double-hung vinyl sashes.

The west elevation of the house is marked by an exterior end brick chimney that has also been truncated at the roof line. Flanking the chimney to the north is a one-over-one, double-hung vinyl sash window. Located to the south on the gabled-roof extension are two pairs of windows containing one-over-one, double-hung vinyl sashes. This sash arrangement is repeated on the south (rear) elevation of the gabled-roof extension, which also includes a centrally placed wood louvered vent within the gable field and an interior brick chimney.

NRHP Assessment

Property 003-COR-1253 is a typical example of a ca. 1930 Craftsman/bungalow style house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the replacement of the original window sashes and the truncation of the exterior end chimneys located on the east and west elevations. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that 003-COR-1253 is not eligible for the NRHP.

Figure 4.34. Property 003-COR-1253; view is southwest featuring the façade and east elevation.

Figure 4.35. Property 003-COR-1253; view is southeast featuring the west elevation.

Figure 4.36. Property 003-COR-1253; view is northeast featuring the south (rear) and west elevations.

Figure 4.37. Property 003-COR-1253; view is northwest featuring the east and south (rear) elevations.

003-COR-1254

Located approximately 0.36 miles northeast of the project area at 2007 Liddon Lake Road, property 003-COR-1254 is a one-story Craftsman/bungalow style house that appears to have been constructed ca. 1930 (see Figure 4.3; Figures 4.38-4.43). The frame building features a side-gabled roof covered with asphalt shingles, an exterior clad with vinyl siding, and a continuous brick foundation. Facing south, the façade reveals a centrally placed door that is flanked on either side by a pair of one-over-one, double-hung vinyl sash windows. Access to the façade door is achieved via a partial-width porch. The porch features a concrete slab deck set on a brick foundation and a series of non-original, square columns used to support a projecting gabled roof. As with the main block, the gable field of the roof is clad with vinyl siding. Located west of the porch is a side-gabled wing that is pierced by a pair of one-over-one, double-hung vinyl sash windows.

The east elevation of the main block includes two one-over-one, double-hung metal sash windows. Positioned to the north and attached to the main block is a hipped-roof extension that continues to the north (rear) elevation of the house. The extension includes a door on its south elevation. An additional door on the east elevation is flanked by a one-over-one, double-hung wood sash window. Attached to the east elevation of the house is a modern, single-bay carport featuring a flat roof supported by a series of wood posts. The west elevation of the house includes two window openings on the side-gabled wing that contain one-over-one, double-hung wood sashes. The north (rear) elevation of the house is marked by two windows containing one-over-one, double-hung wood sashes, and a pair of two-over-two, double-hung wood sash windows. Positioned on the hipped-roof extension is a band of four windows containing four-over-four, double-hung wood sashes.

Associated outbuildings include:

- A modern prefabricated metal storage shed. The south elevation includes a central door that is flanked on either side by a pair of sliding metal sash windows (see Figure 4.42);

- A ca. 1930 utility building. The frame building features a front-gabled roof covered with asphalt shingles, an exterior clad with weatherboard siding, and a continuous foundation composed of brick and concrete blocks. Overall, the building includes a door on the east and south elevations, four windows containing one-over-one, double-hung wood sashes, and a six-over-six, double-hung vinyl sash window on the south elevation (see Figure 4.43).

NRHP Assessment

Property 003-COR-1254 is a typical example of a ca. 1930 Craftsman/bungalow style house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the replacement of some of the original window sashes, the application of vinyl siding, the replacement of the original porch columns, and the construction of the modern carport along the east elevation. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that 003-COR-1254 is not eligible for the NRHP.

Figure 4.38. Property 003-COR-1254; view is northwest featuring the façade and east elevation.

Figure 4.39. Property 003-COR-1254; view is northeast featuring the façade and west elevation.

Figure 4.40. Property 003-COR-1254; view is southwest featuring the east and north (rear) elevations.

Figure 4.41. Property 003-COR-1254; view is south featuring the north (rear) elevation.

Figure 4.42. Property 003-COR-1254; view is north featuring the prefabricated metal storage shed.

Figure 4.43. Property 003-COR-1254; view is northeast featuring the ca. 1930 utility building.

003-COR-1255

Located approximately 0.34 miles northeast of the project area at 2005 Liddon Lake Road, property 003-COR-1255 is a one-story side-gabled house that appears to have been constructed ca. 1930 (see Figure 4.3; Figures 4.44-4.46). The frame building features a roof covered with asphalt shingles, an exterior clad with a combination of vinyl and weatherboard siding, and a covered pier foundation. Facing south, the façade reveals a central door that is flanked on either side by a six-over-six, double-hung vinyl sash window. Access to the façade door is achieved via a modern stoop featuring a wood deck. The east elevation of the house is pierced by two windows containing vertical three-over-one, double-hung wood sashes. This sash type is repeated on an additional window located to the north on a rear shed-roof extension. The west elevation of the house is marked by two window openings containing six-over-six, double-hung vinyl sashes. Attached to the north (rear) elevation is a shed-roof extension that is clad with plywood sheets. The extension includes a pair of window openings that are boarded over with wood.

NRHP Assessment

Property 003-COR-1255 is a typical example of a ca. 1930 side-gabled house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the replacement of some of the original window sashes, the application of vinyl siding, the replacement of the original façade porch, and the construction of the rear extension. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that 003-COR-1255 is not eligible for the NRHP.

Figure 4.44. Property 003-COR-1255; view is northwest featuring the façade and east elevation.

Figure 4.45. Property 003-COR-1255; view is northeast featuring the façade and west elevation.

Figure 4.46. Property 003-COR-1255; view is south featuring the north (rear) elevations.

003-COR-1256

Located approximately 0.32 miles northeast of the project area at 1905 Highway 72 East, property 003-COR-1256 is a one-story Minimal Traditional style house that appears to have been constructed ca. 1945 (see Figure 4.3; Figures 4.47-4.50). The former residence has been converted to business use and currently serves as a beauty salon. The frame building features a side-gabled roof covered with asphalt shingles, an exterior clad with asbestos shingle siding, and a continuous brick foundation. Facing south, the façade reveals a central door that is flanked on either side by a six-over-six, double-hung wood sash window. Access to the façade door is achieved via a partial-width porch that is integral with the main roof. The porch features a concrete slab deck on a brick foundation. A single wood post atop a brick plinth block supports the porch roof. Located east of the porch is a projecting gabled bay that is pierced by a six-over-six, double-hung wood sash window.

The east elevation of the house is pierced by three single windows and a paired window that contain six-over-six, double-hung wood sashes. Highlighting the west elevation of the main block is a projecting gabled bay that is pierced by a pair of six-over-six, double-hung wood sash windows and a modern door that provides access to a modern side-gabled addition. Located north of the projecting gabled bay is an additional door and a pair of six-over-six, double-hung, wood sash windows. Attached to the west elevation is a modern side-gabled addition enclosed with a four-light glass wall. The addition provides interior access to an attached garage. The garage appears to date to ca. 1930 and features a pair of swinging wood doors on the south elevation. The north (rear) elevation of the house is pierced by a single window and a paired window that each contain six-over-six, double-hung wood sashes.

NRHP Assessment

Property 003-COR-1256 is a typical example of a ca. 1945 Minimal Traditional style house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the installation of a modern door and side-gabled addition on the west elevation. In addition, the historic function of the house has changed from residential to commercial use, which likely resulted in alterations to the interior of the building to accommodate its present use as a beauty salon. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that 003-COR-1256 is not eligible for the NRHP.

Figure 4.47. Property 003-COR-1256; view is north featuring the façade.

Figure 4.48. Property 003-COR-1256; view is northwest featuring the façade and east elevation.

Figure 4.49. Property 003-COR-1256; view is east featuring the west elevation.

Figure 4.50. Property 003-COR-1256; view is southeast featuring the north (rear) and west elevations.

003-COR-1257

Located approximately 0.31 miles northeast of the project area at 1903 Highway 72 East, property 003-COR-1257 is a one-story Minimal Traditional style house that appears to have been constructed ca. 1945 (see Figure 4.3; Figures 4.54-4.53). The former residence has been converted to business use and currently serves as an office for an accounting firm. The frame building features a side-gabled roof covered with asphalt shingles, an exterior clad with modern wood panel siding, and a continuous brick foundation. Facing south, the façade reveals a centrally placed door that is flanked on either side by a pair of six-over-six, double-hung vinyl sash windows. Access to the façade door is achieved via a central bay porch. The porch features a concrete slab on a brick foundation and includes two decorative metal posts that are used to support a projecting gabled roof. Additional fenestration along the façade includes a pair of six-over-six, double-hung vinyl sash windows that are positioned on a side-gabled wing attached to the west elevation.

The east elevation of the house is pierced by two windows containing six-over-six, double-hung vinyl sashes. This sash type is repeated on a single window located on the west elevation of the main block and on the side-gabled wing. Additional fenestration found on the west elevation of the side-gabled wing consists of a pair of four-over-four, double-hung vinyl sash windows. The north (rear) elevation of the house includes a modern door that is partly shielded by a projecting gabled canopy. Located east of the door are two pairs of windows and a single window that contain one-over-one, double-hung vinyl sashes.

NRHP Assessment

Property 003-COR-1257 is a typical example of a ca. 1945 Minimal Traditional style house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the replacement of the original window sashes, the application of modern wood panel siding, the replacement of the original porch columns, and the construction of a handicap access ramp attached to the north elevation. In addition, the historic function of the house has changed from residential to commercial use, which likely resulted in alterations to the interior the building to accommodate its present use as an accounting office. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that 003-COR-1257 is not eligible for the NRHP.

Figure 4.51. Property 003-COR-1257; view is northwest featuring the façade and east elevation.

Figure 4.52. Property 003-COR-1257; view is northeast featuring the façade and west elevation.

Figure 4.53. Property 003-COR-1257; view is southeast featuring the north (rear) and west elevations.

003-COR-1258

Located approximately 0.31 miles north of the project area at 1400 Highway 72 East, property 003-COR-1258 is a vacant, two-story International style commercial building that appears to have been constructed ca. 1950 (see Figure 4.3; Figures 4.54-4.59). According to the survey form filed with the MDAH the building last functioned as a funeral home. The building features an overhanging flat roof, an exterior clad with a combination of brick and stone veneer, and a continuous brick foundation. Facing north, the asymmetrical façade is marked by a centrally placed exterior stone chimney, which includes a pair of two-light metal casement sash windows on the first story. Flanking the chimney to the east is a glass door; a single pane, fixed sash window; and a pair of windows containing horizontal two-over-two, double-hung metal sashes. Situated west of the chimney are two bands of three windows that contain horizontal two-over-two, double-hung metal sashes. This sash type is repeated on the second story in a paired and a single window located east of the chimney. Positioned west of the chimney on the second story are two bands of three windows that contain horizontal two-over-two, double-hung metal sashes. Unlike the other elevations of the building, this section of the second story is clad with wood panel siding.

The façade is further marked by a one-story, stone veneer extension which includes a door flanked on either side by a horizontal two-over-two, double-hung metal sash window. In addition, the extension includes a pair of horizontal four-light, fixed wood sash windows positioned east of the door. This sash type is repeated on a one-story, brick veneer-clad extension that is attached to the east elevation of the building. Each door located along the main entrance is shielded by a modern metal canopy that is supported by a series of metal posts.

The west elevation of the building is marked by two pairs of doors that are covered by a metal awning supported by decorative metal posts. Located along the second story are five windows that contain horizontal two-over-two, double-hung metal sashes. The east elevation of the building includes a door, a single and a paired window containing one-over-one, double-hung metal sashes, and a horizontal two-over-two, double-hung metal sash window. Situated on the second story of the main block are five window openings containing horizontal two-over-two, double-hung metal sashes. The south (rear) elevation of the building includes two pairs of glass doors that are shielded by a metal canopy that is supported by metal posts. In addition, the rear elevation includes a single wood door, and a window opening containing two-light metal casement sashes positioned on a one-story brick addition.

Associated outbuildings include:

- A modern garage. The prefabricated metal building includes a low-pitch side-gabled metal roof and an exterior clad with metal siding. Facing east, the garage includes four vehicle bays that contain overhead metal doors. A metal pedestrian door is positioned on the north elevation (see Figure 4.58);

- A ca. 1950 garage. The building includes a low-pitch side-gabled metal roof, an exterior clad with a brick veneer, and a concrete block foundation. Facing east, the garage includes multiple vehicle bays that contain sliding metal doors. Window fenestration on the garage includes a series of horizontal two-over-two, double-hung metal sashes (see Figure 4.59).

NRHP Assessment

Property 003-COR-1258 is a typical example of a ca. 1950 International style commercial building that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the building that have diminished its architectural integrity include the construction of metal canopies along the façade, east and north elevations. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that 003-COR-1258 is not eligible for the NRHP.

Figure 4.54. Property 003-COR-1258; view is south featuring the façade.

Figure 4.55. Property 003-COR-1258; view is southwest featuring the east elevation.

Figure 4.56. Property 003-COR-1258; view is northeast featuring the west and south elevations.

Figure 4.57. Property 003-COR-1258; view is northwest featuring the east and south (rear) elevations.

Figure 4.58. Property 003-COR-1258; view is southwest featuring the modern garage.

Figure 4.59. Property 003-COR-1258; view is south featuring the ca. 1950 garage.

003-COR-1259

Located approximately 0.3 miles north of the project area at 1803 South Johns Street, property 003-COR-1259 is a one-story side-gabled house that appears to have been constructed ca. 1910 (see Figure 4.4; Figures 4.60-4.62). The building features a roof covered with asphalt shingles, an exterior clad with wood drop siding, and a continuous concrete block foundation. Facing west, the façade reveals an off-centered door that is flanked on either side by a four-over-four, double-hung wood sash window. According to the property owner, the façade originally included an additional door which was later removed and the opening concealed by wood siding. Access to the façade door is through a full-width porch that is integral with the main roof. The porch features a wood deck on a concrete block foundation, modern wood balustrades, and a series of modern wood posts that are used to support the porch roof. The north elevation of the house includes two windows containing one-over-one, double-hung wood sashes. Situated along the south elevation is a one-over-one and a four-over-four, double-hung wood sash window. The east (rear) elevation of the house includes a recessed center bay that includes a door. Located east of the central bay is a six-light wood sash window. Situated north of the central bay is a shed-roof extension that contains a door and a six-over-six, double-hung wood sash window.

NRHP Assessment

Property 003-COR-1259 is a typical example of a ca. 1910 side-gabled house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the replacement of the original porch columns, the addition of a modern balustrade on the porch, and the enclosure of the second façade door. In addition, the current owner has initiated plans to extensively remodel the exterior and interior of the house. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that 003-COR-1259 is not eligible for the NRHP.

Figure 4.60. Property 003-COR-1259; view is east featuring the façade.

Figure 4.61. Property 003-COR-1259; view is southeast featuring the façade and north elevation.

Figure 4.62. Property 003-COR-1259; view is northwest featuring the south and east (rear) elevations.

003-COR-1260

Located approximately 0.25 miles north of the project area on the south side of Hinton Street, property 003-COR-1260 is a one-and-one-half-story Minimal Traditional style house that appears to have been constructed ca. 1940 (see Figure 4.3; Figures 4.63-4.66). At the time of TVAR's survey, the house was in the process of being demolished by the current owner. The building features a side-gabled roof covered with asphalt shingles, an exterior partly clad with the remains of a brick veneer, and a continuous brick foundation. Facing north, the façade reveals a partial-width porch situated within a projecting gabled bay that has been enclosed with jalousie windows and single-pane fixed sash windows. A modern storm door located on the projecting bay provides access to the porch. Located on the porch's south and west interior walls, respectively, are a pair of one-over-one, double-hung wood sash windows and a door. A louvered wood attic vent is situated within the gable field of the projecting bay. Positioned west of the projecting bay are two window openings on the main block that contain one-over-one, double-hung wood sashes.

The east elevation of the house is pierced by four windows on the first story and a single window in the half story that each contain one-over-one, double-hung wood sashes. This sash type is repeated along the west elevation in two paired and two single windows. A window opening in the half story contains no sashes. The south (rear) elevation features a projecting gabled bay that is marked by a band of three windows containing two-light wood casement sashes. Additionally, a door is positioned on the east elevation of the projecting bay. Located to the east on the main block is a one-over-one, double-hung wood sash window. This sash type is repeated in a window situated in the half story. Attached to the south elevation of the house is a modern carport which is composed of a flat metal roof supported by a series of metal posts.

NRHP Assessment

Property 003-COR-1260 is a typical example of a ca. 1940 Minimal Traditional style house that fails to exhibit unique features of its architectural style or workmanship. In addition, the integrity of the property is poor due to current efforts to demolish the building. At the time of TVAR's survey, much of the original brick veneer had been pulled off the building and stacked on pallets for resale. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that 003-COR-1260 is not eligible for the NRHP.

Figure 4.63. Property 003-COR-1260; view is south featuring the façade.

Figure 4.64. Property 003-COR-1260; view is southwest featuring the façade and east elevation.

Figure 4.65. Property 003-COR-1260; view is southeast featuring the façade and west elevation.

Figure 4.66. Property 003-COR-1260; view is northwest featuring the east and south (rear) elevations.

003-COR-1261

Located approximately 0.27 miles north of the project area at 1611 Hinton Street, property 003-COR-1261 is a one-story side-gabled house that appears to have been constructed ca. 1920 (see Figure 4.4; Figures 4.67-4.70). Based on physical evidence, it is the opinion of TVAR that the building was originally constructed as a front-gabled house with the main entrance located on the west elevation (see Figure 4.67). The house appears to have been modified in the mid-twentieth century, with the re-orientation of the main entrance to the south elevation. The building features a gabled roof covered with asphalt shingles, an exterior clad with weatherboard siding, and a brick pier foundation. Facing south, the façade reveals an off-centered door that is flanked to the east by a three-part picture window containing horizontal two-over-two, double-hung wood sashes. Located east of this window arrangement is a pair of one-over-one, double-hung metal sash windows. Positioned west of the door is a one-over-one, double-hung wood sash window. The east elevation of the house includes a shed-roof extension that contains a door and a series of five windows containing six-over-six, double-hung wood sashes. This sash type is repeated on a single window located on the main block. The west elevation of the house, which appears to have served as the original façade, features a projecting gabled bay. The gabled bay is pierced by three windows that contain horizontal two-over-two, double-hung wood sashes. Attached to the west elevation is a projecting gabled roof that shielded a porch which is no longer extant. The roof is supported by three wood posts atop brick plinth blocks. The north (rear) elevation is marked by a paired and a single window that contain horizontal two-over-two, double-hung wood sashes. An additional window opening on the elevation has been concealed with a wood board.

NRHP Assessment

Property 003-COR-1261 is a typical example of a ca. 1920 side-gabled house that fails to exhibit unique features of its architectural style or workmanship. It is TVAR's opinion that the building appeared to have been originally constructed as a front-gabled house with the main entrance located on the west elevation. During the mid-twentieth century, the location of the main entrance was moved to the south elevation within a shed-roof addition that was attached to the main block. Additional alterations that have diminished the architectural integrity of the resource include the removal of the west elevation porch deck. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that 003-COR-1261 is not eligible for the NRHP.

Figure 4.67. Property 003-COR-1261; view is northeast featuring the west (former primary façade) and south elevations.

Figure 4.68. Property 003-COR-1261; view is northwest featuring the east and south elevations.

Figure 4.69. Property 003-COR-1261; view is southwest featuring the north and west (former primary façade) elevations.

Figure 4.70. Property 003-COR-1261; view is southwest featuring the north elevation.

003-COR-1262

Located approximately 0.32 miles north of the project area at 1504 Highway 72 East, property 003-COR-1262 is a one-and-one-half-story Minimal Traditional style house that appears to have been constructed ca. 1950 (see Figure 4.3; Figures 4.71-4.74). The former residence has been converted to business use and currently serves as dental offices. The building features a side-gabled roof covered with asphalt shingles, an exterior clad with a brick veneer, and a continuous brick foundation. Facing north, the façade reveals an off-centered door that is flanked to the east by an oval-shaped window containing a single-light wood sash. Access to the façade door is achieved via a concrete handicap access ramp that is bordered with metal railings. The door is partly shielded by a modern, projecting gabled entry roof, which is supported by two columns composed of synthetic materials. Located west of the door, on a slightly projecting bay, is a band of three windows containing five-light metal casement sashes. Additional fenestration positioned to the west includes a pair of three-light metal casement sashes.

The east elevation of the house is accented with a curvilinear bay that contains a band of four horizontal two-over-two, double-hung metal sash windows. An additional window filled with glass blocks is positioned to the south. Attached to the west elevation is a former garage wing that has been converted for office use. The garage includes a modern door and sliding glass patio doors to the west that are positioned within the original vehicle bay. Additionally, a six-over-six, double-hung metal sash window is located on the west elevation of the garage wing. Fenestration on the main block includes a pair of three-light metal casement sashes.

The south (rear) elevation features a modern central bay addition that projects slightly from the main block. Topped with a shed roof, the addition is clad with vinyl siding and includes a door and two window openings containing six-over-six, double-hung vinyl sashes. Located east of the central bay is a six-over-six, double-hung metal sash window, a pair of three-light metal casement sash windows, and a window opening filled with glass blocks. Positioned west of the central bay is a pair of six-over-six, double-hung metal sash windows.

Located south of the building is a modern storage shed. The prefabricated wood-frame structure features a side-gabled roof covered with asphalt shingles, an exterior clad with wood panel siding, and a concrete block pier foundation. The north elevation includes a door and a one-over-one, double-hung vinyl sash window (see Figure 4.74).

NRHP Assessment

Property 003-COR-1262 is a typical example of a ca. 1950 Minimal Traditional style house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the renovations to the rear addition, the replacement of some of the original window sashes, and the reconstruction of the façade entry porch. Lastly, the historic function of the house has changed from residential to commercial use, which likely resulted in alterations to the interior the building to accommodate its present use as a dental office. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that 003-COR-12562 is not eligible for the NRHP.

Figure 4.71. Property 003-COR-1262; view is southeast featuring the façade and the west elevation garage wing.

Figure 4.72. Property 003-COR-1262; view is southwest featuring the façade and east elevation.

Figure 4.73. Property 003-COR-1262; view is northwest featuring the east and south (rear) elevations.

Figure 4.74. Property 003-COR-1262; view is southwest featuring the modern storage shed.

Newly Recorded Architectural Resources

IS-1

Located approximately 0.37 miles north of the project area at 1704 South Johns Street, property IS-1 is a Ranch style house that appears to have been constructed ca. 1955 (see Figure 4.4; Figures 4.75-4.76). The building features a side-gabled roof covered with asphalt shingles, an exterior clad with a brick veneer, and a continuous brick foundation. Facing east, the façade reveals a centrally placed door that is flanked to the north by a band of three windows containing two-over-one, double-hung metal sashes. Located south of the door is a picture window with nine lights set within a metal sash and a single window opening containing horizontal two-over-two, double-hung metal sashes. Attached to the north elevation of the building is a single-bay carport that is capped with a side-gabled roof covered with asphalt shingles. The carport roof is supported by three decorative metal posts. The interior west wall of the carport has been partially enclosed to increase the square footage of the interior living space. The altered section of the carport is clad with vinyl siding and includes a door and two windows containing four-over-four, double-hung vinyl sashes. Situated along the north interior wall of the carport is a pair of two-over-one, double-hung metal sash windows. The south elevation of the house is pierced by two window openings that contain horizontal two-over-two, double-hung metal sashes. The west (rear) elevation of the house was not accessible at the time of TVAR's survey.

NRHP Assessment

Property IS-1 is a typical example of a ca. 1955 Ranch style house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the alterations made to the carport. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-1 is not eligible for the NRHP.

Figure 4.75. Property IS-1; view is southwest featuring the façade and the north elevation garage wing.

Figure 4.76. Property IS-1; view is northwest featuring the façade and south elevation.

IS-2

Located approximately 0.34 miles north of the project area at 1706 South Johns Street, property IS-2 is a Ranch style house that appears to have been constructed ca. 1955 (see Figure 4.4; Figures 4.77-4.78). The building features a side-gabled roof covered with asphalt shingles, an exterior clad with a brick veneer, and a continuous brick foundation. Facing east, the façade reveals a recessed central bay that includes a door and a band of three windows containing horizontal two-over-two, double-hung wood sashes. Access to the façade door is through the center bay porch that is integral with the main roof. Flanking either side of the central bay are projecting bays that are each pierced with a window opening containing horizontal two-over-two, double-hung wood sashes. Attached to the north elevation of the building is a single-bay carport that is capped with a side-gabled roof covered with asphalt shingles. The carport roof is supported by a metal post at the northeast corner of the building. The interior north wall of the carport includes a door and a pair of horizontal two-over-two, double-hung wood sashes. This sash type is repeated on two windows that pierce the south elevation. The west (rear) elevation of the house was not accessible at the time of TVAR's survey.

NRHP Assessment

Property IS-2 is a typical example of a ca. 1955 Ranch style house that fails to exhibit unique features of its architectural style or workmanship. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-2 is not eligible for the NRHP.

Figure 4.77. Property IS-2; view is southwest featuring the façade and the north elevation carport wing.

Figure 4.78. Property IS-2; view is northwest featuring the façade and south elevation.

IS-3

Located approximately 0.33 miles north of the project area at 1708 South Johns Street, property IS-3 is a Ranch style house that appears to have been constructed ca. 1955 (see Figure 4.4; Figures 4.79-4.80). The building features a side-gabled roof covered with asphalt shingles, an exterior clad with a brick veneer, and a continuous brick foundation. Facing east, the façade reveals an off-centered door that is flanked to the north by a pair of horizontal two-over-two, double-hung wood sash windows. This sash type is repeated on a picture window and a paired window located south of the door. Access to the façade door is achieved via a single-bay concrete stoop. The stoop features a concrete slab deck that is partly shielded by a fabric awning. Attached to the north elevation of the building is a single-bay carport that is capped with a flat roof. The carport roof is partly supported by a decorative metal post at the northeast corner of the building. The interior of the carport has been altered to include a screened-in porch that provides access to a door located on the north elevation of the building. Situated east of the door is a pair of horizontal two-over-two, double-hung wood sash windows. This sash type is repeated on three windows located along the south elevation. The west (rear) elevation of the house was not accessible at the time of TVAR's survey.

NRHP Assessment

Property IS-3 is a typical example of a ca. 1955 Ranch style house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the construction of the screened-in porch within the carport. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-3 is not eligible for the NRHP.

Figure 4.79. Property IS-3; view is west featuring the façade and the north elevation carport wing.

Figure 4.80. Property IS-3; view is northwest featuring the façade and south elevation.

IS-4

Located approximately 0.32 miles north of the project area at 1800 South Johns Street, property IS-4 is a Ranch style house that appears to have been constructed ca. 1955 (see Figure 4.4; Figures 4.81-4.82). The building features a side-gabled roof covered with asphalt shingles, an exterior clad with a brick veneer, and a continuous brick foundation. Facing east, the façade reveals an off-centered door that is flanked to the south by a paired window and two single windows that each contain six-over-six, double-hung vinyl sashes. Access to the façade door is achieved via a single bay concrete stoop. The stoop features a concrete slab deck on a brick foundation. Attached to the north elevation of the building is a single-bay carport that is integral with the main roof. The carport roof is partly supported by two decorative metal posts. The north interior wall of the carport includes a door and a six-over-six, double-hung vinyl sash window. Located along the south elevation is a horizontal two-over-two, double-hung wood sash window and a six-over-six, double-hung vinyl sash window. The west (rear) elevation of the house was not accessible at the time of TVAR's survey, however, an extension to the house containing a one-over-one, double-hung vinyl window was noted from the street.

NRHP Assessment

Property IS-4 is a typical example of a ca. 1955 Ranch style house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the replacement of the original window sashes. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-4 is not eligible for the NRHP.

Figure 4.81. Property IS-4; view is southwest featuring the façade and the north elevation carport wing.

Figure 4.82. Property IS-4; view is northwest featuring the façade and south elevation.

IS-5

Located approximately 0.31 miles north of the project area at 1802 South Johns Street, property IS-5 is a Ranch style house that appears to have been constructed ca. 1955 (see Figure 4.4; Figures 4.83-4.84). The building features a side-gabled roof covered with asphalt shingles, an exterior clad with a brick veneer, and a continuous brick foundation. Facing east, the façade reveals a centrally placed door that is flanked to the north by a pair of one-over-one, double-hung vinyl sash windows. This sash type is repeated in two single windows positioned south of the main entrance. Access to the façade door is achieved via a partial-width porch. The porch features a concrete slab deck on a brick foundation and a series of decorative metal posts that are used to support a shed roof, which is integral with the main roof of the house. Attached to the north elevation of the building is a single-bay carport that is integral with the main roof. The carport roof is partly supported by three decorative metal posts. The north interior wall of the carport includes a door that provides access to the house. In addition, another door is positioned on the west interior wall, which provides access to a storage closet. Located along the south elevation are two windows containing one-over-one, double-hung vinyl sashes. The west (rear) elevation of the house was not accessible at the time of TVAR's survey.

NRHP Assessment

Property IS-5 is a typical example of a ca. 1955 Ranch style house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the replacement of the original window sashes. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-5 is not eligible for the NRHP.

Figure 4.83. Property IS-5; view is southwest featuring the façade and the north elevation carport wing.

Figure 4.84. Property IS-5; view is northwest featuring the façade and south elevation.

IS-6

Located approximately 0.31 miles north of the project area at 1805 South Johns Street, property IS-6 is a Ranch style house that appears to have been constructed ca. 1955 (see Figure 4.4; Figures 4.85-4.86). The building features a side-gabled roof covered with standing seam metal, an interior brick chimney, an exterior clad with a brick veneer, and a continuous brick foundation. Facing west, the façade reveals a centrally placed projecting gabled bay that includes a door which is flanked to the north by a pair of six-over-six, double-hung vinyl sash windows. This sash type is repeated in a pair of windows positioned north of the projecting bay. Access to the façade door is achieved via a concrete stoop. Additional fenestration along the façade includes a picture window containing a central fixed vinyl sash with 12-lights, flanked by four-over-four, double-hung vinyl sash windows. Attached to the north elevation of the building is a carport wing that has been enclosed and converted into a single-bay garage. The exterior of this section of the house is clad with vinyl siding and includes an overhead metal door, which provides access to the garage. The north elevation of the house includes a door and a six-over-six, double-hung vinyl sash window that is accessible through a modern side porch. The porch is partially enclosed with metal screens and includes a storm door on the west elevation. Situated along the south elevation (former carport wing) is a six-over-six, double-hung vinyl sash window. Highlighting the east (rear) elevation of the house are five window openings containing six-over-six, double-hung vinyl sashes.

Located in front of the house is a modern carport. The prefabricated metal structure features a front-gabled roof that is supported by a series of metal posts (see Figure 4.86).

NRHP Assessment

Property IS-6 is a typical example of a ca. 1955 Ranch style house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the replacement of the original window sashes, the construction of the north elevation porch, and the enclosure of the carport wing. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-6 is not eligible for the NRHP.

Figure 4.85. Property IS-6; view is east featuring the façade and modern carport.

Figure 4.86. Property IS-6; view is northwest featuring the east (rear) elevation.

IS-7

Located approximately 0.22 miles north of the project area at 1614 Hinton Street, property IS-7 is a Ranch style house that appears to have been constructed ca. 1960 (see Figure 4.4; Figures 4.87-4.88). The building features a side-gabled roof covered with asphalt shingles, an interior brick chimney, an exterior clad with a brick veneer, and a continuous brick foundation. Facing north, the façade reveals a central bay marked with a door that is flanked to the east by a 20-light wood sash picture window. The central bay also includes a covered porch featuring a concrete slab deck on a brick foundation and four rounded wood columns that are used to support a projecting gabled roof. The gable field of the porch roof is clad with vinyl siding. Additional fenestration along the façade includes a window east of the central bay and two windows west of the central bay that contain six-over-six, double-hung wood sashes. Attached to the east elevation of the building is a single-bay carport wing. The carport roof is supported by a wall on the north elevation that is pierced by two six-over-six, double-hung wood sash windows. Additional support is provided by two rounded wood columns that support the south slope of the roof. The west interior wall of the carport includes a door, which provides access to the main block. The west elevation of the house is pierced by two windows containing six-over-six, double-hung wood sashes. This sash type is repeated on four windows located along the south (rear) elevation of the house, which also includes a modern sliding patio door.

NRHP Assessment

Property IS-7 is a typical example of a ca. 1960 Ranch style house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the application of vinyl siding along the gable fields of the porch roof and main block. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-7 is not eligible for the NRHP.

Figure 4.87. Property IS-7; view is south featuring the façade.

Figure 4.88. Property IS-7; view is northwest featuring the south (rear) elevation and carport wing attached to the east elevation.

IS-8

Located approximately 0.22 miles north of the project area at 2003 Liddon Lake Road, property IS-8 is a Ranch style house that appears to have been constructed ca. 1965 (see Figure 4.3; Figures 4.89-4.92). The building features a side-gabled roof covered with asphalt shingles, an exterior clad with a combination of vinyl siding and brick veneer, and a continuous concrete block foundation. Facing south, the façade reveals an off-centered door that is flanked to the east by a three-part picture window containing a central single-pane, fixed wood sash that is flanked by four-over-four, double-hung wood sashes. Located west of the door are two windows containing six-over-six, double-hung wood sashes. Attached to the east elevation of the building is a single-bay carport. The carport is integral with the main roof and is partially supported by two metal posts. The interior east wall of the carport includes a door that provides access to the house. An additional door is positioned on the interior north wall that provides access to a storage closet. The west elevation of the house is pierced by two windows containing six-over-six, double-hung wood sashes. The north (rear) elevation of the house is dominated by a modern one-story addition featuring a gabled roof covered with asphalt shingles, an exterior clad with vinyl siding, and a concrete block foundation. The addition includes an exterior end chimney that is flanked on either side by a single-pane fixed wood sash. Situated on the west elevation of the addition are two one-over-one, double-hung wood sash windows. A sliding patio door is positioned on the north (rear) elevation of the addition. Located on the main block are three windows containing six-over-six, double-hung wood sashes.

North of the house is a ca. 1970 utility shed. The frame structure features a front-gabled roof covered with standing seam metal, an exterior clad with board-and-batten wood siding, and a covered pier foundation. Facing south, the shed includes a pair of swinging wood doors that are flanked on either side by a horizontal two-over-two, double-hung metal sash window (see Figure 4.92).

NRHP Assessment

Property IS-8 is a typical example of a ca. 1965 Ranch style house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the application of vinyl siding and the construction of the rear elevation addition. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-8 is not eligible for the NRHP.

Figure 4.89. Property IS-8; view is north featuring the façade.

Figure 4.90. Property IS-8; view is southwest featuring the modern addition attached to the north (rear) elevation.

Figure 4.91. Property IS-8; view is southeast featuring the west elevation of the main block.

Figure 4.92. Property IS-8; view is north featuring the ca. 1970 storage shed.

TVA Holly Springs Substation

TVAR's architectural survey of the proposed expansion of the TVA Holly Springs substation revisited two previously documented architectural resources, the NRHP-listed East Holly Springs and Depot-Compress historic districts. Portions of each historic district are located within the architectural survey radius, but lie outside the APE. Based on the results of TVAR's architectural survey, each of the historic districts are located outside the viewshed to the project area (see Figure 4.2; Figures 4.93-4.110). At their nearest points, the East Holly Springs Historic District and the Depot-Compress Historic District are located 0.48 and 0.36 miles away from the project area, respectively. TVAR's in-field assessment observed that direct visual lines-of-sight to the project area from each of the NRHP-listed historic districts are completely obscured by a combination of rolling terrain and mature tree growth (see Figures 4.104-4.110). In the opinion of TVAR, the proposed undertaking will not compromise the integrity or diminish the historical and architectural significance for which either the East Holly Springs Historic District or the Depot-Compress Historic District were listed on the NRHP. For these reasons, TVAR recommends that the proposed project will have no effect on the NRHP-listed East Holly Springs or Depot-Compress historic district.

Additionally, TVAR's architectural survey resulted in the identification of 11 previously undocumented architectural resources, IS-9-IS-19, which fall within the architectural APE of the proposed project area. Based on the results of its survey, it is the opinion of TVAR that properties IS-9-IS-19 are not eligible for the NRHP due to their lack of architectural distinction and loss of integrity caused by modern alterations. Based on the results of the architectural survey, it is the opinion of TVAR that no historic properties will be affected by the proposed expansion of the TVA Holly Springs substation. TVAR recommends no additional investigation of above-ground resources in connection with the proposed project.

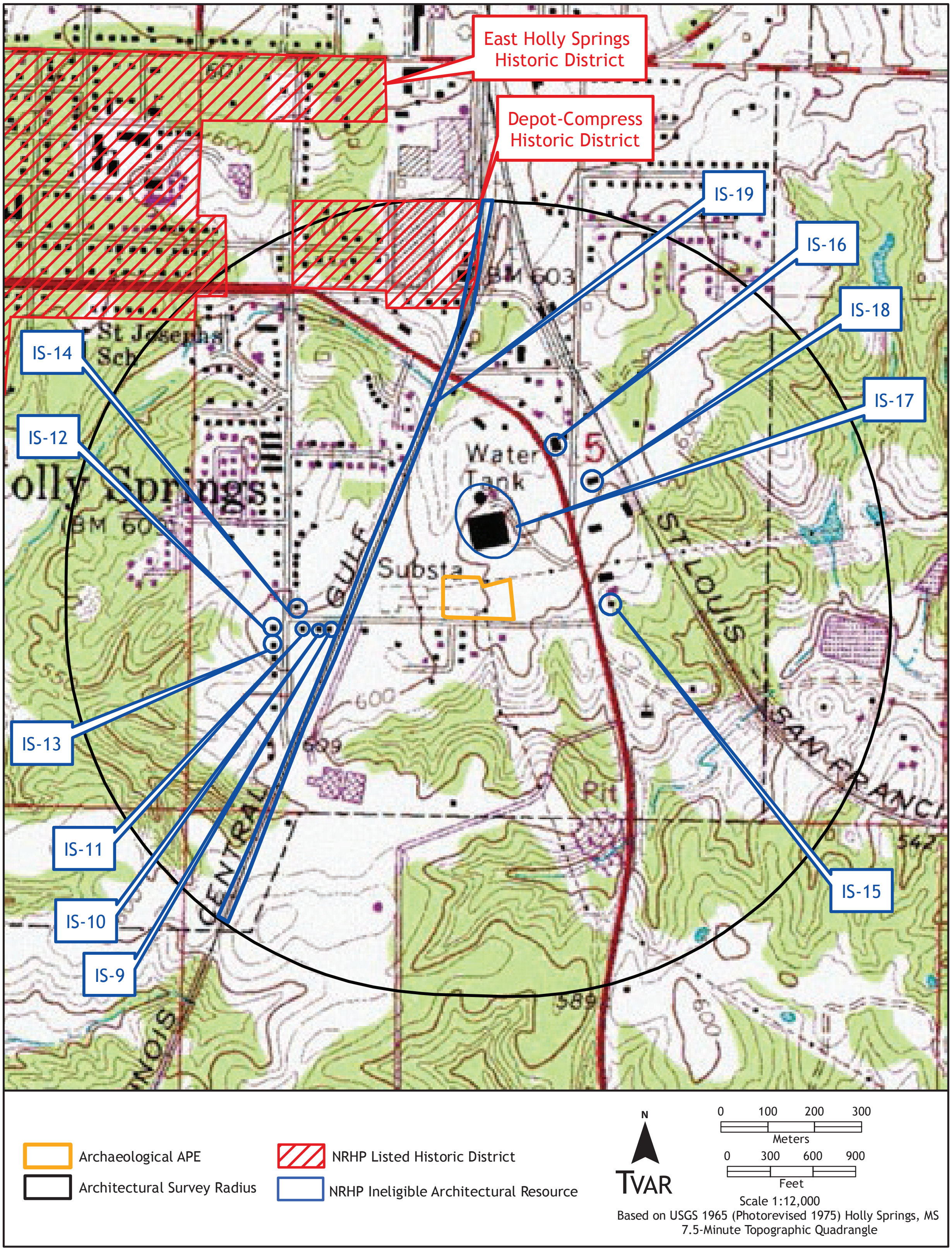


Figure 4.93. Excerpt of the USGS Holly Springs, MS topographic quadrangle showing the proposed project area, survey radius, and location of previously and newly recorded architectural resources.

Figure 4.94. TVA Holly Springs substation expansion project area; view is north.

Figure 4.95. TVA Holly Springs substation expansion project area; view is east.

Figure 4.96. TVA Holly Springs substation expansion project area; view is south.

Figure 4.97. TVA Holly Springs substation expansion project area; view is west.

Figure 4.98. LOS-5; view is northeast.

Figure 4.99. LOS-6; view is east.

Figure 4.100. LOS-7; view is southeast.

Figure 4.101. LOS-8; view is northwest.

Figure 4.102. LOS-9; view is southeast.

Figure 4.103. LOS-10; view is southeast.

Figure 4.104. LOS-11; Depot-Compress Historic District; view is south from the intersection of S. Compress Street and E. Van Dorn Avenue looking toward the project area.

Figure 4.105. LOS-12; Depot-Compress Historic District; view is south from the intersection of S. Bethlehem Street and E. Van Dorn Avenue looking toward the project area.

Figure 4.106. LOS-13; Depot-Compress Historic District; view is south from E. Van Dorn Avenue looking toward the project area.

Figure 4.107. Holly Springs substation project area; view is north looking toward the Depot-Compress Historic District.

Figure 4.108. LOS-14; East Holly Springs Historic District; view is southeast looking toward the project area.

Figure 4.109. Holly Springs substation project area; view is northwest looking toward the East Holly Springs Historic District.

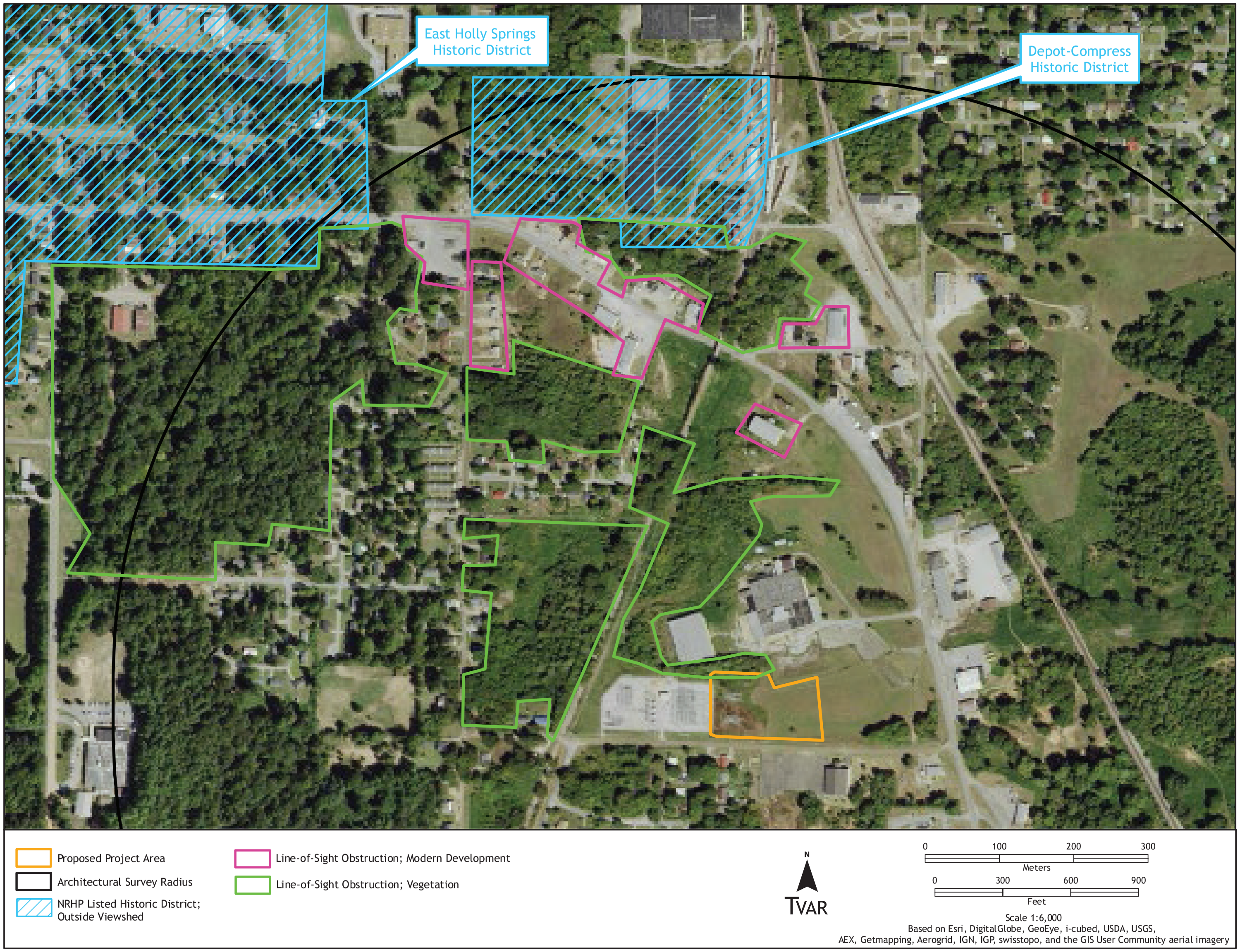


Figure 4.110. Current aerial imagery of the project area illustrating line-of-sight obstructions to the NRHP-listed Depot-Compress and East Holly Springs historic districts.

Newly Recorded Architectural Resources

IS-9

Located approximately 0.18 miles west of the project area at 449 Neely Avenue, property IS-9 is a one-story pyramidal-roof house that appears to have been constructed ca. 1920 (see Figure 4.93; Figures 4.111-4.112). The building features a roof covered with asphalt shingles, an exterior clad with asbestos shingle siding, and a covered pier foundation. Facing north, the façade reveals a central door that is flanked on either side by a six-over-six, double-hung wood sash window. Access to the façade door is achieved via a full-width porch. The porch features a wood deck on a concrete block pier foundation and four non-original wood posts that are used to support a hipped roof. The east elevation of the house is pierced by a six-over-six, double-hung wood sash window and a horizontal two-over-two, double-hung metal sash window. Positioned on a rear shed extension is a six-light wood casement sash window. The west elevation of the house is marked by two windows that contain six-over-six, double-hung wood sashes and a single six-light wood casement sash window set in a rear shed extension. Highlighting the south (rear) elevation is a recessed central bay that includes a door and a six-over-six, double-hung wood sash window. Access to the door is through a center bay porch that is formed by flanking shed extensions. The porch includes a wood deck and two modern wood posts that help support the roof. In addition, a six-light wood casement sash window is located on the interior east wall of the porch. Each extension is clad with modern fiberboard siding.

NRHP Assessment

Property IS-9 is a typical example of a ca. 1920 pyramidal-roof house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the application of fiberboard siding and the replacement of the columns associated with the façade and rear elevation porches. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-9 is not eligible for the NRHP.

Figure 4.111. Property IS-9; view is southwest featuring the façade and east elevation.

Figure 4.112. Property IS-9; view is northeast featuring the south (rear) and west elevations.

IS-10

Located approximately 0.19 miles west of the project area at 435 Neely Avenue, property IS-10 is a one-story hipped-roof house that appears to have been constructed ca. 1920 (see Figure 4.93; Figures 4.113-4.114). The concrete block building features a roof covered with asphalt shingles, an interior brick chimney, an exposed concrete block exterior, and a continuous concrete block foundation. Facing north, the façade reveals a central door that is flanked on either side by a six-over-six, double-hung vinyl sash window. Access to the façade door is achieved via a full-width porch. The porch features a wood deck on a concrete block foundation and four non-original wood posts that are used to support a flat roof. The east elevation of the house is pierced by two six-over-six, double-hung vinyl sash windows. This sash type is repeated on three windows located along the west elevation. Attached to the rear elevation is a full-width shed-roof extension. Composed of concrete blocks, the extension includes a centrally placed door that is flanked to the east by a six-over-six, double-hung vinyl sash window.

NRHP Assessment

Property IS-10 is a typical example of a ca. 1920 hipped-roof house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the replacement of the original porch columns and window sashes. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-10 is not eligible for the NRHP.

Figure 4.113. Property IS-10; view is southeast featuring the façade and west elevation.

Figure 4.114. Property IS-10; view is northwest featuring the east and south (rear) elevations.

IS-11

Located approximately 0.19 miles west of the project area at 445 Neely Avenue, property IS-11 is a one-story hipped-roof house that appears to have been constructed ca. 1920 (see Figure 4.93; Figures 4.115-4.116). The frame building features a roof covered with asphalt shingles, two interior brick chimneys, an exterior clad with weatherboard siding, and a continuous concrete block foundation. Facing north, the façade reveals a central door that is flanked on either side by a four-over-four, double-hung wood sash window. Access to the façade door is achieved via a full-width porch. The porch features a wood deck on a concrete block foundation and four non-original wood posts that are used to support a hipped roof. Both the east and west elevations of the house are pierced by a single and a paired window that each contain four-over-four, double-hung wood sashes. Located to the south, on the east and west elevations of a rear shed extension, is a six-over-six, double-hung wood sash window. Attached to the south (rear) elevation of the house is a full-width shed-roof extension that includes a centrally placed door. Flanking the door to the east is a paired window and to the west is a band of three windows that each contain six-over-six, double-hung wood sashes.

NRHP Assessment

Property IS-11 is a typical example of a ca. 1920 hipped-roof house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the replacement of the original porch columns. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-11 is not eligible for the NRHP.

Figure 4.115. Property IS-11; view is southwest featuring the façade and east elevation.

Figure 4.116. Property IS-11; view is northeast featuring the south (rear) and west elevations.

IS-12

Located approximately 0.23 miles west of the project area at 370 South Chesterman Street, property IS-12 is a one-story hipped-roof house that appears to have been constructed ca. 1920 (see Figure 4.93; Figures 4.117-4.120). The frame building features a roof covered with asphalt shingles, an interior brick chimney, an exterior clad with weatherboard siding, and a brick pier foundation infilled with concrete blocks. Facing east, the façade reveals a central door that is flanked on either side by a pair of one-over-one, double-hung wood sashes. Access to the façade door is achieved via a full-width porch that is integral with the main roof. The porch features a concrete slab deck on a concrete block foundation and four non-original decorative metal posts, which are used to support the roof. The north elevation of the house is marked by a non-original exterior chimney and by three window openings containing one-over-one, double-hung wood sashes. This sash type is repeated on two windows located along the south elevation. Additional fenestration consists of a horizontal two-over-two, double-hung metal sash window. Attached to the west (rear) elevation is a ca. 1955 gabled-roof addition. The addition is clad with wood drop siding and features a concrete block foundation. Fenestration on the rear addition includes two paired windows and a single window that each contain horizontal two-over-two, double-hung metal sashes. Lastly, the rear addition includes a door located within a recessed corner porch.

Associated outbuildings include:

- A ca. 1950 storage shed. The frame structure features a shed roof covered with standing seam metal and an exterior clad with vertical wood boards. A door is positioned on the north elevation (see Figure 4.119);

- A ca. 1970 carport/garage. The frame building features a front-gabled roof covered with asphalt shingles and an exterior clad with vertical wood boards. Facing east, the building includes a single-bay that contains an overhead metal door. Additionally, the south elevation includes an exterior brick chimney and a window opening containing horizontal two-over-two, double-hung metal sashes (see Figure 4.120).

NRHP Assessment

Property IS-12 is a typical example of a ca. 1920 hipped-roof house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the construction of the north elevation chimney and the replacement of the original porch columns. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-12 is not eligible for the NRHP.

Figure 4.117. Property IS-12; view is southwest featuring the façade and north elevation.

Figure 4.118. Property IS-12; view is northeast featuring the south and west (rear) elevations.

Figure 4.119. Property IS-12; view is west featuring the ca. 1950 storage shed.

Figure 4.120. Property IS-12; view is north featuring the ca. 1970 carport/garage building.

IS-13

Located approximately 0.27 miles southwest of the project area at 396 South Chesterman Street, property IS-13 is a one-story side-gabled house that appears to have been constructed ca. 1920 (see Figure 4.93; Figures 4.121-4.122). Based on physical evidence, it is the opinion of TVAR that the building was originally constructed as a front-gabled house with the main entrance located on the east elevation, fronting South Chesterman Street. Within the past ten years, the house appears to have been modified with the reorientation of the main entrance to the south elevation. The building features a gabled roof covered with standing seam metal, an interior brick chimney, an exterior clad with weatherboard siding, and a brick pier foundation infilled with concrete blocks. Facing south, the façade reveals an off-centered door that is flanked to the west by a four-over-four, double-hung vinyl sash window. The east elevation of the house, which appears to have served as the original façade, features a modern projecting gabled bay. The gabled bay is clad with drop wood siding and is pierced by a single window containing six-over-six, double-hung vinyl sashes. The west elevation of the house includes a shed-roof extension marked by a modern two-light, sliding vinyl sash window and a door. Positioned south of the extension is a six-over-over-six, double-hung vinyl sash window. Two windows containing four-over-four, double-hung vinyl sashes are located on the north elevation.

NRHP Assessment

Property IS-13 is a typical example of a ca. 1920 side-gabled house that fails to exhibit unique features of its architectural style or workmanship. It is TVAR's opinion that the building appeared to have been originally constructed as a front-gabled house with the main entrance located on the east elevation. Recently, the location of the main entrance was moved to the south elevation. Additional alterations that have diminished the architectural integrity of the resource include the construction of the projecting gabled addition on the east elevation and the replacement of the original window sashes. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-13 is not eligible for the NRHP.

Figure 4.121. Property IS-13; view is northeast featuring the west elevation and the south elevations.

Figure 4.122. Property IS-13; view is southwest featuring the east (former primary façade) and north elevations.

IS-14

Located approximately 0.24 miles west of the project area at 440 Neely Avenue, property IS-14 is a one-story hipped-roof house that appears to have been constructed ca. 1920 (see Figure 4.93; Figures 4.123-4.124). The frame building features a roof covered with asphalt shingles, an interior brick chimney, an exterior clad with asbestos shingle siding, and a covered pier foundation. Facing south, the façade reveals a central door that is flanked on either side by a six-over-six, double-hung vinyl sash window. Access to the façade door is achieved via a full-width porch. The porch features a wood deck on a concrete block foundation and four non-original wood posts that are used to support a hipped roof. The east elevation of the house is marked by an exterior end brick chimney, two windows containing six-over-six, double-hung vinyl sashes and a paired window containing the same sash type. Situated along the west elevation are three window openings containing six-over-six, double-hung vinyl sashes. The north (rear) elevation includes a centrally placed door that is flanked to the west by a six-over-six, double-hung vinyl sash window. A partial-width hipped-roof porch provides access to the rear elevation door. The porch features a wood deck on a concrete block foundation and four non-original wood posts that support a hipped roof. Positioned east of the porch is a shed-roof extension pierced with a six-over-six, double-hung vinyl sash window.

NRHP Assessment

Property IS-14 is a typical example of a ca. 1920 hipped-roof house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the replacement of the original façade and rear elevation porch columns and the replacement of the original window sashes. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-14 is not eligible for the NRHP.

Figure 4.123. Property IS-14; view is northwest featuring the façade and east elevation.

Figure 4.124. Property IS-14; view is southeast featuring the north (rear) and west elevations.

IS-15

Located approximately 0.1 mile east of the project area at 850 State Route 178, property IS-15 is a one-story Minimal Traditional style house that appears to have been constructed ca. 1940 (see Figure 4.93; Figures 4.125-4.128). The frame building features a roof covered with asphalt shingles, an exterior clad with asbestos shingle siding, and a covered pier foundation. Facing west, the façade reveals a central door that is flanked to the north by a modern window opening containing a 12-light, fixed vinyl sash. Located south of the door is a pair of six-over-six, double-hung vinyl sash windows. Access to the façade door is through a central bay porch. The porch features a concrete slab deck on a brick foundation and two non-original wood posts atop brick plinth blocks that support a projecting gabled roof. The north elevation of the house is pierced with two windows containing six-over-six, double-hung vinyl sashes and an additional window containing four-over-four, double-hung vinyl sashes. The south elevation of the house is marked by a pair of six-over-six, double-hung vinyl sashes and a single window containing one-over-one, double-hung vinyl sashes. Attached to the east (rear) elevation is a gabled-roof extension that is clad with asbestos shingle siding and rests on a covered pier foundation. The extension includes two six-over-six, double-hung vinyl sash windows on the east elevation and a door positioned on the south elevation. Lastly, a six-over-six, double-hung vinyl sash window is located on the main block.

Located east of the house is a storage shed that appears to date to the mid-twentieth century. The frame structure features a side-gabled roof covered with corrugated metal sheets and an exterior clad with vertical wood boards. A door is positioned on the west elevation (see Figure 4.128).

NRHP Assessment

Property IS-15 is a typical example of a ca. 1940 Minimal Traditional style house that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the house that have diminished its architectural integrity include the replacement of the original porch columns and the replacement of the original window sashes. Based upon the lack of architectural merit, as well as the inability to associate the house and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-15 is not eligible for the NRHP.

Figure 4.125. Property IS-15; view is east featuring the façade.

Figure 4.126. Property IS-15; view is southeast featuring the north (rear) and west elevations.

Figure 4.127. Property IS-15; view is northwest featuring the east (rear) and south elevations.

Figure 4.128. Property IS-15; view is east featuring the storage shed.

IS-16

Located approximately 0.2 miles northeast of the project area on the east side of State Route 178, property IS-16 is a vacant one-story commercial plaza that appears to have been constructed ca. 1960 (see Figure 4.93; Figures 4.129-4.132). The concrete block building features a flat roof, an exterior clad with a brick veneer, and a concrete block foundation. Facing west, the façade is divided into ten storefront entrances that contain glass doors flanked by single and multi-pane plate glass windows. The façade is largely accented by a non-original wood awning that appears to have been added to the building in the 1980s. The awning features Classical detailing including a decorative entablature with dentil molding, which is supported by a series of Tuscan-style wood columns. TVAR's assessment of the east (rear) elevation noted at least two steel doors that provided access to the northern section of the building. However, a full assessment of the rear elevation could not be conducted due to heavy vegetation that obscures much of the building (see Figure 4.131).

NRHP Assessment

Property IS-16 is a typical example of a mid-twentieth century commercial plaza that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the building that have diminished its architectural integrity include the replacement of the windows and the construction of the ca. 1980 awning along the length of the façade. In addition, the integrity of the building is poor due to neglect. Based upon the lack of architectural merit, as well as the inability to associate the building and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-16 is not eligible for the NRHP.

Figure 4.129. Property IS-16; view is southeast featuring the northern portion of the plaza façade.

Figure 4.130. Property IS-16; view is north featuring the southern portion of the plaza façade.

Figure 4.131. Property IS-16; view is northwest featuring the east (rear) and south elevations.

Figure 4.132. Property IS-16; view is southwest featuring the east (rear) and elevation.

IS-17

Located less than 0.1 mile north of the project area on the west side of State Route 178, property IS-17 is a vacant manufacturing plant once operated by Thompson Industries (see Figure 4.93; Figures 4.133-4.142). The complex is anchored by a square-shaped, steel-frame building that features a flat roof, an exterior clad with a brick veneer, and a concrete slab foundation. Based on physical evidence, the original manufacturing building has been altered over time through the construction of an office wing on the east elevation and a series of storage bays on the west and north elevations. These sections stand out from the original building core through their contrasting exterior finishes such as metal mansard roofs and unfinished concrete block walls.

The primary façade of the manufacturing plant faces south and includes a centrally placed door opening containing a pair of swinging metal doors. Situated east of the door are a single-pane, fixed sash window and a band of five modern windows containing a lower metal awning sash topped by a single-pane fixed sash. Flanking the door to the west are two pairs of windows that contain six-light metal awning sashes. This portion of the façade is shielded by a metal canopy that is supported by a series of metal posts. Attached to the east elevation of the building is a one-story office wing that appears to have been added to the building in the mid-1980s. The office wing is clad with a brick veneer and features a mansard roof covered with metal siding. A glass door located within a recessed entry porch appears to have served as the main entrance for visitors to the plant. Fenestration on the office wing consists of two pairs of windows and two bands of three windows containing single-pane fixed metal sashes.

The west elevation of the manufacturing plant is dominated by a one-story warehouse that is clad with a brick veneer and includes an original loading bay containing an overhead metal door. An additional bay entrance located to the west has been infilled with brick and altered to include a pedestrian door. Connected to the south elevation of the warehouse section is a modern addition clad with metal siding and featuring a truck loading bay containing an overhead metal door. Attached to the west elevation of the warehouse is an open vehicle storage bay that is comprised of a flat metal roof supported by a series of steel columns. The north (rear) elevation of the plant is characterized by an assortment of vehicle bays for loading and off loading materials and goods.

Associated buildings and structures include:

- A modern warehouse. The steel-frame structure is located west of the main plant and features a low-pitch metal gabled roof and an exterior clad with metal siding. Facing east, the building includes three vehicle bays marked with overhead metal doors. In addition, two centrally placed metal pedestrian doors are also located along the east elevation (see Figure 4.137);

- A water tower that appears to date to the original construction of the plant. Located north of the main plant, the steel-frame structure is supported by four legs reinforced with X-bracing (see Figure 4.138);

- A modern pole shed. Located north of the main plant, the pole shed features a concrete slab base and a flat metal roof supported by a series of metal poles (see Figure 4.139);

- A modern concrete block garage. Located north of the main plant, the partially dismantled garage features the remains of a flat metal roof, an exposed concrete block exterior, and a concrete slab foundation. Two open vehicle bays are positioned along the north elevation (see Figure 4.140);

- A modern storage building. Located north of the main plant, the metal-frame structure features a low-pitch metal gabled roof and an exterior clad with metal siding. Facing south, the building contains a centrally placed door opening with a pair of swinging metal doors (see Figure 4.141);

- A modern utility shed. Located north of the main plant, the wood-frame building features a front-gabled roof covered with asphalt shingles, an exterior clad with vinyl siding, and a concrete slab foundation. A door opening is located on the south elevation (see Figure 4.141);

- A one-story manufacturing building. Located north of the main plant, the steel-frame building features a low-pitch metal gabled roof, an exterior clad with metal siding, and a raised concrete foundation. The building is pierced by a series of window openings that contain nine-light metal awning sashes (see Figure 4.142).

NRHP Assessment

Property IS-17 is a typical example of a mid-twentieth century manufacturing plant that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the building that have diminished its architectural integrity include the construction of the office wing and warehouse additions to the east and west elevations. In addition, the integrity and historic setting of the complex has been compromised due to neglect and the construction of modern auxiliary buildings throughout the plant grounds. Based upon the lack of architectural merit, as well as the inability to associate the building and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that IS-17 is not eligible for the NRHP.

Figure 4.133. Property IS-17; view is north featuring the main façade of the original plant building.

Figure 4.134. Property IS-17; view is northwest featuring the office wing attached to the east elevation of the original manufacturing building.

Figure 4.135. Property IS-17; view is northeast featuring the west elevation warehouse.

Figure 4.136. Property IS-17; modern concrete block warehouse addition attached to the west elevation; view is east.

Figure 4.137. Property IS-17; modern warehouse building; view is west.

Figure 4.138. Property IS-17; original water tower; view is northeast.

Figure 4.139. Property IS-17; modern pole shed; view is north.

Figure 4.140. Property IS-17; modern concrete block garage building; view is southeast.

Figure 4.141. Property IS-17; view is northeast featuring the modern storage building and utility shed.

Figure 4.142. Property IS-17; view is southeast featuring the manufacturing building.

IS-18

Located approximately 0.17 miles northeast of the project area on the east side of Highway 178, property IS-18 is a one-story hipped-roof commercial building that appears to have been constructed ca. 1955 and is currently vacant (see Figure 4.93; Figures 4.143-4.144). The building is composed of brick laid in a common bond, and features a roof covered with asphalt shingles and a continuous brick foundation. Facing west, the façade reveals an exterior clad with a brick veneer and an off-center glass and metal door that is shielded by a flat metal canopy. The door is flanked on each side by a window opening containing a two-light lower awning metal sash topped by a four-light fixed metal sash. An additional window opening north of this arrangement has been bricked in. The south elevation is marked by two overhead bay doors, three bricked-in window openings, and a window containing a two-light lower awning metal sash topped by a four-light fixed sash. A concrete block addition is attached to the east (rear) elevation and features a shed roof covered with metal sheeting and two open bays on its south elevation. The north elevation was inaccessible at the time of TVAR's survey due to heavy vegetation.

NRHP Assessment

Property IS-18 is a typical example of a ca. 1955 hipped-roof commercial building that fails to exhibit unique features of its architectural style or workmanship. Modern alterations to the building that have diminished its architectural integrity include the enclosure of original window openings and the construction of the east elevation addition. Based upon the lack of architectural merit, as well as the inability to associate the building and/or its original owner(s) with an important historical event or series of events, it is the opinion of TVAR that property IS-18 is not eligible for the NRHP.

Figure 4.143. Property IS-18; view is northeast and features the façade and south elevation.

Figure 4.144. Property IS-18; view is northwest and features the east and south elevations.

IS-19/ Mississippi Central Railroad

Located approximately 0.12 miles west of the project area, property IS-19 consists of a one-mile-long segment of the Mississippi Central Railroad (also once known as the Illinois Central Gulf Railroad), that crosses within the APE (see Figure 4.93; Figures 4.145-4.148). Actively operated by Pioneer Railcorp, the railroad segment features a raised embankment covered with ballast that supports a modern track composed of wood cross ties and steel rails. The segment located within the project APE is situated within a tree-lined corridor and extends through a combination of light industrial and residential development. A number of at-grade crossings are located along the segment. Due to the heavy vegetation that lines the rail corridor, the crossing at Neely Avenue is the only portion of the segment that has a direct visual line-of-sight to the project area.

At Holly Springs, construction on the rail line began in 1852 and was completed in 1856, connecting the city with New Orleans (Guren 1980). During the Civil War the railroad was extensively used by both the Confederate and Union troops for the movement of supplies and men. Damaged during various raids on Holly Springs, the railroad was rebuilt during the Reconstruction period. It was purchased by the Chicago, St. Louis, and New Orleans Railroad in 1878 and then by the Illinois Central Railroad in 1882 (Guren 1980). Overall, the entire Mississippi Central Railroad stretches 51 miles from Oxford, Mississippi to Grand Junction, Tennessee. An additional line runs from Corinth, Mississippi to Red Bay, Alabama. Today used primarily for freight, the main products shipped along the Mississippi Central Railroad are animal feed ingredients, fertilizer, and wood (Pioneer Railcorp 2015).

NRHP Assessment

Property IS-19/Mississippi Central Railroad is a segment of a mid-nineteenth century railroad that has been continuously altered through routine maintenance over a 150-year period. As an actively managed rail line, the railroad bed has received regular repairs which has resulted in the replacement of the original tracks, cross-ties, and ballast. As such, no materials associated with the original construction of the railroad remain, diminishing its architectural integrity. Moreover, modern industrial and residential development in the area has comprised the railroad's historic setting. For these, reasons it is the opinion of TVAR that property IS-19/Mississippi Central Railroad is not eligible for the NRHP.

Figure 4.145. Property IS-19; view is west and features the at-grade crossing at Neely Avenue.

Figure 4.146. Property IS-19; view is east and features the at-grade crossing at Neely Avenue.

Figure 4.147. Property IS-19; view is northeast from Neely Avenue.

Figure 4.148. Property IS-19; view is southwest from Neely Avenue.

CHAPTER 5. ARCHAEOLOGICAL SURVEY

Under contract with TVA, TVAR conducted a Phase I cultural resources survey to document and assess cultural resources located within the APE associated with the Corinth and Holly Springs substation expansion projects in Alcorn and Marshall Counties, Mississippi. The APE for the archaeological survey consisted of the footprints of the Corinth (2.42 ha [5.98 acres]) and Holly Springs (1.21 ha [2.98 acres]) substation expansion areas. The purpose of the investigation was to assist TVA in its Section 106 compliance and to provide an inventory of cultural resources within the project area, descriptions of the current conditions at each resource identified, and NRHP eligibility recommendations for each resource. The survey was consistent with the Secretary of the Interior's *Standards and Guidelines for Identification* (NPS 1983) and met the requirements established by the MDAH.TVAR's archaeological survey resulted in the identification of one site (22AL726) within the APE associated with the Corinth substation expansion. No resources were identified within the APE associated with the Holly Springs substation expansion. The following provides a review of background information relevant to the project area, descriptions of the resource identified, and a recommendation regarding its NRHP eligibility.

Archaeological Background Literature and Records Search

In March of 2016, TVAR consulted the MDAH Historic Resources Inventory Database (HRID) to conduct a background literature and records search to identify documented archaeological sites and previous archaeological investigations within the project area. The background study area was defined as a 0.8 km radius surrounding each of the project areas comprising the archaeological APE (Figures 5.1 and 5.2). To supplement the information obtained from the MDAH HRID, TVAR also reviewed numerous cartographic and ethnohistoric databases including the NRHP, University of Alabama Historic Maps Archive, Dave Rumsey Map Collection (DRMC), Library of Congress Map Archive, and U.S. Geological Survey (USGS) Earth Explorer data portal. Cartographic research associated with the Corinth substation expansion utilized the 1950 Corinth 15-minute topographic quadrangle, a 1921 soil survey map of Alcorn County, an 1862 map entitled "Topographic sketch of Corinth, Mississippi and its environs: showing the enemy entrenchments, and the approach of the U.S. forces" (Michler and Weyss 1862), an 1862 map entitled "Map of the Country Between Monterey, Tenn. & Corinth, Miss." (Matz 1862), an 1875 map entitled "Environs de Corinth" (Vorzet, Ed. Dumas; Le Comte de Paris 1875), and an 1895 map entitled "Plan of the Battle of Corinth," (Rosencrans 1895). Maps referenced during research for the Holly Springs substation expansion included the USGS 1953 15-minute and 1965 Holly Springs 7.5-minute topographic quadrangles. A Bureau of Land Management, General Land Office Records (BLM, GLO) search was conducted for all land parcels encompassed by the APE, and the original land patents are included in Appendix B.

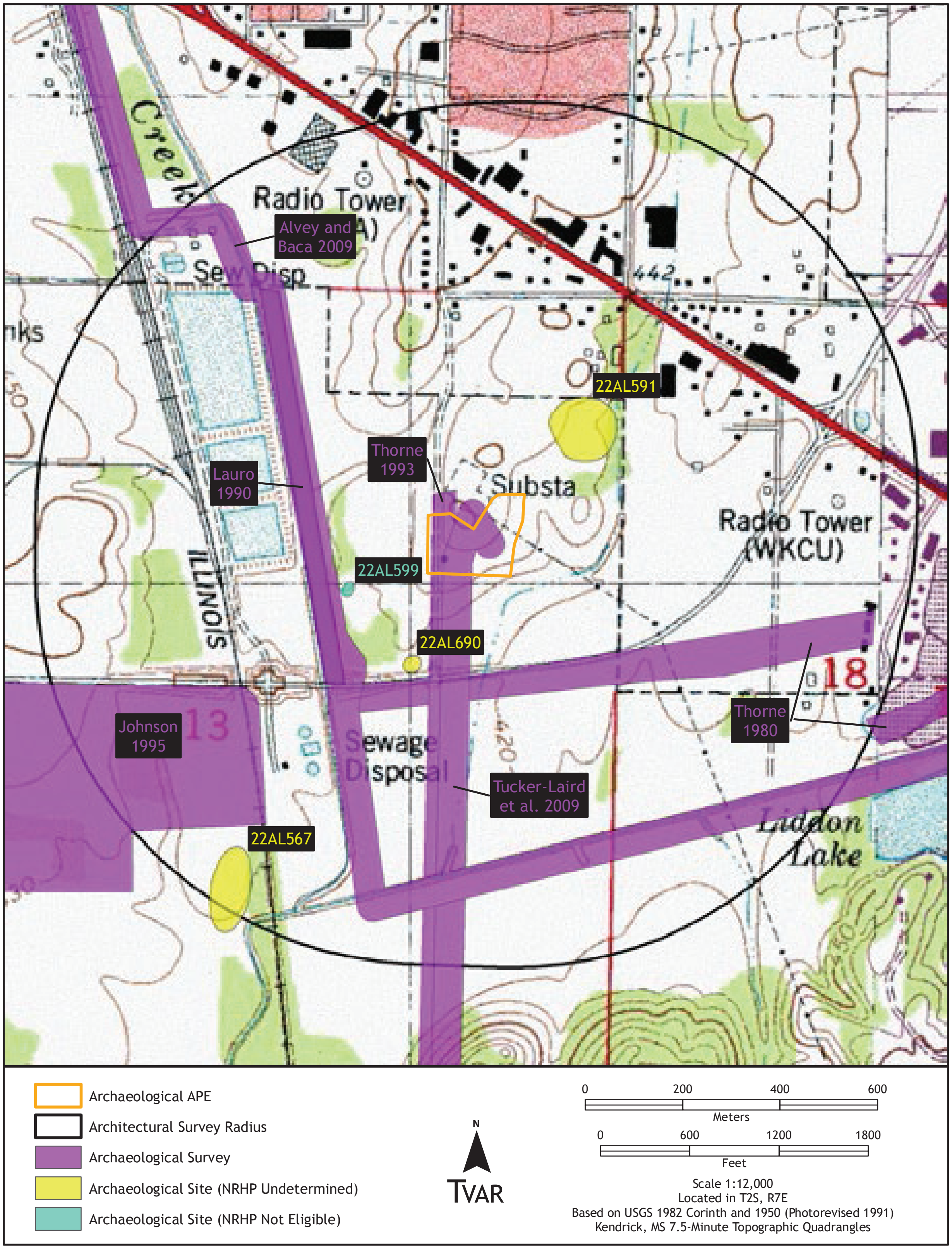


Figure 5.1. Background study area associated with the Corinth substation expansion.

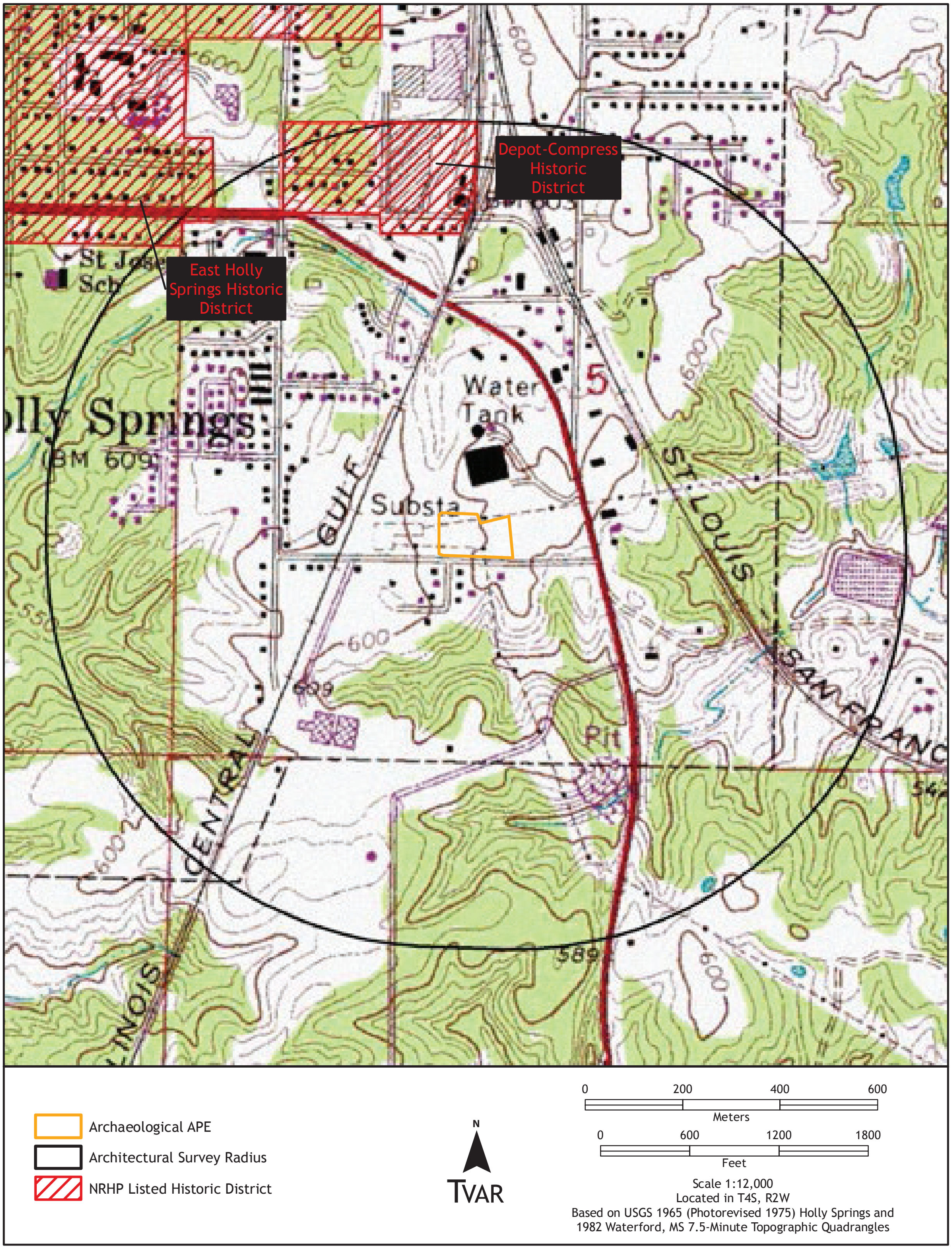


Figure 5.2. Background study area associated with the Holly Springs substation expansion.

The NRHP lists 20 properties in Alcorn County and another 20 in Marshall County. None of the Alcorn County properties fall within the background study area or APE associated with the Corinth substation expansion project, but two of the Marshall County NRHP-listed properties, the Depot-Compress Historic District and the East Holly Springs Historic District, fall within the background area associated with the Holly Springs substation expansion project. The properties are discussed in greater detail in the previous chapter of this report. No Traditional Cultural Properties or historic cemeteries were identified in either background study area.

TVAR's research using the MDAH HRID identified four archaeological sites within the background study area associated with the Corinth substation expansion, but none were recorded within the APE (Table 5.1). No archaeological sites fell within the background study area or APE associated with the Holly Springs substation expansion. In addition the MDAH HRID identified six previously conducted cultural resources survey in within the background study area associated with the Corinth substation expansion, two of which overlapped with the current APE (Table 5.2). No previously conducted cultural resources surveys fell within the background study area or APE associated with the Holly Springs substation expansion.

Table 5.1. Archaeological Sites Within the Background Study Area.

Site Number	Temporal Affiliation	NRHP Status	Reference
22AL567	Early-Late Archaic; Middle-Late Woodland	Undetermined	Atkinson 1987
22AL591	Late Archaic; Mississippian	Undetermined	MDAH
22AL599	Unknown Aboriginal	Ineligible	MDAH
22AL690	Unknown Aboriginal	Undetermined	MDAH

Table 5.2. Previous Cultural Resources Surveys Within the Background Study Area.

Project Description	Level of Investigation	Survey Area (ha)	Survey Dimensions	Overlap with Current APE (Acres)	Archaeological Resources	Reference
Sewer treatment plant and wasterwater collection	Survey	Unknown	Unknown	N/A	Unknown	Thorne 1980
Corinth Sewage Lagoon	Survey	0.4	2,500 ft by 20 ft tract	N/A	None	Lauro 1990
TVA ROW from Ripley to Corinth	Survey	137.59	28 mi with 100 ft ROW	1.35	None	Thorne 1993
Improvements to South Corinth Industrial Park	Survey	30.35	75 acres	N/A	None	Johnson 1995
Water Line Route in Corinth	Survey	25.14	8,380 m long, 30 m wide corridor	N/A	22AL689	Alvey and Baca 2009
Corinth-Biggersville Transmission Line	Survey	44.42	9.2 mi long, 30 m wide corridor	2.44	None	Tucker-Laird et al. 2009

Methods of Investigation

The Phase I survey included pedestrian reconnaissance of the APE with a combination of shovel testing and surface inspection as the basis for the identification and delineation of archaeological resources. Systematic shovel testing (herein referred to as planned shovel test locations) was conducted at 30 m intervals within the archaeological APE. Shovel tests were 30-x-30 cm square units and excavated to a depth of 70 centimeters below surface (cmbs), or until the water table or sterile subsoil was encountered. Test soils were passed through 1/4-inch hardware mesh to recover cultural materials. Artifacts recovered in the screen were bagged and labeled by provenience, including a shovel test number and a temporary site number. Systematic shovel testing was complemented with visual inspection of exposed ground surfaces, root balls, and rodent burrows, when possible. Lastly, TVAR conducted judgmental shovel tests within the archaeological APE to investigate any area that fell outside the planned 30 m shovel test interval but was considered a high probability location for archaeological resources.

When archaeological resources were identified during the survey, TVAR implemented a close interval (10 m) shovel testing program to delineate both the horizontal and vertical boundaries of the resources within the archaeological APE. Shovel testing at 10 m intervals was conducted in an opportunistic manner depending on the landform and orientation of the APE. Close interval shovel testing continued within the APE until two sequential negative tests were completed. All excavated deposits were passed through 1/4-inch mesh screen. Artifacts recovered in the screen were bagged and labeled by provenience, including a shovel test number and a temporary site number.

All locations (planned, judgmental, and resource delineation) investigated during the survey were recorded using a field computer (Topcon GRS-1) with a global positioning system (GPS) receiver with sub-meter precision and specialized data-capturing software tailored to archaeological surveying. The combination of hardware and software provided for realtime data acquisition and visualization while furnishing important information to the field crews, including the locations of archaeological sites, environmental features, and survey boundaries. Using software developed by TVAR, detailed information, such as soil descriptions, artifact locations, landscape features, and photographic information, was recorded at the time of observation and linked via geographic coordinates. All pertinent project records and materials will be curated at the Erskine Ramsay Archaeological Repository at Moundville Archaeological Park (Appendix C).

Results of the Corinth Substation Expansion Survey

One site (22AL726) was identified during the survey of the APE associated with the Corinth substation expansion. No linear resources were identified. A total of 25 planned shovel test locations were visited during the survey, one of which was positive for cultural material. In addition, one judgmental shovel test was conducted in the southwestern portion of the APE, but it did not produce any artifacts. Finally, nine shovel tests were conducted during the delineation of 22AL726, which is discussed in greater detail below. The locations of all shovel tests are depicted in Figure 5.3, a shovel test roster is included in Appendix D, and the completed MDAH site form for 22AL726 is provided in Appendix E.

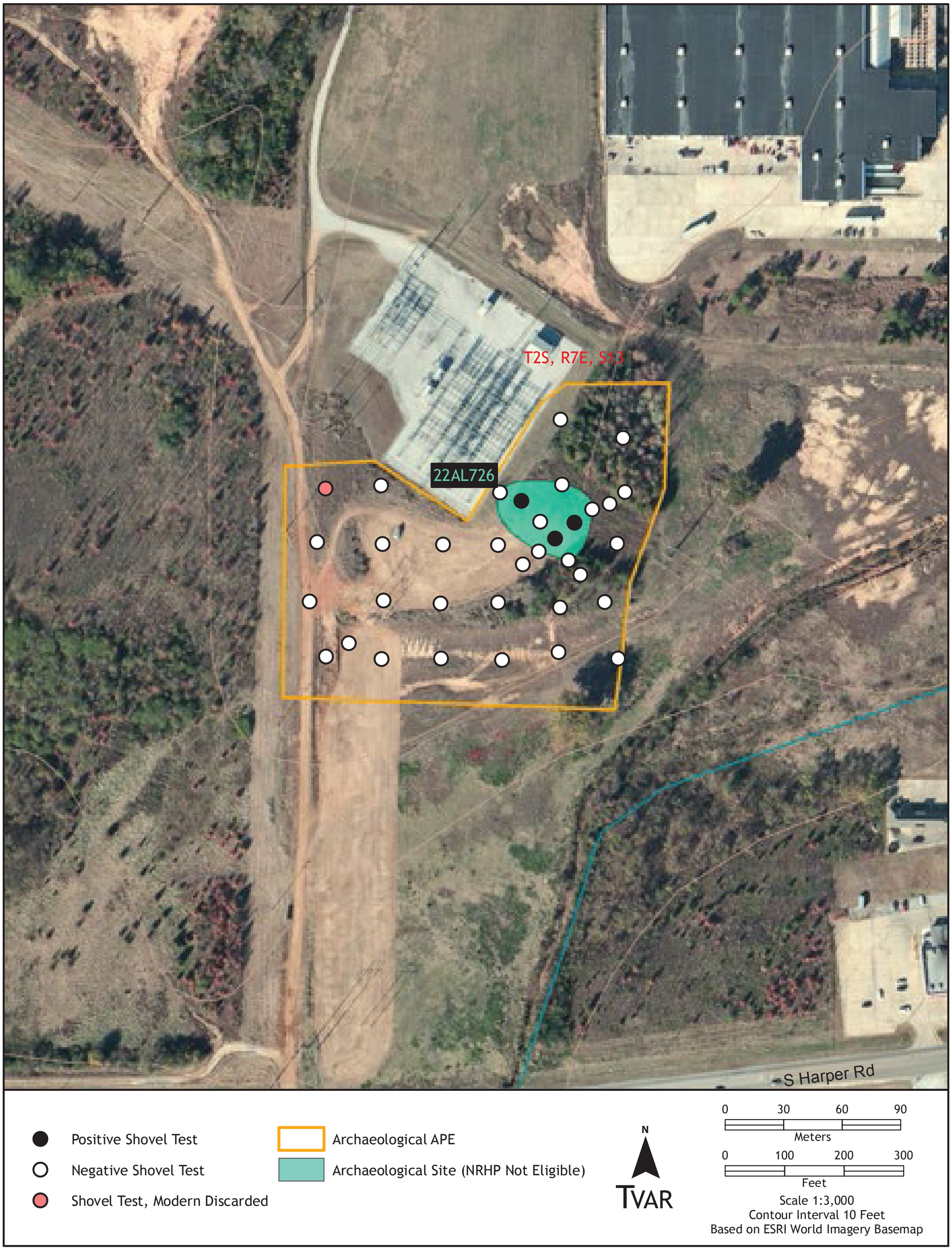


Figure 5.3. Shovel test locations within the APE associated with the Corinth substation expansion.

22AL726

Site 22AL726 is a 1,493 m^2, low-density prehistoric pottery scatter with a historic isolate. It is located on the summit and shoulder of a northeast-southwest trending ridge and 130 m northwest of an unnamed tributary of Bridge Creek. At the time of TVAR's survey, the site was situated in a field of tall grass and briars less than 10 m southeast of the existing substation (Figure 5.4).

BLM, GLO records indicate that the parcel encompassing 22AL726 was originally registered to Mul La Le Tubby, a Chickasaw Indian, through the 1832 Treaty of Pontotoc (see Appendix B). The USGS 1950 15-minute and 1982 7.5-minute Corinth topographic quadrangle maps depict a structure 100 m to the southwest of the site, but no structure was observed at that location during the current survey; thus, the structure must have been demolished sometime after 1982.

A total of 12 shovel tests were conducted during TVAR's investigation of the site, including three that produced artifacts (n=5) from a maximum depth of 25 cmbs (Figure 5.5). A general representative profile was witnessed in Shovel Test 27 and consisted of a brown (7.5YR 5/4) silty clay loam (0 to 20 cmbs) underlain by a strong brown (7.5YR 5/6) silty clay (20 to 29 cmbs) (Figure 5.6). Artifacts recovered are listed below.

Shovel Test 27 (0-14 cmbs)
- 2 2.34 g coarse sand tempered sherdlet

Shovel Test 29 (18-25 cmbs)
- 1 0.83 g coarse sand tempered sherdlet

Shovel Test 64 (0-11 cmbs)
- 1 0.45 g 1/4-inch debitage, chert (undifferentiated)
- 1 6.53 g brick fragment

In sum, 22AL726 is a low-density prehistoric pottery scatter northwest of a tributary of Bridge Creek. The artifact assemblage recovered during TVAR's investigation of the site was primarily comprised of coarse sand-tempered ceramics, which could indicate a Woodland occupation at the site. Additionally, a historic brick fragment was found, but it can not be precisely dated to the time during which a structure was extant near the site. Due to the sparse nature of the artifact distribution, location of artifacts within the plowzone, and the inability to associate the assemblage with a more specific prehistoric time period or historic structure, it is the opinion of TVAR that 22AL726 lacks the potential to significantly contribute to research concerning the prehistory or history of the region. As such, TVAR recommends that the site is not eligible for listing on the NRHP and that no further archaeological investigations of 22AL726 are necessary in connection with the proposed project.

Figure 5.4. Briars and tall grass at 22AL726.

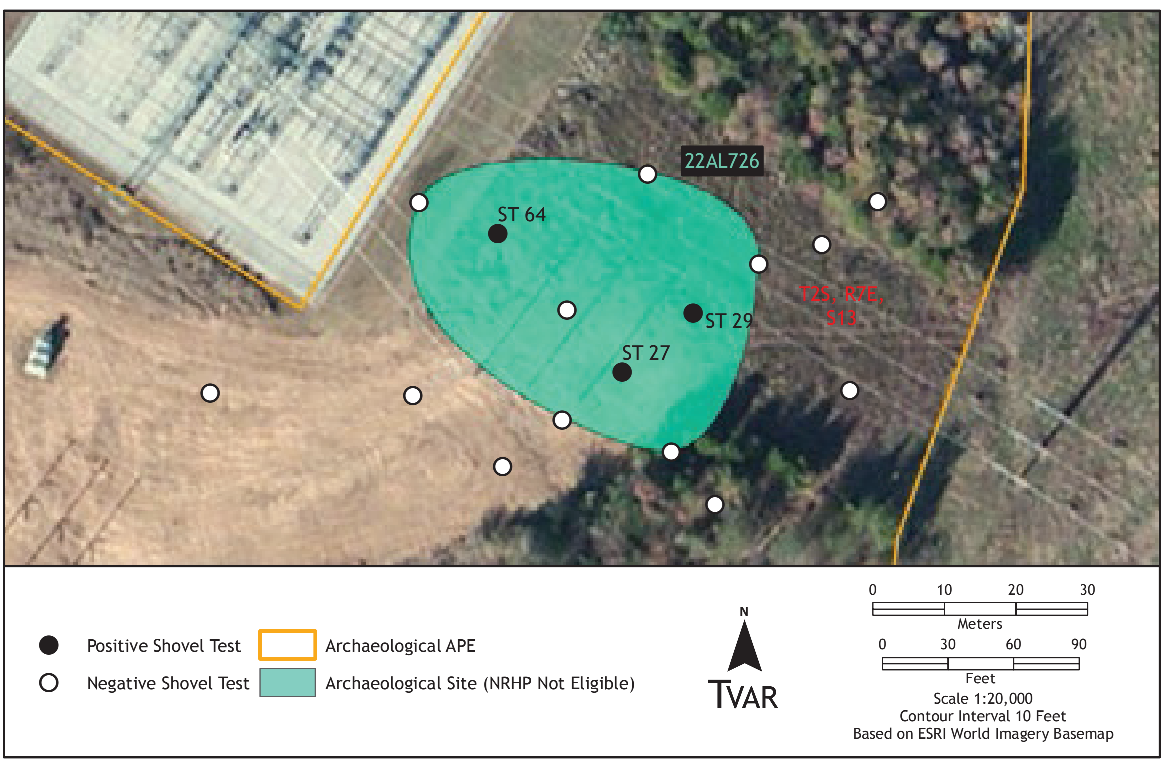


Figure 5.5. Map of 22AL726

Figure 5.6. West profile of Shovel Test 27 at 22AL726.

Results of the Holly Springs Substation Expansion Survey

No archaeological or linear resources were identified during TVAR's survey of the APE associated with the Holly Springs substation expansion project. A total of 15 planned shovel test locations were visited during the survey, none of which were positive for archaeological cultural material (Figure 5.7; see Appendix D). The project area fell within a manicured grass field (Figure 5.8), and shovel testing produced a general profile (witnessed in Shovel Test 13) consisting of a dark grayish brown (10YR 4/2) silty clay loam (0 to 10 cmbs) underlain by a mottled yellowish brown (10YR 5/4) silty clay loam (10 to 34 cmbs). The bottommost stratum observed was a mottled yellowish brown (10YR 5/6) silty clay (34 to 41 cmbs) (Figure 5.9).

Figure 5.7. Shovel test locations within the APE associated with the Holly Springs substation expansion.

Figure 5.8. Manicured grass comprising the Holly Springs substation expansion project area (view of the northwest).

Figure 5.9. Southwest profile of Shovel Test 13 within the APE associated with the Holly Springs substation expansion.

CHAPTER 6. MATERIALS RECOVERED

Field notes, maps, artifacts, photos, and pertinent records generated during this Phase I survey were transported to the TVAR laboratory in Huntsville, Alabama. At the laboratory facilities, artifacts and other associated materials recovered during the survey were thoroughly washed and allowed to air dry. Provenience information was verified for accuracy at this stage, and all materials were accounted for by a physical inventory. All items were assigned unique catalog numbers and placed in 4 mil polypropylene resealable bags. Prior to entering the material data into a relational database, a final check of provenience and material data was performed. The data were then entered into the database, and both query-driven and physical data checks were used to verify the accuracy of the entries. All materials and documents generated during this Phase I study will be curated at the Erskine Ramsay Archaeological Repository located at Moundville Archaeological Park. This facility meets U. S. Department of Interior 36 CFR § 79 guidelines. Materials collected during the current survey are summarized below.

Sherdlet

Sherdlet represents a <1/2-inch size-grade category of ceramics. Specimens this size typically are regarded as too small for accurately discerning surface treatment and/or temper. Consequently, sherdlets are not placed into any chronological type. However, whenever possible, temper and/or surface treatment is recorded for specimens recovered from proveniences containing only sherdlets or for unique specimens within a provenience. Three coarse sand-tempered sherdlets were recovered from 22AL726. Sand-tempered pottery is typically associated with Gulf Formational and Woodland assemblages in northern Mississippi (Jenkins 1981:15-29; Rafferty 1990).

Lithic Debitage

Debitage is the byproduct of lithic reduction activities, i.e., flintknapping. Specimens were classified in accordance with Ahler's (1989) aggregate analysis methods, in which recorded attributes include raw material type, size grade, and presence of cortex. All debitage was size graded through nested 1-inch, 1/2-inch, and 1/4-inch screens. One piece of 1/4-inch debitage knapped from undifferentiated chert was recovered from 22AL726.

Brick

Bricks are produced from tempered clay which is formed in a mold or cut into a rectangular block and fired in a kiln. The manufacturing of brick in the United States began soon after European colonists arrived. Machine-made bricks began replacing hand-made bricks throughout the nineteenth century and became the primary method of brick production in the late nineteenth century (Holly 2009). Site 22AL726 yielded one brick fragment.

CHAPTER 7. SUMMARY AND RECOMMENDATIONS

Under contract with TVA, TVAR conducted a Phase I cultural resources survey to document and assess cultural resources located within the APE associated with the Corinth and Holly Springs substation expansion projects in Alcorn and Marshall Counties, Mississippi. The APE for the archaeological survey consisted of the footprints of the Corinth (2.42 ha [5.98 acres]) and Holly Springs (1.21 ha [2.98 acres]) substation expansion areas. The architectural APE consisted of a 0.8 km (0.5 mi) radius surrounding the substation footprints. Areas within the architectural survey radii that were determined not to be in view of the substations due to terrain, vegetation, and/or modern built environments were not considered as part of the architectural APE.

The purpose of the investigation was to assist TVA in its Section 106 compliance and to provide an inventory of cultural resources within the project area, descriptions of the current conditions at each resource identified, and NRHP eligibility recommendations for each resource. The survey was consistent with the Secretary of the Interior's *Standards and Guidelines for Identification* (NPS 1983) and met the requirements established by the MDAH.

TVAR's architectural assessment of the survey radius surrounding the proposed Corinth substation expansion resulted in the revisitation of 14 previously documented architectural resources (003-COR-1249, 1251, 1252, 1253, 1254, 1255, 1256, 1257, 1258, 1259, 1260, 1261, 1262, and 1263). Of the 14 previously documented architectural resources, 13 (003-COR-1249, 1251, 1252, 1253, 1254, 1255, 1256, 1257, 1258, 1259, 1260, 1261, 1262, and 1263) are extant and located within the architectural APE. TVAR recommends these architectural resources not eligible for the National Register of Historic Places (NRHP) due to their lack of architectural distinction and loss of integrity caused by modern alterations and/or damage. TVAR's survey noted previously recorded property 003-COR-1251 is located outside the viewshed of the proposed project area. In addition, TVAR's survey of the APE associated with the Corinth substation identified six resources (IS-1-IS-6) within the survey radius, none of which are recommended as eligible for listing on the NRHP due to their lack of architectural and historic significance. Consequently, TVAR recommends no additional investigation of above-ground resources in connection with the proposed Corinth substation expansion project.

TVAR's architectural assessment of the survey radius surrounding the proposed Holly Springs substation expansion revisited two NRHP-listed historic districts, the Depot-Compress Historic District and the East Holly Springs Historic District, within the survey radius. Based on the results of TVAR's architectural survey, the two historic districts are located outside the viewshed to the project area and will not be affected by the proposed undertaking. In addition, TVAR's survey resulted in the identification of 14 resources (IS-1-IS-14) within the survey radius, none of which are recommended as eligible for listing on the NRHP due to their lack of architectural and historic significance. Consequently, TVAR recommends no additional investigation of above-ground resources in connection with the Holly Springs substation expansion project.

TVAR's archaeological survey resulted in the identification of one site (22AL726) within the APE associated with the Corinth substation expansion, but it lacks the potential to significantly contribute to research concerning the prehistory of the region. Consequently, TVAR recommends that the site is not eligible for listing on the NRHP. No resources were identified during TVAR's survey of the APE associated with the Holly Springs substation expansion. No further archaeological investigations are recommended in connection with either of the proposed projects.

REFERENCES CITED

Adams, George I., Charles Butts, Lloyd W. Stephenson, and Wythe Cooke
1926 *Geology of Alabama*. Alabama Geological Survey, Special Report 14.

Ahler, Stanley
1989 Mass Analysis of Flaking Debris: Studying the Forest Rather Than the Trees. In *Alternative Approaches to Lithic Analysis*, edited by Donald O. Henry and George H. Odell, pp. 85-118. Archaeological Papers of the American Anthropological Association No. 1. American Anthropological Association, Washington.

The Alliance (City of Corinth and Alcorn County, Mississippi)
2016 Economic Development. Electronic document, http://economicdevelopment.corinthalliance.com/, accessed May 9, 2016.

Alvey, Jeffrey S., and Keith A. Baca
2009 *A Phase I Cultural Resources Survey of a Proposed Water Line Route in the City of Corinth, Alcorn County, Mississippi*. Cobb Institute of Archaeology, Mississippi State University. Submitted to Cook Coggin Engineers, Inc., Corinth, MS.

Anderson, David G.
1994 *The Savannah River Chiefdoms: Political Change in the Late Prehistoric Southeast*. University of Alabama Press, Tuscaloosa.

Anderson, David G., Jerald Ledbetter, Lisa O'Steen, Daniel T. Elliott, Dennis Blanton, Glen T. Hanson, and Frankie Snow
1994 Paleoindian and Early Archaic in the Lower Southeast: A View from Georgia. In *Ocmulgee Archaeology*, 1936-1986, edited by David J. Hally, pp. 55-70. The University of Georgia Press, Athens.

Anderson, David G., and Robert C. Mainfort, Jr.
2002 An Introduction to Woodland Archaeology in the Southeast. In *The Woodland Southeast,* edited by David G. Anderson and Robert C. Mainfort, pp. 1-19. The University of Alabama Press, Tuscaloosa.

Anderson, David G., Lisa D. O'Steen, and Kenneth E. Sassaman
1996 Environmental and Chronological Considerations. In *The Paleoindian and Early Archaic Southeast*, edited by David G. Anderson and Kenneth E. Sassaman, pp. 5-15. The University of Alabama Press, Tuscaloosa.

Atkinson, James R.
1986 Post-Woodland and Period Archaeological Phases in the Upper Tombigbee River Valley Between Tibbee-Line Creeks and Tupelo, Mississippi. Manuscript in possession of the author, Office of the Natchez Trace Parkway, Tupelo.

Atkinson, James R., John C. Phillips, and Richard Walling
1980 The Kellogg Village Site Investigations Clay County, Mississippi. Report for the U.S. Army Corps of Engineers, Mobile District by Department of Anthropology Mississippi State University.

Bense, Judith A.
1983a *Archaeological Investigations at Site 22IT581 Itawamba County, Mississippi*. Office of Archaeological Research Report of Investigations No. 19. The University of Alabama.

1983b Tuscaloosa Formation. In *Archaeological Investigations in the Upper Tombigbee Valley, Mississippi: Phase I*, Vol. 4, edited by Judith A. Bense, pp.IIIF.1. The University of West Florida.

1994 *Archaeology of the Southeastern United States: Paleoindian to World War I*. Academic Press, San Diego.

Blitz, John H.
1988 Adoption of the Bow in Prehistoric North America. *North American Archaeologist* 9(2):123-145.

Blitz, John H., and Karl G. Lorenz
2006 *The Chattahoochee Chiefdoms*. The University of Alabama Press, Tuscaloosa.

Bohannon, Charles F.
1972 Excavations at the Pharr Mounds, Prentiss and Itawamba Counties, Mississippi and Excavations at the Bear Creek Site Tishomingo County, Mississippi. U.S. Department of the Interior, National Park Service, Office of Archeology and Historic Preservation. Washington, D.C.

Braund, Kathryn E. Holland
1993 *Deerskins & Duffels: The Creek Indian Trade with Anglo-America, 1685-1815*. University of Nebraska Press, Lincoln.

Brown, James A.
2004 Exchange and Interaction Until 1500. In Southeast, edited by Raymond D. Fogelson, pp. 677-685. *Handbook of North American Indians*, Vol. 15, William C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Cambron, James W., and Spencer Waters
1961 Flint Creek Rock Shelter (Part II). *Journal of Alabama Archaeology* 7(1):1-49.

Chapman, Shannen S., Glenn E. Griffith, James M. Omernik, Jeffrey A. Comstock, Michael C. Beiser, and Delany Johnson
2004 Ecoregions of Mississippi. United States Geological Survey. Electronic document, ftp://ftp.epa.gov/wed/ecoregions/ms/ms_front.pdf, accessed April 2016.

Clark, Thomas D., and John D. Guice
1989 *Frontiers in Conflict, The Old Southwest, 1795-1830*. University of New Mexico Press, Albuquerque.

Code of Federal Regulations (CFR)
2013a *Protection of Historic Properties*. Title 36, Part 800, Sections 1–16. Electronic Document, http://www.gpo.gov/fdsys/pkg/CFR-2011-title36-vol3/pdf/CFR-2011-title36-vol3-part800.pdf, accessed May 16, 2016.

2013b *National Register of Historic Places: Criteria for Evaluation*. Title 36, Part 60, Section 4. Electronic Document, http://www.gpo.gov/fdsys/pkg/CFR-2011-title36-vol1/pdf/CFR-2011-title36-vol1-part60.pdf, accessed May 16, 2016.

Cole, Gloria G.
1981 T*he Murphy Hill Site (1MS300): The Structural Study of a Copena Mound and Comparative Review of the Copena Mortuary Complex*. The University of Alabama Office of Archaeological Research, Research Series 3.

DeBow, J.D.B.
1853 *The Seventh Census of the United States: 1850*. Robert Armstrong, Washington, D.C.

DeJarnette, David L., Edward B. Kurjack, and James W. Cambron
1962 The Stanfield-Worley Bluff Shelter. *Journal of Alabama Archaeology* 8(1-2):1-111.

Derry, Anne, H. Ward Jandl, Carol D. Shull, and Jan Thorman
1985 *Guidelines for Local Surveys: A Basis for Preservation Planning*. National Register Bulletin 24, U.S. Department of the Interior, National Park Service, Washington D.C.

Dowd, John T.
1989 *The Anderson Site: Middle Archaic Adaptation in Tennessee's Central Basin*. Tennessee Anthropological Association, Miscellaneous Paper 13.

Dye, David H.
1996 *Riverine Adaptation in the Midsouth. In Of Caves and Shell Mounds*, edited by Kenneth C. Carstens and Patty Jo Watson, pp. 140-158. The University of Alabama Press, Tuscaloosa.

Elliott, Jack D. Jr., and Mark R. Barnes
1996 *Dancing Rabbit Creek Treaty Site*. National Register of Historic Places Nomination. Mississippi Department of Archives and History, Historic Preservation Division, Jackson.

Ensor, H. Blaine
1981 *Archaeological Investigations in the Gainesville Lake Area of the Tennessee-Tombigbee Waterway 3. Gainesville Lake Area Lithics: Chronology, Technology and Use*. Office of Archaeological Research Report of Investigations No. 3. The University of Alabama.

Ethridge, Robbie
2009 Introduction: Mapping the Mississippian Shatter Zone. In *Mapping the Mississippian Shatter Zone: The Colonial Indian Slave Trade and Regional Instability in the American South*, edited by Robbie Ethridge and Sheri M. Shuck-Hall, pp. 1-62. University of Nebraska Press, Lincoln.

FamilySearch.org
2015 Marshall County, Mississippi. Electronic document, https://familysearch.org/learn/wiki/en/Marshall_County,_Mississippi_Genealogy#Military, accessed May 5, 2016.

2016a Tippah County, Mississippi. Electronic document, https://familysearch.org/wiki/en/Tippah_County,_Mississippi_Genealogy#Military, accessed May 5, 2016.

2016b Tishomingo County, Mississippi. Electronic document, https://familysearch.org/wiki/en/Tishomingo_County,_Mississippi_Genealogy#Military, accessed May 5, 2016.

Faulkner, Charles H.
1996 The Old Stone Fort Revisited: New Clues to an Old Mystery. In *Mounds, Embankments, and Ceremonialism in the Midsouth*, edited by Robert C. Mainfort and Richard Walling, pp. 7-11. Arkansas Archeological Survey Research Series 46.

Franks, Bob

2009 A Concise History of Itawamba County, Mississippi. The Itawamba Historical Society. Electronic document, http://www.itawambahistory.org/history.html, accessed May 5, 2016.

Futato, Eugene F.

1999 *Lithic Raw Materials and Settlement Patterns in the Western Middle Tennessee Valley Uplands*. Proceedings of the 16th Annual Mid-South Archaeological Conference 29:44-56. Jackson.

Gibson, Jon L.

2000 *The Ancient Mounds of Poverty Point: Place of Rings*. University Press of Florida, Gainesville.

2007 "Formed from the Earth at That Place": The Material Side of Community at Poverty Point. *American Antiquity* 72(3):509-523.

2010 Poverty Point Redux. In *Archaeology of Louisiana,* edited by Mark A. Rees, pp. 77-96. Louisiana State University Press, Baton Rouge.

Goodyear, Albert C.

2005 Evidence for Pre-Clovis Sites in the Eastern United States. In *Paleoamerican Origins: Beyond Clovis*, edited by Robson Bonnichsen, Bradley T. Lepper, Dennis Stanford, and Michael Waters, pp. 103-112. Center for the Study of the First Americans, College Station, Texas.

Guren, Pamela

1980 *Depot-Compress Historic District*. National Register of Historic Places nomination form. Mississippi Department of Archives and History, Historic Preservation Division, Jackson.

Halbert, Henry S.

1902 Story of the Treaty of Dancing Rabbit. In *Publications of the Mississippi Historical Society, Vol. VI*, edited by Franklin L. Riley, pp. 373–402. Oxford, Mississippi.

Hally, David J.

1993 The Territorial Size of Mississippian Chiefdoms. In *Archaeology of Eastern North America: Papers in Honor of Stephen Williams*, edited by James B. Stoltman, pp. 143-168. Mississippi Department of Archives and History, Archaeological Report 25, Jackson.

Haynes, Robert V.

2010 *The Mississippi Territory and the Southwest Frontier, 1795-1817*. University Press of Kentucky, Lexington.

Hoffman, Michael P.

1993 The Depopulation and Abandonment of Northeastern Arkansas in the Protohistoric Period. In *Archaeology of Eastern North America: Papers in Honor of Stephen Williams,* edited by James B. Stoltman, pp. 261-275. Mississippi Department of Archives and History, Archaeological Report 25. Jackson.

Hollingsworth, Caryn Yeager

1991 The Archaeology of Sheeps Bluff shelter (1FR324), Franklin County, Alabama. *Journal of Alabama Archaeology* 37(1-2):1-155.

Holly Jr., I. B.

2009 The Mechanization of Brickmaking. *Technology and Culture* 50(1): 82-102.

Holstein, Harry O., Curtis E. Hill, and Keith J. Little
1995 *Archaeological Investigation of Stone Mounds on the Fort McClellan Military Reservation, Calhoun County, Alabama*. United States Department of Defense Legacy Resource Management Program.

Hoseman, Delbert
2012 *Mississippi Blue Book*. Secretary of State, Jackson.

Hudson, Charles, and Carmen Chaves Tesser
1994 Introduction. In The Forgotten Centuries: Indians and Europeans in the *American South, 1521-1704*, edited by Charles Hudson and Carmen Chaves Tesser, pp. 7-14. The University of Georgia Press, Athens.

Ingmanson, John Earl, and John W. Griffin
1974 Material Culture. In *Investigations in Russell Cave by John W. Griffin* pp. 29-62. National Park Service, Publications in Archeology 13. Washington.

Jackson, H. Edwin, and Susan L. Scott
2002 Woodland Faunal Exploitation in the Midsouth. In The Woodland Southeast, edited by David G. Anderson and Robert C. Mainfort, Jr., pp. 461-482. The University of Alabama Press, Tuscaloosa.

Jefferies, Richard W.
1976 *The Tunacunnhee Site: Evidence of Hopewell Interaction in Northwest Georgia*. Anthropological Papers of the University of Georgia 1.

1996 The Emergence of Long Distance Exchange Networks in the Southeastern United States. In *Archaeology of the Mid-Holocene Southeast*, edited by Kenneth E. Sassaman and David G. Anderson, pp.222-234. University Press of Florida, Gainesville.

Jefferies, Richard W., and Paul R. Fish
1978 *Investigation of Two Stone Mound Localities, Monroe County, Georgia*. University of Georgia Laboratory of Archaeology Series, Report 17.

Jenkins, Ned J.
1979 Miller Hopewell in the Tombigbee Drainage. In Hopewell Archaeology, The Chillicothe Conference, D. S. Brose and N'omi Greber, eds. Kent State University Press, Kent.

1981 *Gainesville Lake Area Ceramic Description and Chronology*. The University of Alabama Office of Archaeological Research, Report of Investigations 12.

Jenkins, Ned J., and Richard A. Krause
1986 *The Tombigbee Watershed in Southeastern Prehistory*. The University of Alabama Press, University.

Jeter, Marvin D.
2002 From Prehistory Through Protohistory to Ethnohistory in and near the Northern Lower Mississippi Valley. In *The Transformation of the Southeastern Indians, 1540-1760*, edited by Robbie Ethridge and Charles Hudson, pp. 177-221. University Press of Mississippi, Jackson.

Johnson, Hunter B. and Scott C. Meeks
1994 Source Areas and Prehistoric Use of Fort Payne Chert. *Journal of Alabama Archaeology* 40(1&2):66-78.

Johnson, Jay K.
1988 Woodland Settlement in Northeast Mississippi: The Miller Tradition. In Middle Woodland Settlement and Ceremonialism in the Midsouth and Lower Mississippi Valley, ed. by R.C. Mainfort, Jr., pp. 49-59. Archaeological Report 22. Mississippi Department of Archives and History, Jackson.

Johnson, Jay K.
1995 *Cultural Resources Survey of Proposed Industrial Park Improvements, South Corinth Industrial Park, Alcorn County, Mississippi*. University of Mississippi. Submitted to Northeast Mississippi Planning and Development District.

Johnson, Jay K., and Samuel O. Brookes
1989 Benton Points, Turkey Tails, and Cache Blades: Middle Archaic Exchange in the Midsouth. *Southeastern Archaeology* 8(2):134-145.

Kennedy, Joseph C.
1864 *Agriculture of the United States in 1860; Compiled from the Original Returns of the Eighth Census, Under the Direction of the Secretary of the Interior*. Government Printing Office, Washington, D.C.

Keith, Scot J.
2010 *Archaeological Data Recovery at the Leake Site, Bartow County, Georgia, Volume 1- Final Report*. Submitted to the Georgia Department of Transportation by Southern Research.

Kidder, Tristram R.
2002 Mapping Poverty Point. *American Antiquity* 67(1):89-101.

Knight, Vernon James, Jr.
1994 The Formation of the Creeks. In *The Forgotten Centuries: Indians and Europeans in the American South, 1521-1704*, edited by Charles Hudson and Carmen Chaves Tesser, pp. 373-392. The University of Georgia Press, Athens.

2001 Feasting and the Emergence of Platform Mound Ceremonialism in Eastern North America. In *Feasts: Archaeological and Ethnographic Perspectives on Food, Politics, and Power*, edited by M. Dietler and B. Hayden, pp. 239-254. Smithsonian Institution Press, Washington, D.C.

Knight, Vernon James, Jr., and Vincas P. Steponaitis
1998 A New History of Moundville. In *Archaeology of the Moundville Chiefdom*, edited by Vernon James Knight, Jr. and Vincas P. Steponaitis, pp. 1-25. Smithsonian Institution Press, Washington.

Larson, Lewis H., Jr.
1972 Functional Considerations of Warfare in the Southeast During the Mississippi Period. *American Antiquity* 37(3):383-392.

Lauro, James
1993 *Survey for Corinth Sewage Lagoon*. Archaeology Mississippi, Inc. Submitted to Soil Conservation Service.

Lehman, Geoffrey R.
1982 *The Jaketown Site: Surface Collections from a Poverty Point Regional Center in the Yazoo Basin, Mississippi*. Archaeological Report No. 9, Mississippi Department of Archives and History, Jackson.

Lewis R. Barry, and Charles Stout
1998 The Town as Metaphor. In *Mississippian Towns and Sacred Spaces,* edited by R. Barry Lewis and Charles Stout, pp. 227-241.The University of Alabama Press, Tuscaloosa.

Lewis, Thomas M.N., and Madeline Kneberg Lewis
1961 *Eva: An Archaic Site*. The University of Tennessee Press, Knoxville.

Little, Keith J.
2008 European Artifact Chronology and Impacts of Spanish Contact in the Sixteenth- Century Coosa Valley. Ph.D. dissertation, The University of Alabama Department of Anthropology, Tuscaloosa.

Little, Keith J., Catherine C. Meyer, Kevin Harrelson, Hunter B. Johnson, and Ann Marshall
2013 *A Synopsis of Phase II Archaeological Investigations in the West Flint Creek Watershed*. Submitted to the Alabama Department of Transportation by MRS Consultants, Southeastern Anthropological Institute, and Tennessee Valley Archaeological Research.

Little, Keith J., Hunter B. Johnson, and Russell Holloway
2012 *The Widows Creek Site: A Contextual Study of Site Chronology, Formation, and Use*. Tennessee Valley Archaeological Research, Special Investigation 2. Huntsville, Alabama.

Little, Keith J., Hunter B. Johnson, Travis Rael, Katherine Wright, and J. Rocco de Gregory
2016 *Archaeological Investigations Along Chickasawhay Creek, Kemper County, Mississippi*. Tennessee Valley Archaeological Research, Special Investigation 6. Huntsville, Alabama.

Lloyd, Janet R., Judith A. Bense, and Jesse L. Davis, Jr.
1983 Tallahatta Quartzite Quarries in the Escambia River Drainage. *Journal of Alabama Archaeology* 29(2):125-142.

Lowry, Robert and William H. McCardle
1891 *A History of Mississippi*. R.H. Henry and Company, Jackson, Mississippi.

Mainfort, Robert C., Jr.
1989 Pinson Mounds: Internal Chronology and External Relationships. In *Middle Woodland Settlement and Ceremonialism in the Mid-South and Lower Mississippi Valley*, edited by Robert C. Mainfort, Jr., pp. 132-146. Proceedings of the 1984 Mid-South Archaeological Conference, Mississippi Department of Archives and History, Jackson.

McGahey, Samuel O.
1999 *Use and Avoidance of Kosciusko Quartzite in Prehistoric Mississippi Flaked Stone Assemblages*. Proceedings of the 16th Annual Mid-South Archaeological Conference 29:1-11. Jackson.

McNutt, Charles H.
2008 The Benton Phenomenon and Middle Archaic Chronology in Adjacent Portions of Tennessee, Mississippi, and Alabama. *Southeastern Archaeology* 27(1):45-60.

Matz, Otto H.
1862 "Map of the country between Monetery, Tenn: & Corinth, Miss: showing the lines of entrenchments made & the routes followed by the U.S. forces under the command of Maj. Genl. Halleck, U.S. Army, in their advance upon Corinth in May 1862." Electronic document, https://www.loc.gov/item/99447412/, accessed April 2016.

Meeks, Scott C.
1999 *The "Function" of Stone Tools in Prehistoric Exchange Systems: A Look at Benton Interaction in the Mid-South*. Proceedings of the 16th Annual Mid-South Archaeological Conference 29:29-28. Jackson.

Meeks, Scott C., and David G. Anderson
2012 Evaluating the Effect of the Younger Dryas on Human Population Histories in the Southeastern United States. In *Hunter-Gatherer Behavior: Human Response During the Younger Dryas,* edited by Metin I. Eren, pp. 111-138. Left Coast Press, Walnut Creek, CA.

Michler, N. (Nathanial), and J.E. Weyss
1862 "Topographic sketch of Corinth, Mississippi and its environs: showing the enemy entrenchments, and the approach of the U.S. forces." Electronic document, https://www.loc.gov/item/2008621633/, accessed April 2016.

Mississippi Department of Archives and History (MDAH)
2008 *Survey Inclusion Guidelines*. Manuscript on file, MDAH, Jackson.

2011 *Survey Standards*. Manuscript on file, MDAH, Jackson.

Morse, Dan F., and Phyllis A. Morse
1983 *Archaeology of the Central Mississippi Valley*. Academic Press, New York.

MSGenWeb
2015 Alcorn County, Mississippi. Electronic document, http://msgw.org/alcorn/, accessed May 5, 2016.

MSGHN Executive Council [MSGHN]
2013 Marshall County Mississippi Genealogy and History Network. Electronic document, http://marshall.msghn.org/index.html, accessed April 2016.

National Park Service (NPS)
1983 Archaeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines [As Amended and Annotated]. Electronic document, http://www.nps.gov/history/local-law/arch_stnds_2.htm, accessed April 2016.

National Register of Historic Places (NRHP)
2002 *How to Apply the National Register Criteria for Evaluation*. National Register Bulletin 15, U.S. Department of the Interior, National Park Service, Washington D.C.

Natural Resources Conservation Service (NRCS)
2016 Web Soil Survey. Electronic database, http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx, accessed April 2016.

O'Hear, John W., Janet E. Rafferty, John C. Phillips, and Richard Walling
1985 *Archaeological Investigations in the Divide-Cut Section Tennessee Tombigbee Waterway Tishomingo County, Mississippi*. Cobb Institute of Archaeology Report of Investigations No. 2. Mississippi State University.

Ortmann, Anthony L.
2010 Placing the Poverty Point Mounds in Their Temporal Context. *American Antiquity* 75(3):657-678.

Penman, John T.
1977 Archaeological Survey in Mississippi 1974-1975. Archaeological Report No. 2. Mississippi Department of Archives and History, Jackson.

Pettry, David E.
1983 Geology. In *Archaeological Investigations in the Upper Tombigbee Valley, Mississippi: Phase I*, Vol. 1, edited by Judith A. Bense, pp.3.1. The University of West Florida.

Pioneer Railcorp
2015 Mississippi Central Railroad Co. Electronic document, http://www.pioneer-railcorp.com/MSCI.html, accessed May 12, 2016.

Rafferty, Janet
1990 Test Excavations at Ingomar Mounds, Mississippi. *Southeastern Archaeology* 9(2):93-102.

Randall, Asa R.
2000 Blue-Gray Ft. Payne and the Identification of Chert. *Journal of Alabama Archaeology* 46(1):58-71.

Regnier, Amanda L.
2014 *Reconstructing Tascalusa's Chiefdom: Pottery Styles and the Social Composition of Late Mississippian Communities Along the Alabama River*. University of Alabama Press, Tuscaloosa.

Rosecrans, William S.
1895 "Plan of the Battle of Corinth." Electronic document, http://www.davidrumsey.com/maps1100153-26857.html, accessed April 2016.

Rowland, Dunbar
1907 *Encyclopedia of Mississippi History: Comprising Sketches of Counties, Towns, Events, Institutions and Persons*. Selwyn A. Brant, Madison, Wisconsin.

Russo, Michael
1996 Southeastern Archaic Mounds. In *Archaeology of the Mid-Holocene Southeast*, edited by Kenneth E. Sassaman and David G. Anderson, pp.259-287. University Press of Florida, Gainesville.

Sassaman, Kenneth E.
1993 *Early Pottery in the Southeast: Tradition and Innovation in Cooking Technology*. The University of Alabama Press, Tuscaloosa.

2001 Articulating Hidden Histories of the Mid-Holocene in the Southern Appalachians. In *Archaeology of the Appalachian Highlands,* edited by Lynne P. Sullivan and Susan C. Prezzano, pp.103-120. The University of Tennessee Press, Knoxville.

2005 Poverty Point as Structure, Event, and Process. *Journal of Archaeological Method and Theory* 12(4):335-364.

2006 Dating and Explaining Soapstone Vessels: A Comment on Truncer. *American Antiquity* 71(1):141-156.

Saunders, Rebecca
1994 The Case for Archaic Period Mounds in Southeastern Louisiana. *Southeastern Archaeology* 13(2):118-134.

Scarry, C. Margaret
1993 Variability in Mississippian Crop Production Strategies. In *Foraging and Farming in the Eastern Woodlands*, edited by C. Margaret Scarry, pp. 78-90. University Press of Florida, Gainesville.

Schroedl, Gerald F.
1998 Mississippian Towns in the Eastern Tennessee Valley. In *Mississippian Towns and Sacred Spaces,* edited by R. Barry Lewis and Charles Stout, pp. 64-92.The University of Alabama Press, Tuscaloosa.

Semmes, Ryan P. and David S. Nolen
2013 War and Remembrance: Walter Place and Ulysses S. Grant. In The Primary Source, Volume 32 (2). Society of Mississippi Archivists.

Sherwood, Sarah C., Boyce N. Driskell, Asa R. Randall, and Scott C. Meeks
2004 Chronology and Stratigraphy at Dust Cave, Alabama. *American Antiquity* 69(3):533-554.

Smith, Bruce D.
1990 Introduction: Research on the Origins of Mississippian Chiefdoms in Eastern North America. In *The Mississippian Emergence*, edited by Bruce D. Smith, pp. 1-8. Smithsonian Institution Press, Washington, D.C.

2011 The Cultural Context of Plant Domestication in Eastern North America. *Current Anthropology* 52(4):471-484.

Smith, Bruce D., and Richard A. Yarnell
2009 *Initial Formation of an Indigenous Crop Complex in Eastern North America at 3800 B.P.* Proceedings of the National Academy of Sciences of the United States of America 106(16):6561-6566.

Smith, Marvin T.
1987 *Archaeology of Aboriginal Culture Change in the Interior Southeast*. University Presses of Florida, Gainesville.

2006 Aboriginal Population Movements in the Early Historic Period Interior Southeast. In *Powhatan's Mantle: Indians in the Colonial Southeast*, edited by Gregory Waselkov, Peter H. Wood, and Tom Hatley, pp. 43-56. Revised edition. University of Nebraska Press, Lincoln

Stampp, Kenneth M.
1956 *The Peculiar Institution: Slavery in the Antebellum South*. Alfred A. Knopf, New York.

Steponaitis, Vincas P.
1978 Location Theory and Complex Chiefdoms: A Mississippian Example. In *Mississippian Settlement Patterns,* edited by Bruce D. Smith, pp. 417-453. Academic Press, New York.

Thorne, R.M.
1980 *Cultural Resources Survey of Sewer Treatment Plant and Wastewater Collection System in Corinth.*

1993 *A Cultural Resources Survey of a Proposed Tennessee Valley Authority Transmission Line Right-of-Way from Ripley to Corinth, Mississippi.* Robert M. Thorne. Submitted to Tennessee Valley Authority.

Truncer, James
2004 Steatite Vessel Age and Occurrence in Temperate Eastern North America. *American Antiquity* 69(3):487-513.

Tucker-Laird, Emily, G. Ellen Jenkins, Ted Karpynec, and Jeffrey L. Holland
2009 *Phase I Cultural Resources Survey for the 9.2-mile Proposed Corinth-Biggersville 161-kV Transmission Line in Alcorn County, Mississippi.* TRC. Submitted to Tennessee Valley Authority.

United States Census Bureau
1872 *Statistics of Population.* Government Printing Office, Washington, D.C.

2012a 2012 Census of Agriculture County Profile: Alcorn County, Mississippi. Electronic document, https://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Mississippi/cp28003.pdf, accessed May 9, 2016.

2012b Census of Agriculture County Profile: Marshall County, Mississippi. Electronic document, www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Mississippi/cp28093.pdf, accessed May 5, 2016.

2015 State and County Quick Facts: Marshall County, Mississippi. Electronic document, http://quickfacts.census.gov/qfd/states/28/28093.html, accessed May 5, 2016.

2016a State and County QuickFacts: Alcorn County, Mississippi. Electronic document, https://www.census.gov/quickfacts/table/PST045215/28003,00, accessed May 9, 2016.

2016b State and County QuickFacts: Marshall County, Mississippi. Electronic document, https://www.census.gov/quickfacts/table/PST045215/28093,00, accessed May 9, 2016.

United States Geological Survey (USGS)
2014a Geologic units in Alcorn county, Mississippi. Electronic document, http://mrdata.usgs.gov/geology/state/fips-unit.php?code=f28003, accessed April 2016.

2014b Geologic units in Marshall county, Mississippi. Electronic document, http://mrdata.usgs.gov/geology/state/fips-unit.php?code=f28093, accessed April 2016.

Vorzet, Ed. Dumas; Le Comte de Paris
1875 "Planche XIII. Environs de Corinth." Electronic document, http://www.davidrumsey.com/luna/servlet/view/all/where/Mississippi?os=200, access April 2016.

Walthall, John A.
1980 *Prehistoric Indians of the Southeast: Archaeology of Alabama and the Middle-South*. The University of Alabama Press, Tuscaloosa.

1998 Rockshelters and Hunter-Gatherer Adaptation to the Pleistocene/Holocene Transition. *American Antiquity* 63(2):223-238.

Walthall, John A., and Ned J. Jenkins
1976 *The Gulf Formational Stage in Southeastern Prehistory*. Southeastern Archaeological Conference Bulletin 19:43-49.

Waring, Antonio J., Jr.
1945 "Hopewellian" Elements in Northern Georgia. *American Antiquity* 11(2):119-120.

Waselkov, Gregory A.
1988 *Historic Creek Architectural Adaptations to the Deerskin Trade*. Paper presented at the Southeastern Archaeological Conference, New Orleans.

Westley, F. Busbee Jr.
2005 *Mississippi: A History*. Harlan Davidson, Wheeling, Illinois.

White, Richard
1983 *The Roots of Dependency: Subsistence, Environment, and Social Change Among the Choctaws, Pawnees, and Navajos*. University of Nebraska Press, Lincoln.

Wimberly, Steve B., and Harry A. Tourtelot
1941 *The McQuorquodale Mound: A Manifestation of the Hopewellian Phase in South Alabama*. Geological Survey of Alabama Museum Paper 19, University.

Wymer, Dee Anne
1996 The Ohio Hopewell Econiche: Human-Land Interaction in the Core Area. In *A View from the Core: A Synthesis of Ohio Hopewell Archaeology*, edited by Paul J. Pacheco, pp. 36-52. The Ohio Archaeological Council, Columbus.

Yarnell, Richard A.
1993 The Importance of Native Crops during the Late Archaic and Woodland Periods. In *Foraging and Farming in the Eastern Woodlands*, edited by C. Margaret Scarry, pp. 13-26. University Press of Florida, Gainesville.

APPENDIX A:
ARCHITECTURAL FORMS

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

2. Property address/descriptive location
1704 South Johns Street

3. Legal description (and acreage, if required—see instructions)

4. Former/historic use
Residence

5. Present use
Residence

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

8. Brief description
Ranch-style house. The frame building features a side-gabled roof covered with asphalt shingles, an exterior clad with a brick veneer, and a continuous brick foundation. Facing east, the façade reveals a centrally placed door that is flanked to the north by a band of three windows containing 2/1, double-hung metal sashes. Located south of the door is a picture window with nine lights set within a metal sash and a single window opening containing horizontal 2/2, double-hung metal sashes. Attached to the north elevation of the building is a single-bay carport that is capped with a side-gabled roof covered with asphalt shingles. The carport roof is supported by three decorative metal posts. The interior west wall of the carport has been partially enclosed to increase the square footage of the interior living space. The altered section of the carport is clad with vinyl siding and includes a door and two windows containing 4/4, double-hung vinyl sashes.

9. Outbuildings or secondary elements (if significant, use separate form)

10. County
Alcorn

11. City or Town
Corinth
☐ vicinity of

12. Owner's name and address

13. Was interior surveyed?
No

14. Survey seq. no.
1

15. USGS quadrangle map
Corinth

16. UTM reference (if required—see instructions)

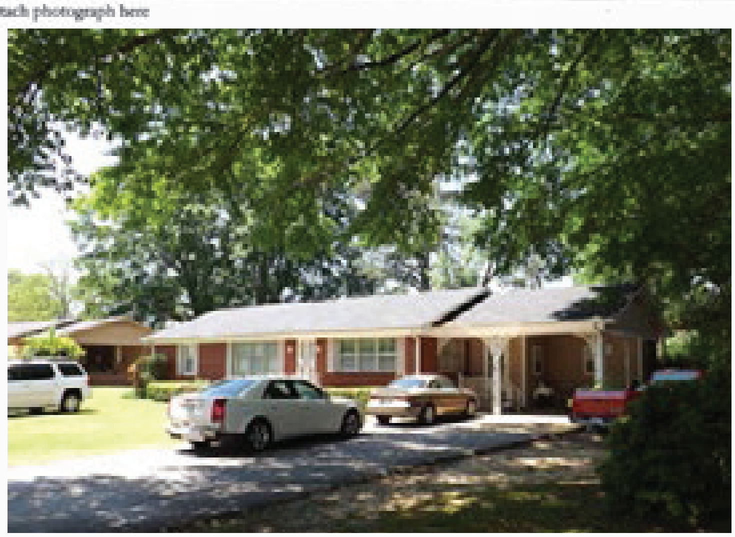
17. Date of construction
ca. 1955
☒ estimated
☐ documented

18. Integrity
☐ very intact ☐ deteriorated
☒ some changes ☐ ruins
☐ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☒ enlarged/altered ca. 2000
☐ artificial siding
☐ replaced windows/doors
☐ enclosed/altered porch
☐ storefront alterations

20. Architectural character or style
Ranch

Attach photograph here



THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 4, 2016

30. Inventory form completed by
(name and organization)
Ted Karpynec
Tennessee Valley Archaeological Research

31. Survey project name
TVA Corinth-Holly Springs Substation Expansion Project

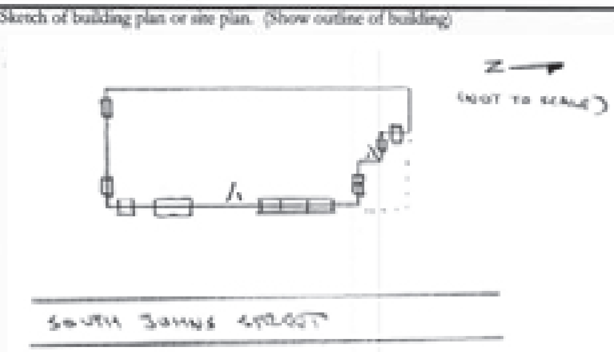
32. Date form completed
May 16, 2016

THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility
a.
- ☐ already listed (see front of form)
- ☐ appears individually eligible
- ☐ potentially eligible if restored
- ☐ would contribute to district
- ☐ does not appear eligible
- ☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)



Draw north arrow here.

(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

2. Property address/descriptive location
1706 South Johns Street

3. Legal description (and acreage, if required—see instructions)

4. Former/historic use
Residence

5. Present use
Residence

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

8. Brief description
Ranch-style house. The frame building features a side-gabled roof covered with asphalt shingles, an exterior clad with a brick veneer, and a continuous brick foundation. Facing east, the façade reveals a recessed central bay that includes a door and a band of three windows containing horizontal 2/2, double-hung wood sashes. Access to the façade door is through the center bay porch that is integral with the main roof. Flanking either side of the central bay are projecting bays that are each pierced with a window opening containing horizontal 2/2, double-hung wood sashes. Attached to the north elevation of the building is a single-bay carport that is capped with a side-gabled roof covered with asphalt shingles. The carport roof is supported by a metal post at the northeast corner of the building. The interior north wall of the carport includes a door and a pair of horizontal 2/2, double-hung wood sashes.

9. Outbuildings or secondary elements (if significant, use separate form)

10. County
Alcorn

11. City or Town
Corinth
☐ vicinity of

12. Owner's name and address

13. Was interior surveyed?
No

14. Survey seq. no.
2

15. USGS quadrangle map
Corinth

16. UTM reference (if required—see instructions)

17. Date of construction
ca. 1955
☒ estimated
☐ documented

18. Integrity
☒ very intact ☐ deteriorated
☐ some changes ☐ ruins
☐ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved ______
☐ enlarged/altered ______
☐ artificial siding ______
☐ replaced windows/doors ______
☐ enclosed/altered porch ______
☐ storefront alterations ______

20. Architectural character or style
Ranch

Attach photograph here

This section for MDAH use only

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district
______
______

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number ______

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 4, 2016

30. Inventory form completed by
(name and organization)
Ted Karpynec
Tennessee Valley Archaeological Research

31. Survey project name
TVA Corinth-Holly Springs Substation Expansion Project

32. Date form completed
May 16, 2016

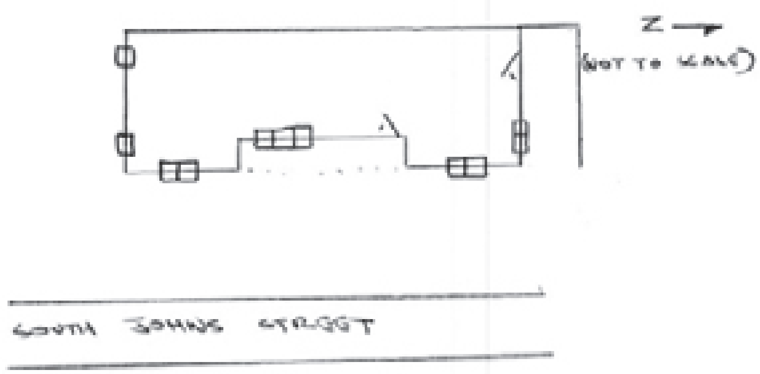
THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility

a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)



Draw north arrow here.

(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

2. Property address/descriptive location

1708 South Johns Street

3. Legal description (and acreage, if required—see instructions)

4. Former/historic use
Residence

5. Present use
Residence

6. Architect

☐ documented ☐ attributed

7. Builder/contractor

☐ documented ☐ attributed

8. Brief description
Ranch-style house. The frame building features features a side-gabled roof covered with asphalt shingles, an exterior clad with a brick veneer, and a continuous brick foundation. Facing east, the façade reveals an off-centered door that is flanked to the north by a pair of horizontal 2/2, double-hung wood sash windows. This sash type is repeated on a picture window and a paired window located south of the door. Access to the façade door is achieved via a single-bay concrete stoop. The stoop features a concrete slab deck that is partly shielded by a fabric awning. Attached to the north elevation of the building is a single-bay carport that is capped with a flat roof. The carport roof is partly supported by a decorative metal post at the northeast corner of the building. The interior of the carport has been altered to include a screened-in porch that provides access to a door located on the north elevation of the building..

9. Outbuildings or secondary elements (if significant, use separate form)

10. County
Alcorn

11. City or Town
Corinth
☐ vicinity of

12. Owner's name and address

13. Was interior surveyed?
No

14. Survey seq. no.
3

15. USGS quadrangle map
Corinth

16. UTM reference (if required—see instructions)

17. Date of construction
ca. 1955
☒ estimated
☐ documented

18. Integrity
☐ very intact ☐ deteriorated
☒ some changes ☐ ruins
☐ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☒ enlarged/altered ca. 2000
☐ artificial siding
☐ replaced windows/doors
☐ enclosed/altered porch
☐ storefront alterations

20. Architectural character or style
Ranch

Attach photograph here

THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 4, 2016

30. Inventory form completed by (name and organization)
Ted Karpynec
Tennessee Valley Archaeological Research

31. Survey project name
TVA Corinth-Holly Springs Substation Expansion Project

32. Date form completed
May 16, 2016

THIS SECTION FOR MDAH USE ONLY

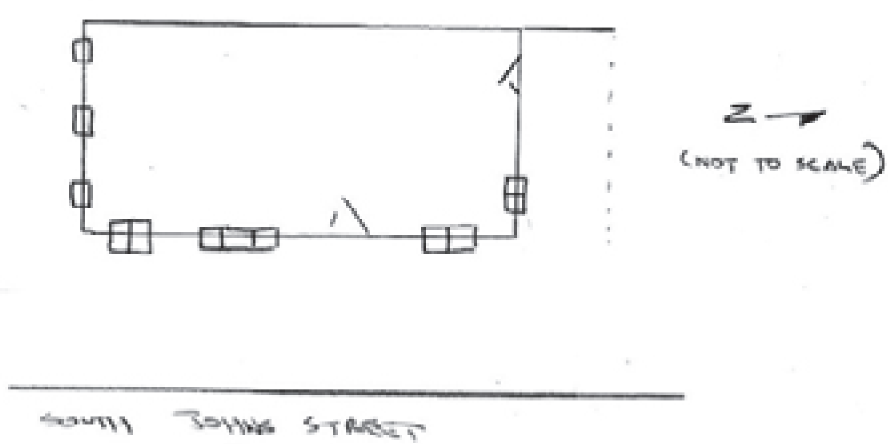
33. Evaluation of National Register eligibility

a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)

Draw north arrow here.



(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

10. County
Alcorn

11. City or Town
Corinth
☐ vicinity of

2. Property address/descriptive location
1800 South Johns Street

12. Owner's name and address

3. Legal description (and acreage, if required—see instructions)

13. Was interior surveyed?
No

14. Survey seq. no.
4

15. USGS quadrangle map
Corinth

4. Former/historic use
Residence

5. Present use
Residence

16. UTM reference (if required—see instructions)

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

17. Date of construction
ca. 1955
☒ estimated
☐ documented

8. Brief description
Ranch-style house. The frame building features a side-gabled roof covered with asphalt shingles, an exterior clad with a brick veneer, and a continuous brick foundation. Facing east, the façade reveals an off-centered door that is flanked to the south by a paired window and two single windows that each contain 6/6, double-hung vinyl sashes. Access to the façade door is achieved via a single bay concrete stoop. The stoop features a concrete slab deck on a brick foundation. Attached to the north elevation of the building is a single-bay carport that is integral with the main roof. The carport roof is partly supported by two decorative metal posts. The north interior wall of the carport includes a door and a 6/6, double-hung vinyl sash window. Located along the south elevation is a horizontal 2/2, double-hung wood sash window and a six-over-six, double-hung vinyl sash window.

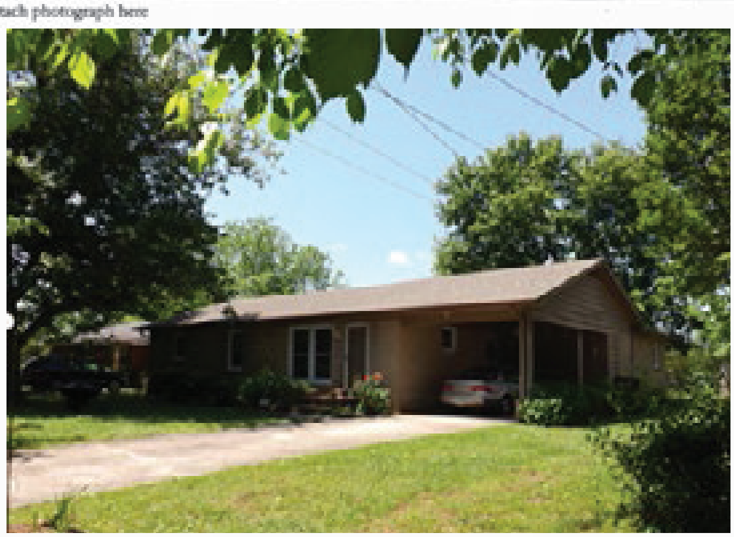
18. Integrity
☒ very intact ☐ deteriorated
☐ some changes ☐ ruins
☐ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☐ enlarged/altered
☐ artificial siding
☒ replaced windows/doors ca.2000
☐ enclosed/altered porch
☐ storefront alterations

9. Outbuildings or secondary elements (if significant, use separate form)

20. Architectural character or style
Ranch

Attach photograph here



THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 4, 2016

30. Inventory form completed by
(name and organization)
Ted Karpynec
Tennessee Valley Archaeological Research

31. Survey project name
TVA Corinth-Holly Springs Substation Expansion Project

32. Date form completed
May 16, 2016

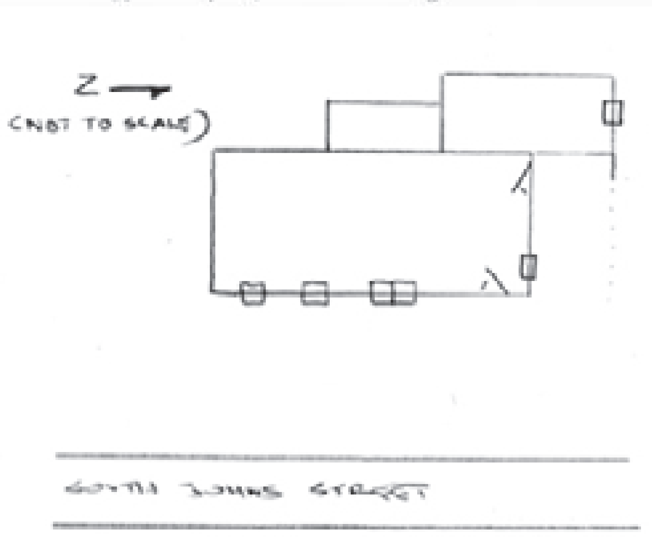
THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility

a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)



Draw north arrow here.

(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

10. County
Alcorn

11. City or Town
Corinth
☐ vicinity of

2. Property address/descriptive location
1802 South Johns Street

12. Owner's name and address

3. Legal description (and acreage, if required—see instructions)

13. Was interior surveyed?
No

14. Survey seq. no.
5

15. USGS quadrangle map
Corinth

4. Former/historic use
Residence

5. Present use
Residence

16. UTM reference (if required—see instructions)

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

17. Date of construction
ca. 1955
☒ estimated
☐ documented

8. Brief description
Ranch-style house. The frame building features a side-gabled roof covered with asphalt shingles, an exterior clad with a brick veneer, and a continuous brick foundation. Facing east, the façade reveals a centrally placed door that is flanked to the north by a pair of 1/1, double-hung vinyl sash windows. This sash type is repeated in two single windows positioned south of the main entrance. Access to the façade door is achieved via a partial-width porch. The porch features a concrete slab deck on a brick foundation and a series of decorative metal posts that are used to support a shed roof, which is integral with the main roof of the house. Attached to the north elevation of the building is a single-bay carport that is integral with the main roof. The carport roof is partly supported by three decorative metal posts. The north interior wall of the carport includes a door that provides access to the house.

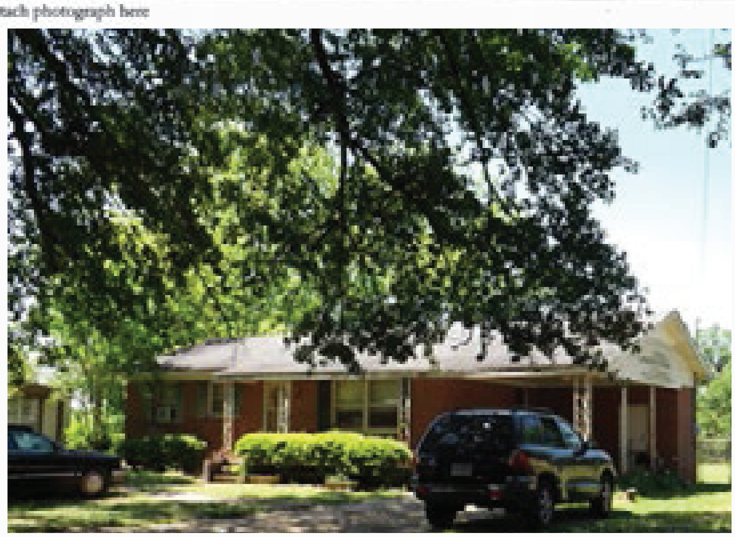
18. Integrity
☒ very intact ☐ deteriorated
☐ some changes ☐ ruins
☐ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☐ enlarged/altered
☐ artificial siding
☒ replaced windows/doors ca.2000
☐ enclosed/altered porch
☐ storefront alterations

9. Outbuildings or secondary elements (if significant, use separate form)

20. Architectural character or style
Ranch

Attach photograph here



THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 4, 2016

30. Inventory form completed by (name and organization)
Ted Karpynec
Tennessee Valley Archaeological Research

31. Survey project name
TVA Corinth-Holly Springs Substation Expansion Project

32. Date form completed
May 16, 2016

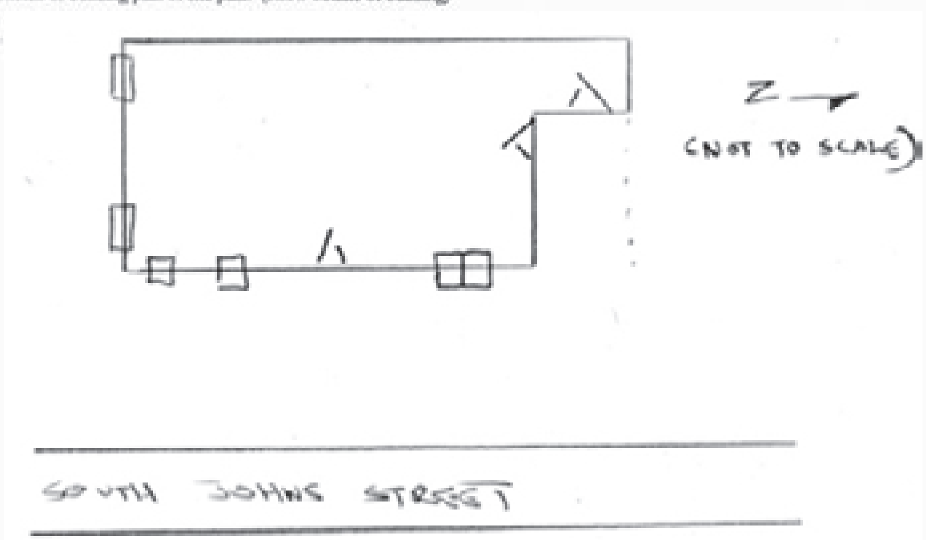
THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility

a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)



Draw north arrow here.

(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

2. Property address/descriptive location
1802 South Johns Street

3. Legal description (and acreage, if required—see instructions)

4. Former/historic use
Residence

5. Present use
Residence

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

8. Brief description
Ranch-style house. The frame building features a side-gabled roof covered with asphalt shingles, an exterior clad with a brick veneer, and a continuous brick foundation. Facing east, the façade reveals a centrally placed door that is flanked to the north by a pair of 1/1, double-hung vinyl sash windows. This sash type is repeated in two single windows positioned south of the main entrance. Access to the façade door is achieved via a partial-width porch. The porch features a concrete slab deck on a brick foundation and a series of decorative metal posts that are used to support a shed roof, which is integral with the main roof of the house. Attached to the north elevation of the building is a single-bay carport that is integral with the main roof. The carport roof is partly supported by three decorative metal posts. The north interior wall of the carport includes a door that provides access to the house.

9. Outbuildings or secondary elements (if significant, use separate form)

10. County
Alcorn

11. City or Town
Corinth
☐ vicinity of

12. Owner's name and address

13. Was interior surveyed?
No

14. Survey seq. no.
6

15. USGS quadrangle map
Corinth

16. UTM reference (if required—see instructions)

17. Date of construction
ca. 1955
☒ estimated
☐ documented

18. Integrity
☒ very intact ☐ deteriorated
☐ some changes ☐ ruins
☐ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☐ enlarged/altered
☐ artificial siding
☒ replaced windows/doors ca.2000
☒ enclosed/altered porch ca. 2000
☐ storefront alterations

20. Architectural character or style
Ranch

Attach photograph here

THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 4, 2016

30. Inventory form completed by (name and organization)
Ted Karpynec
Tennessee Valley Archaeological Research

24. Additional remarks or continuation of other sections

31. Survey project name
TVA Corinth-Holly Springs Substation Expansion Project

32. Date form completed
May 16, 2016

25. Sources of information

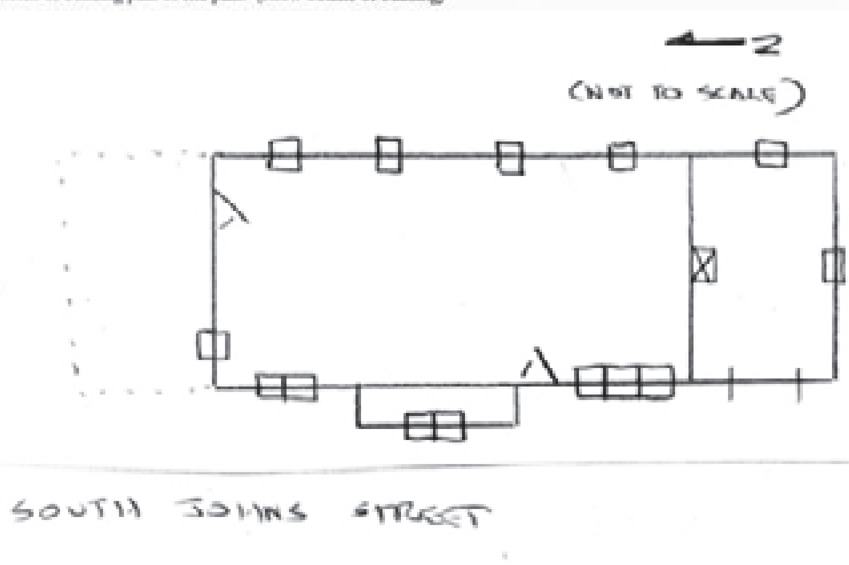
THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility

a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)



Draw north arrow here.

(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

2. Property address/descriptive location
1614 Hinton Street

3. Legal description (and acreage, if required—see instructions)

4. Former/historic use
Residence

5. Present use
Residence

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

8. Brief description
Ranch-style house. The frame building features a side-gabled roof covered with asphalt shingles, an interior brick chimney, an exterior clad with a brick veneer, and a continuous brick foundation. Facing north, the façade reveals a central bay marked with a door that is flanked to the east by a 20-light wood sash picture window. The central bay also includes a covered porch featuring a concrete slab deck on a brick foundation and four rounded wood columns that are used to support a projecting gabled roof. The gable field of the porch roof is clad with vinyl siding. Additional fenestration along the façade includes a window east of the central bay and two windows west of the central bay that contain 6/6, double-hung wood sashes. Attached to the east elevation of the building is a single-bay carport wing. The carport roof is supported by a wall on the north elevation that is pierced by two 6/6, double-hung wood sash windows.

9. Outbuildings or secondary elements (if significant, use separate form)

10. County
Alcorn

11. City or Town
Corinth
☐ vicinity of

12. Owner's name and address

13. Was interior surveyed?
No

14. Survey seq. no.
7

15. USGS quadrangle map
Corinth

16. UTM reference (if required—see instructions)

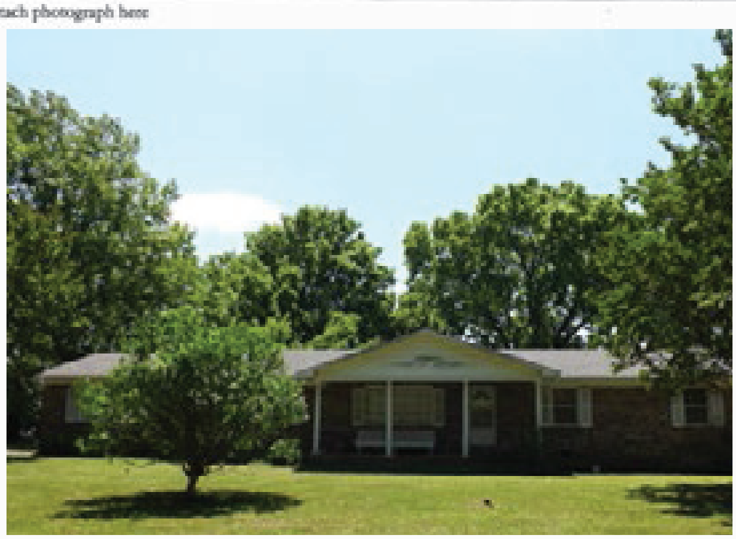
17. Date of construction
ca. 1960
☒ estimated
☐ documented

18. Integrity
☒ very intact ☐ deteriorated
☐ some changes ☐ ruins
☐ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☐ enlarged/altered
☒ artificial siding ca. 2000
☐ replaced windows/doors
☐ enclosed/altered porch
☐ storefront alterations

20. Architectural character or style
Ranch

Attach photograph here



THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 4, 2016

30. Inventory form completed by
(name and organization)
Ted Karpynec
Tennessee Valley Archaeological Research

31. Survey project name
TVA Corinth-Holly Springs Substation Expansion Project

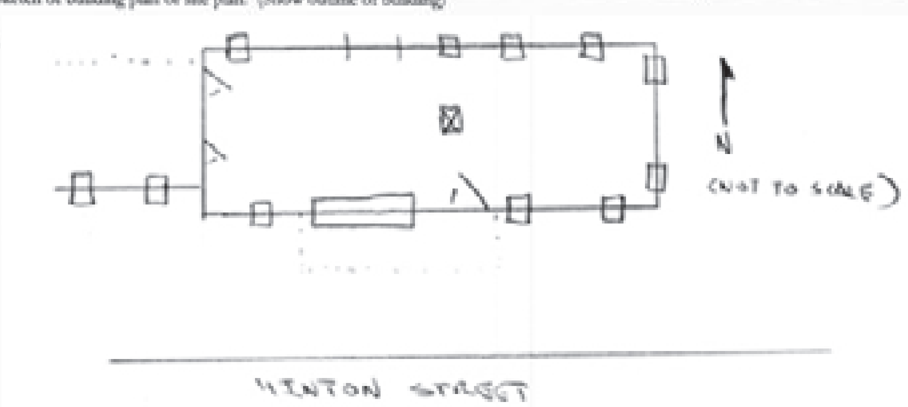
32. Date form completed
May 16, 2016

THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility
a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)



Draw north arrow here.

(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

2. Property address/descriptive location

2003 Liddon Lake Road

3. Legal description (and acreage, if required—see instructions)

4. Former/historic use
Residence

5. Present use
Residence

6. Architect

☐ documented ☐ attributed

7. Builder/contractor

☐ documented ☐ attributed

8. Brief description
Ranch-style house. The frame building features a side-gabled roof covered with asphalt shingles, an exterior clad with a combination of vinyl siding and brick veneer, and a continuous concrete block foundation. Facing south, the façade reveals an off-centered door that is flanked to the east by a three-part picture window containing a central single-pane, fixed wood sash that is flanked by 4/4, double-hung wood sashes. Located west of the door are two windows containing 6/6, double-hung wood sashes. Attached to the east elevation of the building is a single-bay carport. The carport is integral with the main roof and is partially supported by two metal posts. The interior east wall of the carport includes a door that provides access to the house. An additional door is positioned on the interior north wall that provides access to a storage closet. The west elevation of the house is pierced by two windows containing 6/6, double-hung wood sashes. Rear modern addition.

9. Outbuildings or secondary elements (if significant, use separate form)

10. County
Alcorn

11. City or Town
Corinth
☐ vicinity of

12. Owner's name and address

13. Was interior surveyed?
No

14. Survey seq. no.
8

15. USGS quadrangle map
Corinth

16. UTM reference (if required—see instructions)

17. Date of construction
ca. 1965
☒ estimated
☐ documented

18. Integrity
☐ very intact ☐ deteriorated
☐ some changes ☐ ruins
☒ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☒ enlarged/altered ca. 2000
☒ artificial siding ca. 2000
☐ replaced windows/doors
☐ enclosed/altered porch
☐ storefront alterations

20. Architectural character or style
Ranch

Attach photograph here

THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 4, 2016

30. Inventory form completed by (name and organization)
Ted Karpynec
Tennessee Valley Archaeological Research

31. Survey project name
TVA Corinth-Holly Springs Substation Expansion Project

32. Date form completed
May 16, 2016

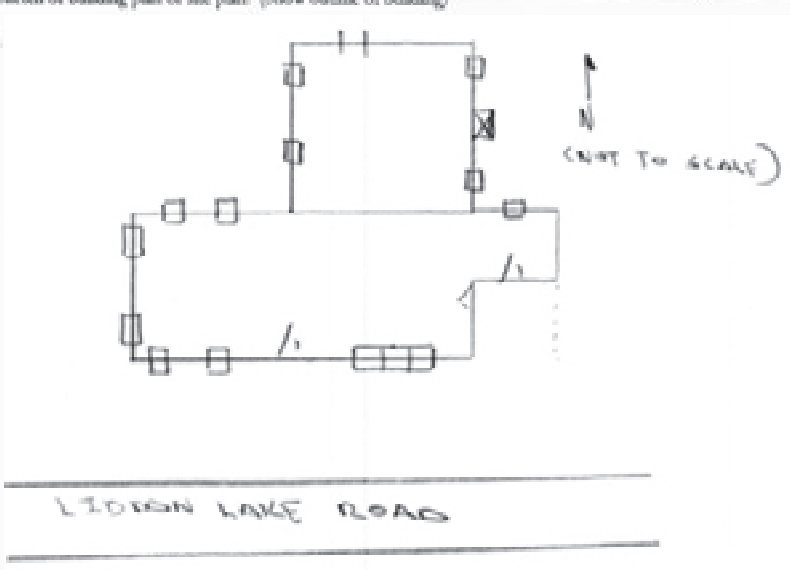
THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility

a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)



(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

2. Property address/descriptive location
449 Neely Avenue

3. Legal description (and acreage, if required—see instructions)

4. Former/historic use
Residence

5. Present use
Residence

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

8. Brief description
A one-story pyramidal roof house that appears to have been constructed ca. 1920. The building features a roof covered with asphalt shingles, an exterior clad with asbestos shingle siding, and a covered pier foundation. Facing north, the façade reveals a central door that is flanked on either side by a six-over-six, double-hung wood sash window. Access to the façade door is achieved via a full-width porch. The porch features a wood deck on a concrete block pier foundation and four non-original wood posts that are used to support a hipped roof. The east elevation of the house is pierced by a six-over-six, double-hung wood sash window and a horizontal two-over-two, double-hung metal sash window. Positioned on a rear shed extension is a six-light wood casement sash window. Highlighting the south (rear) elevation is a recessed central bay porch that includes a door and a six-over-six, double-hung wood sash window. The center bay porch is formed by flanking shed extensions.

9. Outbuildings or secondary elements (if significant, use separate form)

10. County
Marshall

11. City or Town
Holly Springs
☐ vicinity of

12. Owner's name and address

13. Was interior surveyed?
No

14. Survey seq. no.
9

15. USGS quadrangle map
Holly Springs

16. UTM reference (if required—see instructions)

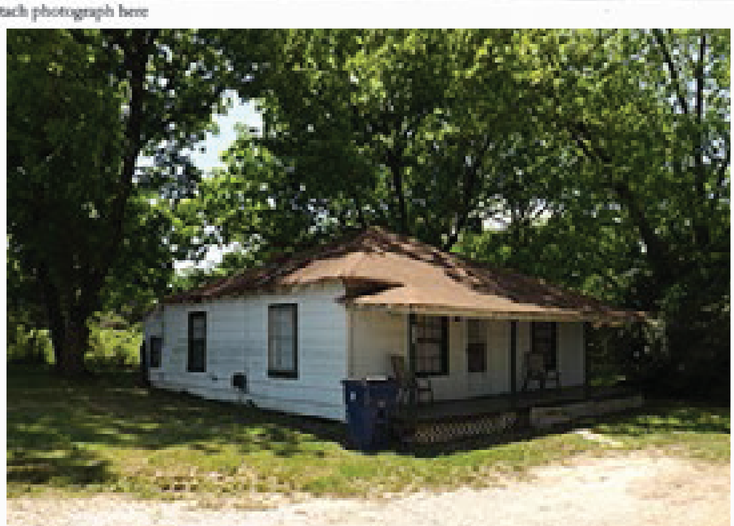
17. Date of construction
ca. 1920
☒ estimated
☐ documented

18. Integrity
☐ very intact
☒ some changes
☐ extensive changes
☐ deteriorated
☐ ruins
☐ no visible remains

19. Dates of changes, if any
☐ moved
☐ enlarged/altered
☒ artificial siding ca. 1985
☐ replaced windows/doors
☒ enclosed/altered porch ca. 1990
☐ storefront alterations

20. Architectural character or style

Attach photograph here



THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 6, 2016

30. Inventory form completed by
(name and organization)
Meghan Weaver
Tennessee Valley Archaeological Research

31. Survey project name
TVA Corinth and Holly Springs Substation Expansion

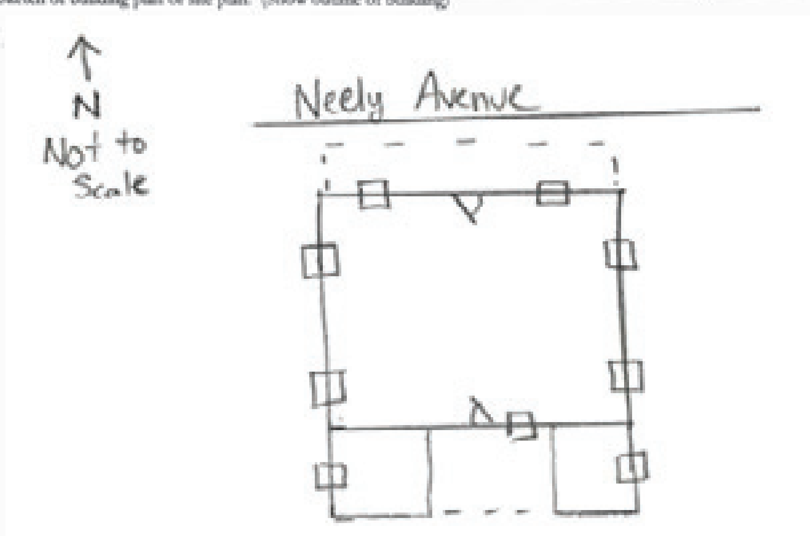
32. Date form completed
May 16, 2016

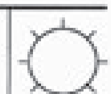
THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility
a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)





Draw north arrow here.

(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

10. County
Marshall

11. City or Town
Holly Springs
☐ vicinity of

2. Property address/descriptive location
435 Neely Avenue

12. Owner's name and address

3. Legal description (and acreage, if required—see instructions)

13. Was interior surveyed?
No

14. Survey seq. no.
10

15. USGS quadrangle map
Holly Springs

4. Former/historic use
Residence

5. Present use
Residence

16. UTM reference (if required—see instructions)

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

17. Date of construction
ca. 1920
☒ estimated
☐ documented

8. Brief description
A one-story hipped-roof house that appears to have been constructed ca. 1920. The concrete block building features a roof covered with asphalt shingles, an interior brick chimney, an exposed concrete block exterior, and a continuous concrete block foundation. Facing north, the façade reveals a central door that is flanked on either side by a six-over-six, double-hung vinyl sash window. Access to the façade door is achieved via a full-width porch. The porch features a wood deck on a concrete block foundation and four non-original wood posts that are used to support a flat roof. The east elevation of the house is pierced by two six-over-six, double-hung vinyl sash windows. This sash type is repeated on three windows located along the west elevation. Attached to the rear elevation is a full-width shed-roof extension. Composed of concrete blocks, the extension includes a centrally placed door that is flanked to the east by a six-over-six, double-hung vinyl sash window.

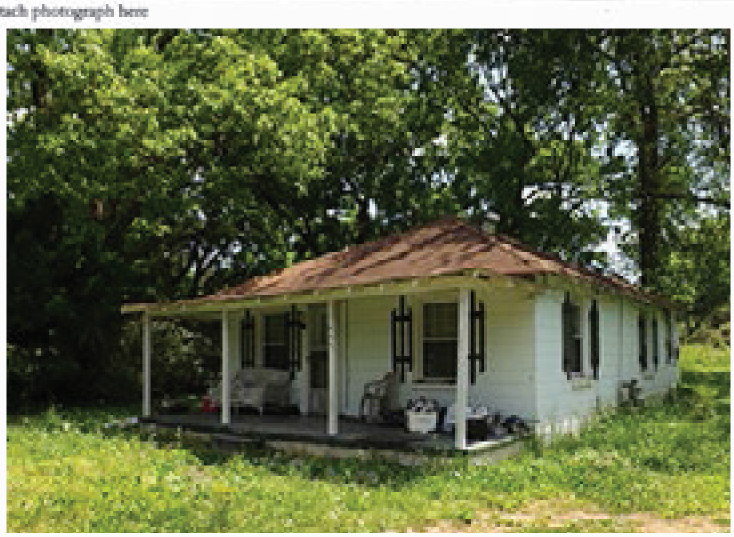
18. Integrity
☐ very intact ☐ deteriorated
☒ some changes ☐ ruins
☐ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☐ enlarged/altered
☐ artificial siding
☒ replaced windows/doors ca. 2000
☒ enclosed/altered porch ca. 1990
☐ storefront alterations

9. Outbuildings or secondary elements (if significant, use separate form)

20. Architectural character or style

Attach photograph here



THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 6, 2016

30. Inventory form completed by
(name and organization)
Meghan Weaver
Tennessee Valley Archaeological Research

31. Survey project name
TVA Corinth and Holly Springs Substation Expansion

32. Date form completed
May 16, 2016

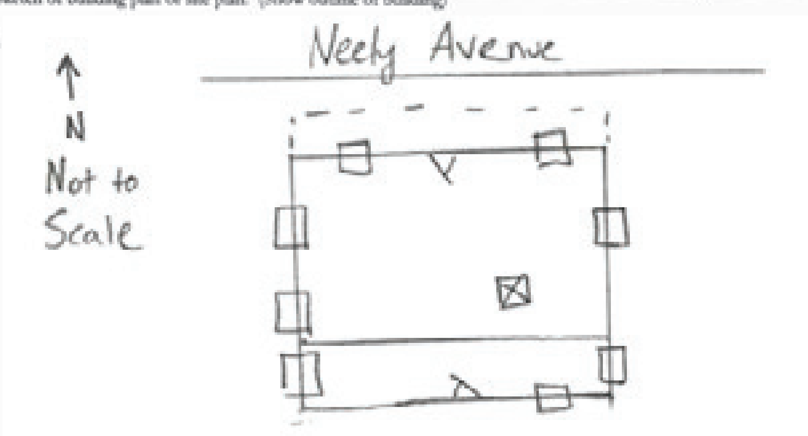
THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility

a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)



Draw north arrow here.

(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

10. County
Marshall

11. City or Town
Holly Springs
☐ vicinity of

2. Property address/descriptive location
445 Neely Avenue

12. Owner's name and address

3. Legal description (and acreage, if required—see instructions)

13. Was interior surveyed?
No

14. Survey seq. no.
11

15. USGS quadrangle map
Holly Springs

4. Former/historic use
Residence

5. Present use
Residence

16. UTM reference (if required—see instructions)

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

17. Date of construction
ca. 1920
☒ estimated
☐ documented

8. Brief description
A one-story hipped-roof house that appears to have been constructed ca. 1920. The frame building features a roof covered with asphalt shingles, two interior brick chimneys, an exterior clad with weatherboard siding, and a continuous concrete block foundation. Facing north, the façade reveals a central door that is flanked on either side by a four-over-four, double-hung wood sash window. Access to the façade door is achieved via a full-width porch. The porch features a wood deck on a concrete block foundation and four non-original wood posts that are used to support a hipped roof. Both the east and west elevations of the house are pierced by a single and a paired window that each contain four-over-four, double-hung wood sashes. Attached to the south (rear) elevation of the house is a full-width shed-roof extension that includes a centrally placed door.

18. Integrity
☐ very intact ☐ deteriorated
☒ some changes ☐ ruins
☐ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☐ enlarged/altered
☐ artificial siding
☐ replaced windows/doors
☒ enclosed/altered porch ca. 2000
☐ storefront alterations

9. Outbuildings or secondary elements (if significant, use separate form)

20. Architectural character or style

Attach photograph here

THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 6, 2016

30. Inventory form completed by (name and organization)
Meghan Weaver
Tennessee Valley Archaeological Research

31. Survey project name
TVA Corinth and Holly Springs Substation Expansion

32. Date form completed
May 16, 2016

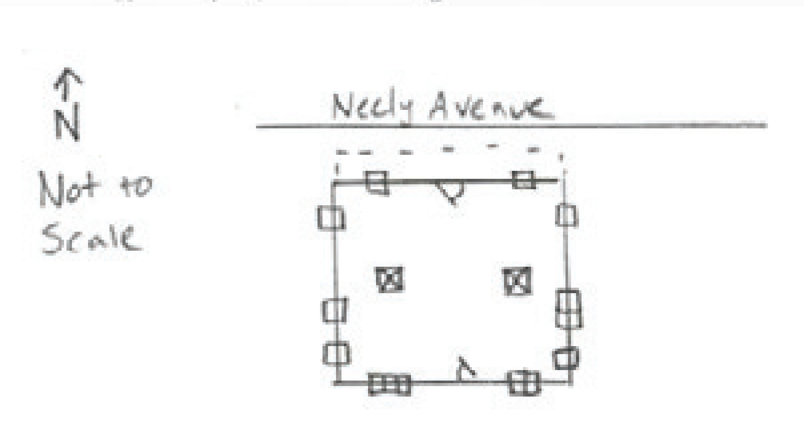
THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility

a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)



Draw north arrow here.

(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

10. County
Marshall

11. City or Town
Holly Springs
☐ vicinity of

2. Property address/descriptive location
370 South Chesterman Street

12. Owner's name and address

3. Legal description (and acreage, if required—see instructions)

13. Was interior surveyed?
No

14. Survey seq. no.
12

15. USGS quadrangle map
Holly Springs

4. Former/historic use
Residence

5. Present use
Residence

16. UTM reference (if required—see instructions)

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

17. Date of construction
ca. 1920
☒ estimated
☐ documented

8. Brief description
A one-story hipped-roof house that appears to have been constructed ca. 1920. The frame building features a roof covered with asphalt shingles, an interior brick chimney, an exterior clad with weatherboard siding, and a brick pier foundation infilled with concrete blocks. Facing east, the façade reveals a central door that is flanked on either side by a pair of one-over-one, double-hung wood sashes. Access to the façade door is achieved via a full-width porch that is integral with the main roof. The porch features a concrete slab deck on a concrete block foundation and four non-original decorative metal posts, which are used to support the roof. The north elevation of the house is marked by a non-original exterior chimney and by three window openings containing one-over-one, double-hung wood sashes. This sash type is repeated on two windows located along the south elevation. Attached to the west (rear) elevation is a ca. 1955 gabled-roof addition.

18. Integrity
☐ very intact ☐ deteriorated
☒ some changes ☐ ruins
☐ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☐ enlarged/altered
☐ artificial siding
☐ replaced windows/doors
☒ enclosed/altered porch ca. 2000
☐ storefront alterations

9. Outbuildings or secondary elements (if significant, use separate form)
1-ca. 1950 storage shed, 1- ca. 1970 garage

20. Architectural character or style

Attach photograph here

THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 6, 2016

30. Inventory form completed by (name and organization)
Meghan Weaver
Tennessee Valley Archaeological Research

31. Survey project name
TVA Corinth and Holly Springs Substation Expansion

32. Date form completed
May 16, 2016

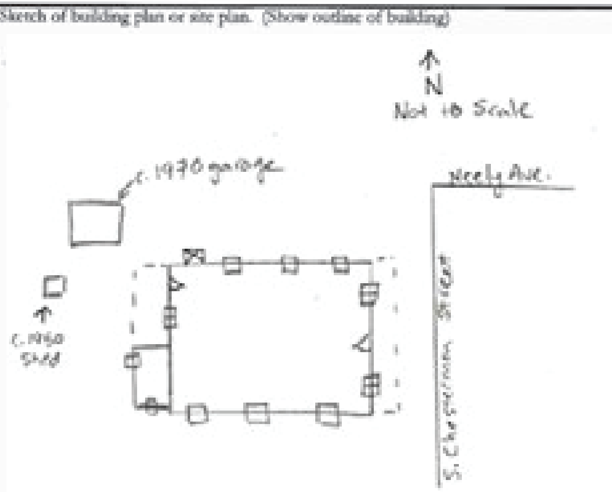
THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility

a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)



Draw north arrow here.

(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

10. County
Marshall

11. City or Town
Holly Springs
☐ vicinity of

2. Property address/descriptive location
396 South Chesterman Street

12. Owner's name and address

3. Legal description (and acreage, if required—see instructions)

13. Was interior surveyed?
No

14. Survey seq. no.
13

15. USGS quadrangle map
Holly Springs

4. Former/historic use
Residence

5. Present use
Residence

16. UTM reference (if required—see instructions)

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

17. Date of construction
ca. 1920
☒ estimated
☐ documented

8. Brief description
A one-story side-gabled house that appears to have been constructed ca. 1920. Based on physical evidence, it is the opinion of TVAR that the building was originally constructed as a front-gabled house with the main entrance located on the east elevation, fronting South Chesterman Street. Within the past ten years, the house appears to have been modified with the reorientation of the main entrance to the south elevation. The building features a gabled roof covered with standing seam metal, an interior brick chimney, an exterior clad with weatherboard siding, and a brick pier foundation infilled with concrete blocks. Facing south, the façade reveals an off-centered door that is flanked to the west by a four-over-four, double-hung vinyl sash window. The east elevation of the house, which appears to have served as the original façade, features a modern projecting gabled bay. The gabled bay is clad with drop wood siding and is pierced by a 6/6, double-hung vinyl sash window.

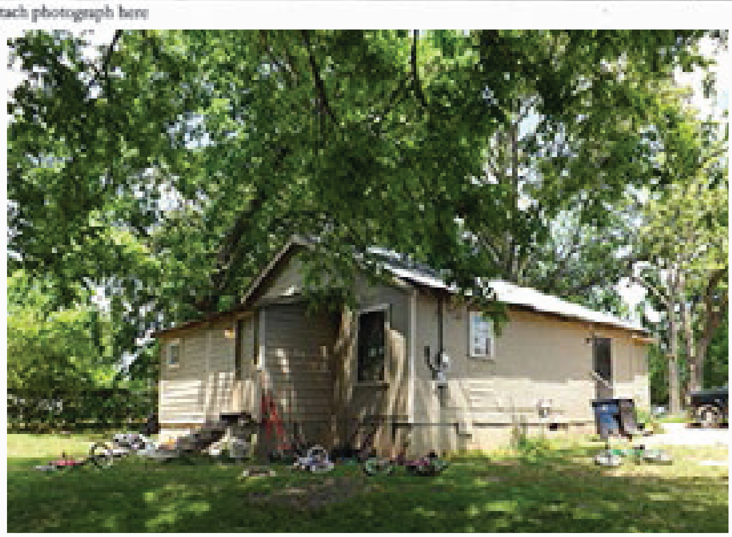
18. Integrity
☐ very intact ☐ deteriorated
☐ some changes ☐ ruins
☒ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☒ enlarged/altered ca. 2005
☐ artificial siding
☒ replaced windows/doors ca. 2005
☒ enclosed/altered porch ca. 2005
☐ storefront alterations

9. Outbuildings or secondary elements (if significant, use separate form)

20. Architectural character or style

Attach photograph here



THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 6, 2016

30. Inventory form completed by (name and organization)
Meghan Weaver
Tennessee Valley Archaeological Research

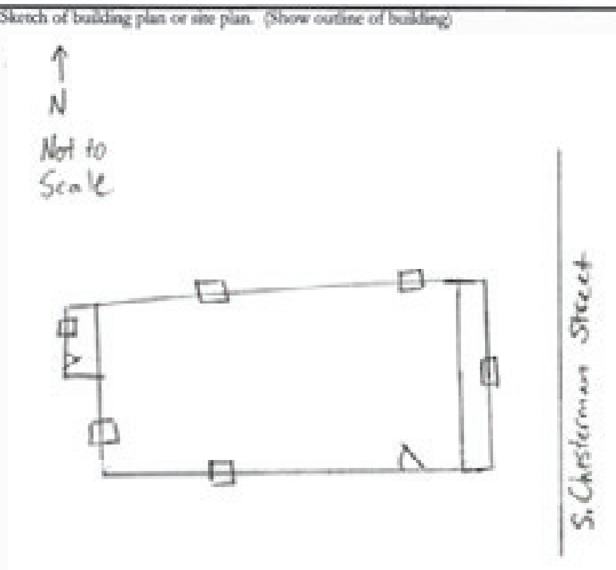
31. Survey project name
TVA Corinth and Holly Springs Substation Expansion

32. Date form completed
May 16, 2016

THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility
a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information
b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)



Draw north arrow here.

(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

2. Property address/descriptive location
440 Neely Avenue

3. Legal description (and acreage, if required—see instructions)

4. Former/historic use
Residence

5. Present use
Residence

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

8. Brief description
A one-story hipped-roof house that appears to have been constructed ca. 1920. The frame building features a roof covered with asphalt shingles, an interior brick chimney, an exterior clad with asbestos shingle siding, and a covered pier foundation. Facing south, the façade reveals a central door that is flanked on either side by a six-over-six, double-hung vinyl sash window. Access to the façade door is achieved via a full-width porch. The porch features a wood deck on a concrete block foundation and four non-original wood posts that are used to support a hipped roof. A partial-width hipped-roof porch provides access to the rear elevation door. The porch features a wood deck on a concrete block foundation and four non-original wood posts that support a hipped roof. Positioned east of the porch is a shed-roof extension pierced with a six-over-six, double-hung vinyl sash window.

9. Outbuildings or secondary elements (if significant, use separate form)

10. County
Marshall

11. City or Town
Holly Springs
☐ vicinity of

12. Owner's name and address

13. Was interior surveyed?
No

14. Survey seq. no.
14

15. USGS quadrangle map
Holly Springs

16. UTM reference (if required—see instructions)

17. Date of construction
ca. 1920
☒ estimated
☐ documented

18. Integrity
☐ very intact ☐ deteriorated
☒ some changes ☐ ruins
☐ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☐ enlarged/altered
☒ artificial siding ca. 1975
☒ replaced windows/doors ca. 2000
☒ enclosed/altered porch ca. 1990
☐ storefront alterations

20. Architectural character or style

Attach photograph here

THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 6, 2016

30. Inventory form completed by
(name and organization)
Meghan Weaver
Tennessee Valley Archaeological Research

31. Survey project name
TVA Corinth and Holly Springs Substation Expansion

32. Date form completed
May 16, 2016

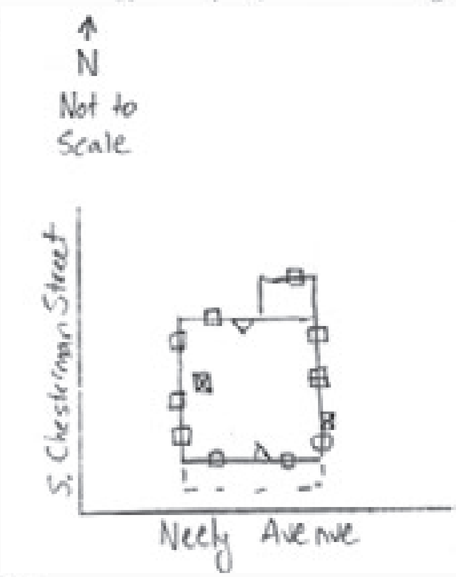
THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility

a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)



Draw north arrow here.

(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

10. County
Marshall

11. City or Town
Holly Springs
☐ vicinity of

2. Property address/descriptive location
850 Highway 178 East

12. Owner's name and address
John S. Huey
850 Highway 178 East
Holly Springs, MS 38635

3. Legal description (and acreage, if required—see instructions)

13. Was interior surveyed?
No

14. Survey seq. no.
15

15. USGS quadrangle map
Holly Springs

4. Former/historic use
Residence

5. Present use
Residence

16. UTM reference (if required—see instructions)

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

17. Date of construction
ca. 1940
☒ estimated
☐ documented

8. Brief description
A one-story Minimal Traditional style house that appears to have been constructed ca. 1940. The frame building features a roof covered with asphalt shingles, an exterior clad with asbestos shingle siding, and a covered pier foundation. Facing west, the façade reveals a central door that is flanked to the north by a modern window opening containing a 12-light, fixed vinyl sash. Located south of the door is a pair of six-over-six, double-hung vinyl sash windows. Access to the façade door is through a central bay porch. The porch features a concrete slab deck on a brick foundation and two non-original wood posts atop brick plinth blocks that support a projecting gabled roof. Attached to the east (rear) elevation is a gabled-roof extension that is clad with asbestos shingle siding and rests on a covered pier foundation.

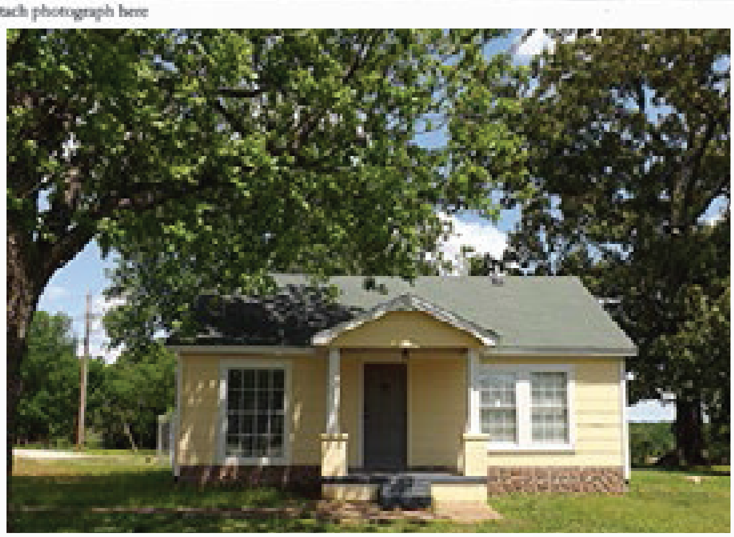
18. Integrity
☐ very intact ☐ deteriorated
☒ some changes ☐ ruins
☐ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☐ enlarged/altered
☒ artificial siding ca. 1975
☒ replaced windows/doors ca. 2000
☒ enclosed/altered porch ca. 2000
☐ storefront alterations

9. Outbuildings or secondary elements (if significant, use separate form)
1- mid. 20th century storage shed

20. Architectural character or style
Minimal Traditional style

Attach photograph here



This section for MDAH use only

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 6, 2016

30. Inventory form completed by (name and organization)
Meghan Weaver
Tennessee Valley Archaeological Research

31. Survey project name
TVA Corinth and Holly Springs Substation Expansion

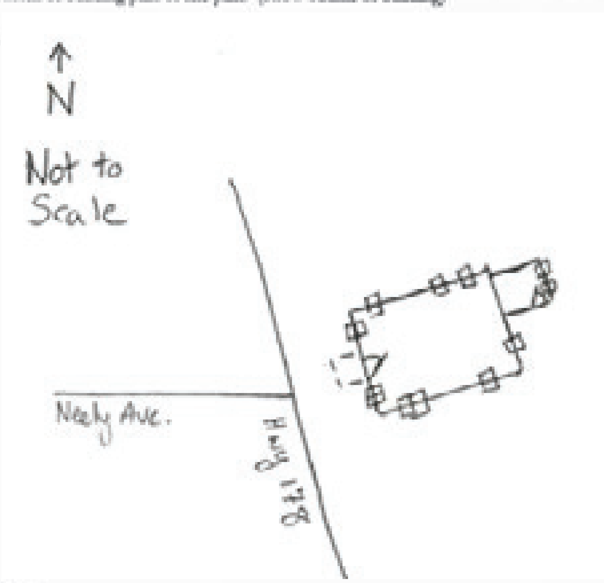
32. Date form completed
May 16, 2016

THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility
a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)



Draw north arrow here.

(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

10. County
Marshall

11. City or Town
Holly Springs
☐ vicinity of

2. Property address/descriptive location
East side of State Route 178

12. Owner's name and address

3. Legal description (and acreage, if required—see instructions)

13. Was interior surveyed?
No

14. Survey seq. no.
16

15. USGS quadrangle map
Holly Springs

4. Former/historic use
Commercial

5. Present use
Vacant

16. UTM reference (if required—see instructions)

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

17. Date of construction
ca. 1960
☒ estimated
☐ documented

8. Brief description
A vacant one-story commercial plaza that appears to have been constructed ca. 1960. The concrete block building features a flat roof, an exterior clad with a brick veneer, and a concrete block foundation. Facing west, the façade is divided into ten storefront entrances that contain glass doors flanked by single and multi-pane plate glass windows. The façade is largely accented by a non-original wood awning that appears to have been added to the building in the 1980s. The awning features Classical detailing including a decorative entablature with dentil molding, which is supported by a series of Tuscan-style wood columns. Assessment of the east (rear) elevation noted at least two steel doors that provided access to the northern section of the building. However, a full assessment of the rear elevation could not be conducted due to heavy vegetation that obscures much of the building.

18. Integrity
☐ very intact ☒ deteriorated
☒ some changes ☐ ruins
☐ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☐ enlarged/altered
☐ artificial siding
☐ replaced windows/doors
☐ enclosed/altered porch
☒ storefront alterations ca. 1980

9. Outbuildings or secondary elements (if significant, use separate form)

20. Architectural character or style
mid-20th century commercial

Attach photograph here

THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 6, 2016

30. Inventory form completed by (name and organization)
Meghan Weaver
Tennessee Valley Archaeological Research

31. Survey project name
TVA Corinth and Holly Springs Substation Expansion

32. Date form completed
May 16, 2016

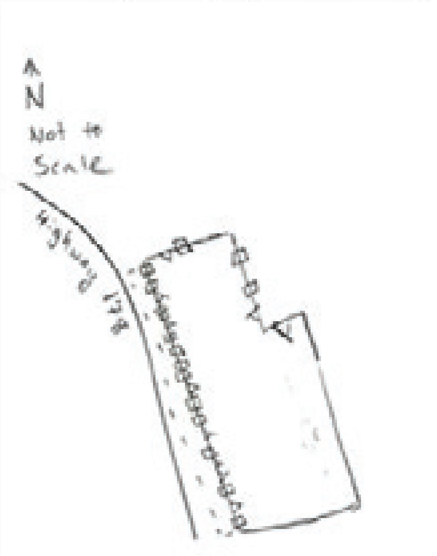
THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility

a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)



Draw north arrow here.

(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

10. County
Marshall

11. City or Town
Holly Springs
☐ vicinity of

2. Property address/descriptive location
West side of State Route 178

12. Owner's name and address

3. Legal description (and acreage, if required—see instructions)

13. Was interior surveyed?
No

14. Survey seq. no.
17

15. USGS quadrangle map
Holly Springs

4. Former/historic use
Industrial

5. Present use
Industrial

16. UTM reference (if required—see instructions)

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

17. Date of construction
mid-20th century
☒ estimated
☐ documented

8. Brief description
Manufacturing complex anchored by a square-shaped, steel-frame building that features a flat roof, an exterior clad with a brick veneer, and a concrete slab foundation. Based on physical evidence, the original manufacturing building has been altered over time through the construction of an office wing on the east elevation and a series of storage bays on the west and north elevations. These sections stand out from the original building core through their contrasting exterior finishes such as metal mansard roofs and unfinished concrete block walls. The primary façade of the manufacturing plant faces south and includes a centrally placed door opening containing a pair of swinging metal doors. Situated east of the door are a single-pane, fixed sash window and a band of five modern windows containing a lower metal awning sash topped by a single-pane fixed sash.

18. Integrity
☐ very intact ☒ deteriorated
☒ some changes ☐ ruins
☐ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☒ enlarged/altered ca. 1985
☐ artificial siding
☐ replaced windows/doors
☐ enclosed/altered porch
☐ storefront alterations

9. Outbuildings or secondary elements (if significant, use separate form)
Original: water tower. Modern: warehouse, storage sheds, garage, pole shed, manufacturing building

20. Architectural character or style

Attach photograph here

THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 6, 2016

30. Inventory form completed by (name and organization)
Meghan Weaver
Tennessee Valley Archaeological Research

31. Survey project name
TVA Corinth and Holly Springs Substation Expansion

32. Date form completed
May 16, 2016

THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility

a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)

Draw north arrow here.

(12-2008)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic

b. Property name, other

10. County
Marshall

11. City or Town
Holly Springs
☐ vicinity of

2. Property address/descriptive location
East side, Highway 178

12. Owner's name and address

3. Legal description (and acreage, if required—see instructions)

13. Was interior surveyed?
No

14. Survey seq. no.
18

15. USGS quadrangle map
Holly Springs

4. Former/historic use
Commercial

5. Present use
Vacant

16. UTM reference (if required—see instructions)

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

17. Date of construction
ca. 1955
☒ estimated
☐ documented

8. Brief description
A one-story commercial building that appears to have been constructed ca. 1955 and is currently vacant. The building is composed of brick laid in a common bond, and features a hipped roof covered with asphalt shingles and a continuous brick foundation. Facing west, the façade reveals an exterior clad with a brick veneer and an off-center glass and metal door that is shielded by a flat metal canopy. The door is flanked on each side by a window opening containing a two-light lower awning metal sash topped by a four-light fixed metal sash. An additional window opening north of this arrangement has been bricked in. The south elevation is marked by two overhead bay doors, three bricked-in window openings, and a two-light lower awning metal sash topped by a four-light fixed metal sash. A concrete block addition is attached to the east elevation and features a shed roof covered with metal sheeting and two open bays on its south elevation.

18. Integrity
☐ very intact ☒ deteriorated
☒ some changes ☐ ruins
☐ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☒ enlarged/altered ca. 1985
☐ artificial siding
☐ replaced windows/doors
☐ enclosed/altered porch
☐ storefront alterations

9. Outbuildings or secondary elements (if significant, use separate form)

20. Architectural character or style

Attach photograph here

THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

24. Additional remarks or continuation of other sections

25. Sources of information

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 6, 2016

30. Inventory form completed by (name and organization)
Meghan Weaver
Tennessee Valley Archaeological Research

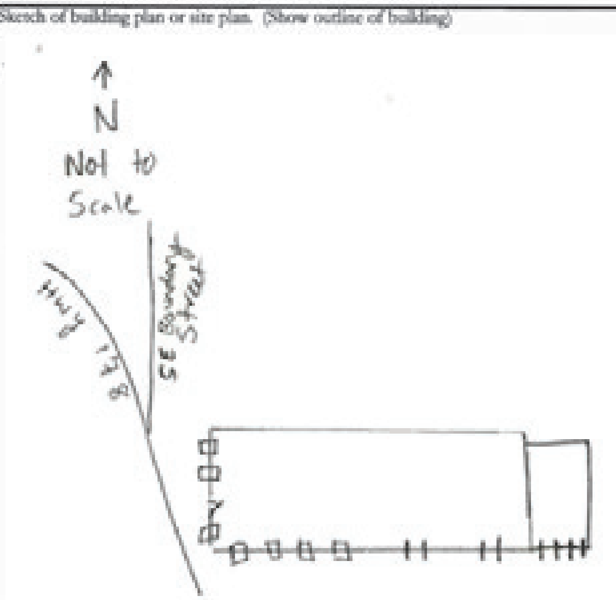
31. Survey project name
TVA Corinth and Holly Springs Substation Expansion

32. Date form completed
May 16, 2016

THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility
a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information
b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)



Draw north arrow here.

(12-2005)

State of Mississippi
Department of Archives and History
P.O. Box 571
Jackson, MS 39205

HISTORIC RESOURCES INVENTORY

1. a. Property name, historic
Mississippi Central Railroad

b. Property name, other

10. County
Marshall

11. City or Town
Holly Springs
☐ vicinity of

2. Property address/descriptive location
1 mile segment running in a southwest/northeasterly direction, from 0.43 miles southwest of Neely Avenue to 0.1 mile north of East Van Dorn Avenue

12. Owner's name and address
Pioneer Railcorp
1318 S Johanson Rd, Peoria, IL 61607

3. Legal description (and acreage, if required—see instructions)

13. Was interior surveyed?
No

14. Survey seq. no.
19

15. USGS quadrangle map
Holly Springs

4. Former/historic use
Railroad

5. Present use
Railroad

16. UTM reference (if required—see instructions)

6. Architect
☐ documented ☐ attributed

7. Builder/contractor
☐ documented ☐ attributed

17. Date of construction
1852-1856
☐ estimated
☒ documented

8. Brief description
Actively operated by Pioneer Railcorp, the railroad segment features a raised embankment covered with ballast that supports a modern track composed of wood cross ties and steel rails. The segment is situated within a tree-lined corridor and extends through a combination of light industrial and residential development. A number of at-grade crossings are located along the segment. As an actively managed rail line, the railroad bed has received regular repairs which has resulted in the replacement of the original tracks, cross-ties, and ballast; no original construction materials remain.

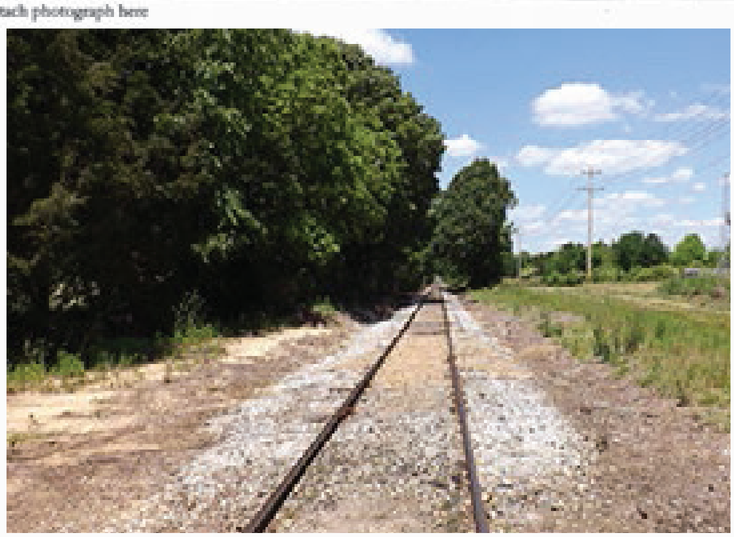
18. Integrity
☐ very intact ☐ deteriorated
☐ some changes ☐ ruins
☒ extensive changes ☐ no visible remains

19. Dates of changes, if any
☐ moved
☐ enlarged/altered
☐ artificial siding
☐ replaced windows/doors
☐ enclosed/altered porch
☐ storefront alterations

9. Outbuildings or secondary elements (if significant, use separate form)

20. Architectural character or style

Attach photograph here



THIS SECTION FOR MDAH USE ONLY

21. Registration status
☐ NHL
☐ listed NR
☐ in NR district
☐ Mississippi landmark
☐ local landmark/local district

22. If located in historic district
a. Name of district

b. Rating
☐ contributing
☐ previously listed
☐ noncontributing

c. District element number

MDAH Inventory Code

MISSISSIPPI HISTORIC RESOURCES INVENTORY
Page 2

23. Historical information

At Holly Springs, construction on the rail line began in 1852 and was completed in 1856, connecting the city with New Orleans (Guren 1980). During the Civil War the railroad was extensively used by both the Confederate and Union troops for the movement of supplies and men. Damaged during various raids on Holly Springs, the railroad was rebuilt during the Reconstruction period. It was purchased by the Chicago, St. Louis, and New Orleans Railroad in 1878 and then by the Illinois Central Railroad in 1882 (Guren 1980). Overall, the entire Mississippi Central Railroad stretches 51 miles from Oxford, Mississippi to Grand Junction, Tennessee. An additional line runs from Corinth, Mississippi to Red Bay, Alabama. Today used primarily for freight, the main products shipped along the Mississippi Central Railroad are animal feed ingredients, fertilizer, and wood.

24. Additional remarks or continuation of other sections

25. Sources of information

Guren, Pamela
1980 Depot-Compress Historic District. National Register of Historic Places nomination form.

Pioneer Railcorp
2015 Mississippi Central Railroad Co. Electronic document, http://www.pioneer-railcorp.com/MSCI.html, accessed May 12, 2016.

27. Photographer or photo source
Meghan Weaver
Tennessee Valley Archaeological Research

28. Photo roll and frame number(s)

29. Photo date
May 6, 2016

30. Inventory form completed by (name and organization)
Meghan Weaver
Tennessee Valley Archaeological Research

31. Survey project name
TVA Corinth and Holly Springs Substation Expansion

32. Date form completed
May 16, 2016

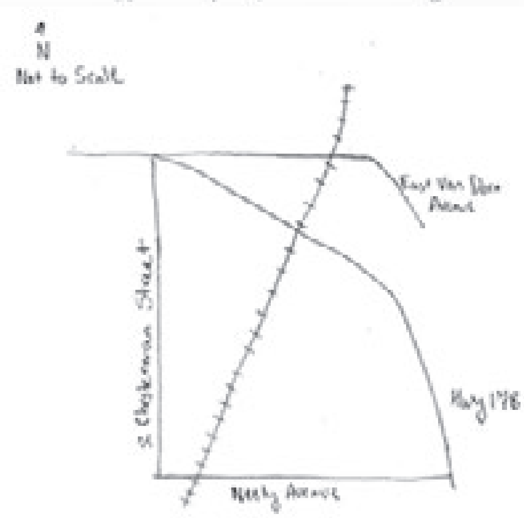
THIS SECTION FOR MDAH USE ONLY

33. Evaluation of National Register eligibility

a. ☐ already listed (see front of form)
☐ appears individually eligible
☐ potentially eligible if restored
☐ would contribute to district
☐ does not appear eligible
☐ insufficient information

b. Evaluated by/date

26. Sketch of building plan or site plan. (Show outline of building)



Draw north arrow here.

(12-2005)

APPENDIX B:
LAND PATENTS

THE UNITED STATES OF AMERICA.

To all to whom these presents shall come, Greeting:

Whereas [illegible] CITY OF WASHINGTON [illegible]

UNITED STATES [illegible]

[illegible] **Whereas** the **President of the United States** [illegible]

[illegible]

NOW KNOW YE, [illegible]

United States of America [illegible]

[illegible]

In Testimony Whereof, I, MARTIN VAN BUREN,

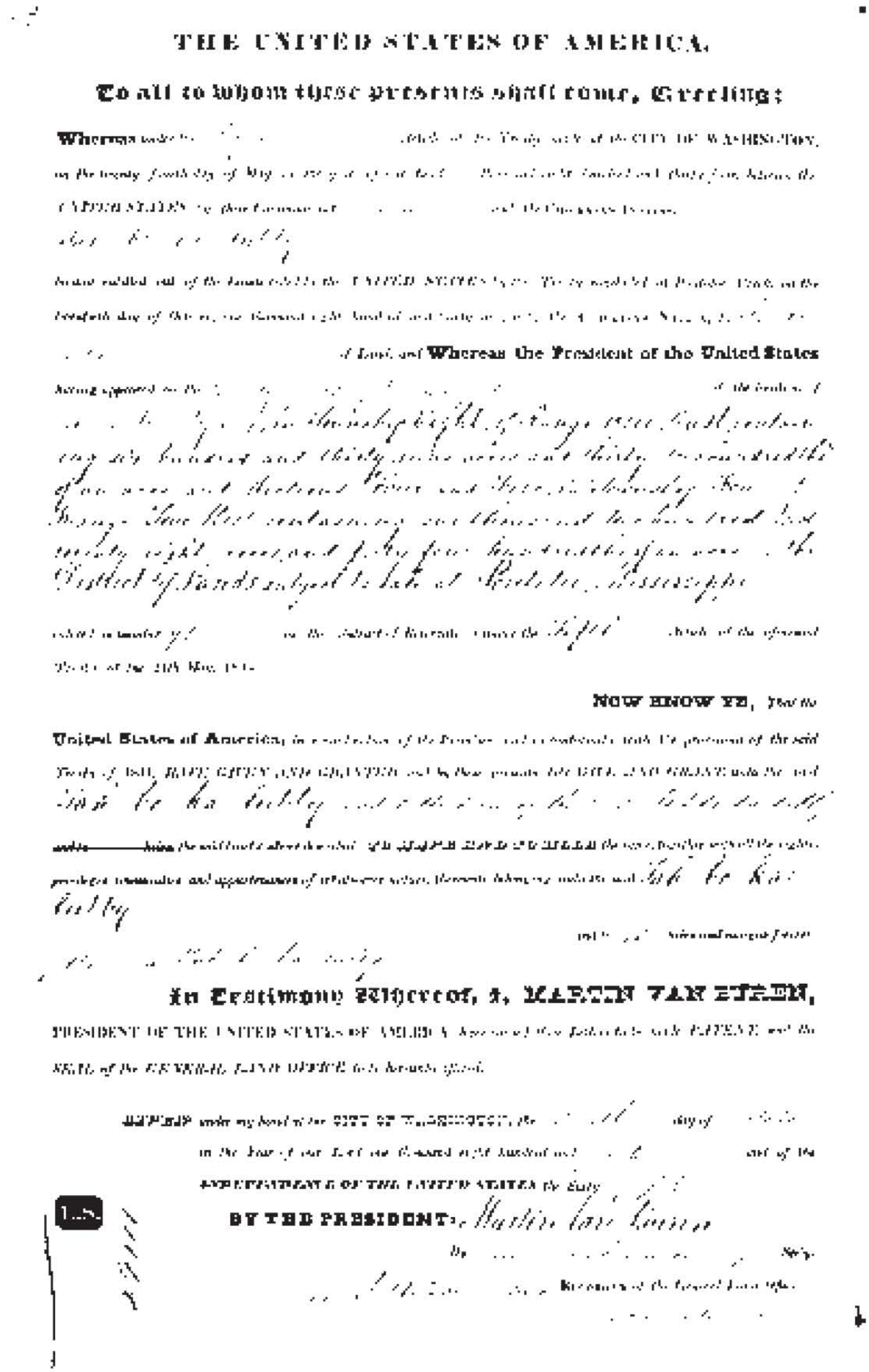
PRESIDENT OF THE UNITED STATES OF AMERICA, [illegible]

[illegible] CITY OF WASHINGTON [illegible]

L.S.

BY THE PRESIDENT: [illegible]

[illegible]



THE UNITED STATES OF AMERICA,

To all to whom these presents shall come, Greeting:

Whereas ... Treaty made at the CITY OF WASHINGTON, ... UNITED STATES ...

... of Land, and Whereas the President of the United States ...

NOW KNOW YE, That the United States of America, ...

In Testimony Whereof, I, MARTIN VAN BUREN, PRESIDENT OF THE UNITED STATES OF AMERICA, ...

GIVEN under my hand at the CITY OF WASHINGTON, ...

L.S.

BY THE PRESIDENT: Martin Van Buren

... Recorder of the General Land Office.

APPENDIX C:
CURATION LETTER

University of Alabama Museums
Office of Archaeological Research

THE UNIVERSITY OF
ALABAMA
MUSEUMS

May 6, 2016

Hunter Johnson
Tennessee Valley Archaeological Research
2211 Seminole Drive, Suite 302
Huntsville AL 35805

Dear Hunter:

As per your request, this letter is to establish an agreement with you to provide curation services to Tennessee Valley Archaeological Research on an as-needed basis. We are recognized by a variety of Federal agencies as a repository meeting the standards in 36 CFR Part 79 and have formal agreements to provide curation under these guidelines to agencies such as the Department of Defense, National Park Service, U.S. Fish and Wildlife Service, U.S. Soil Conservation Service, U.S. Army Corps of Engineers, Tennessee Valley Authority, National Forest Service, etc.

Please be advised that once a year we must be notified of all reports in which we were named as the repository. Project collections must be submitted within one calendar year of completion. Small projects may be compiled for periodic submission. For Alabama, the AHC survey policy specifies which materials must be curated (Administrative Code of Alabama, Chapter 460-X-9). Archaeological documentation must be curated even if no artifacts are recovered. Renewal of this agreement is contingent upon compliance.

We appreciate having the opportunity to assist you with curation services and look forward to working with you in the future.

Sincerely,

Eugene Futato

Eugene M. Futato RPA
Deputy Director

13075 Moundville
Archaeological Park
Moundville, Alabama 35474
(205) 371-2266
fax (205) 371-2494

APPENDIX D:
SHOVEL TEST ROSTER

Unit Type	Test	Status	NAD 27 Easting	NAD 27 Northing	Site	Shovel Test Depth (cmbs)	Auger Test Depth (cmbs)
Shovel Test	1	modern discarded	277243.700764	3849084.584552		0-70	
Shovel Test	2	modern discarded	277272.023444	3849083.87128		0-35	
Shovel Test	3	negative	277302.122674	3849083.562129		0-41	
Shovel Test	4	negative	277332.468698	3849082.761991		0-45	
Shovel Test	5	negative	277361.238592	3849084.311887		0-29	
Shovel Test	6	negative	277244.915284	3849139.168348		0-47	
Shovel Test	7	negative	277269.916456	3849141.458257		0-35	
Shovel Test	8	negative	277302.282961	3849143.752345		0-33	
Shovel Test	9	modern discarded	277330.823275	3849140.992125		0-34	
Shovel Test	10	negative	277362.599223	3849143.957575		0-34	
Shovel Test	11	negative	277242.64652	3849112.004963		0-70	
Shovel Test	12	negative	277272.642461	3849112.983337		0-54	
Shovel Test	13	negative	277301.045225	3849114.341631		0-41	
Shovel Test	14	negative	277333.494018	3849114.980979		0-37	
Shovel Test	15	negative	277362.052446	3849114.153885		0-30	
Shovel Test	16	modern discarded	362054.701653	3864141.322436		0-34	
Shovel Test	17	negative	362050.406337	3864113.846376		0-27	
Shovel Test	18	negative	362046.638636	3864083.521087		0-24	
Shovel Test	19	negative	362054.872868	3864055.198358		0-35	
Shovel Test	20	negative	362083.331333	3864053.899483		0-28	
Shovel Test	21	negative	362066.729726	3864062.149791		0-34	
Shovel Test	22	negative	362084.339605	3864084.074711		0-70	
Shovel Test	23	negative	362113.693037	3864082.526868		0-51	
Shovel Test	24	negative	362142.98422	3864082.879734		0-27	

Unit Type	Test	Status	NAD 27 Easting	NAD 27 Northing	Site	Shovel Test Depth (cmbs)	Auger Test Depth (cmbs)
Shovel Test	25	negative	362144.064502	3864139.338753	22AL726	0-30	
Shovel Test	26	negative	362174.989885	3864176.700824		0-28	
Shovel Test	27	positive	362172.358766	3864115.717232	22AL726	0-29	
Shovel Test	28	negative	362164.711374	3864124.400165	22AL726	0-28	
Shovel Test	29	positive	362182.296051	3864123.94496	22AL726	0-32	
Shovel Test	30	negative	362191.478018	3864130.796497	22AL726	0-34	
Shovel Test	31	negative	362200.291986	3864133.54484		0-31	
Shovel Test	32	negative	362164.005883	3864109.033329	22AL726	0-34	
Shovel Test	33	negative	362155.689489	3864102.578719		0-41	
Shovel Test	34	negative	362179.254751	3864104.573923	22AL726	0-35	
Shovel Test	35	negative	362185.376175	3864097.234404		0-27	
Shovel Test	50	negative	362084.035908	3864112.878789		0-24	
Shovel Test	51	negative	362114.878516	3864112.776614		0-22	
Shovel Test	52	negative	362083.265857	3864142.878055		0-23	
Shovel Test	53	negative	362113.851914	3864054.240685		0-34	
Shovel Test	54	negative	362145.10149	3864053.438134		0-28	
Shovel Test	55	negative	362143.183964	3864112.435315		0-51	
Shovel Test	56	negative	362175.957055	3864143.322651	22AL726	0-30	
Shovel Test	57	negative	362174.964671	3864080.523375		0-27	
Shovel Test	58	negative	362173.97643	3864057.636616		0-27	
Shovel Test	59	negative	362204.4893	3864054.179242		0-32	
Shovel Test	60	negative	362197.631169	3864083.195957		0-28	
Shovel Test	61	negative	362204.116324	3864113.159418		0-33	
Shovel Test	62	negative	362208.045625	3864139.576407		0-32	

Unit Type	Test	Status	NAD 27 Easting	NAD 27 Northing	Site	Shovel Test Depth (cmbs)	Auger Test Depth (cmbs)
Shovel Test	63	negative	362207.212475	3864167.224102		0-40	
Shovel Test	64	positive	362155.03965	3864135.042515	22AL726	0-29	

APPENDIX E:
SITE FORM

Mississippi Department of Archives and History

SITE NAME: ____ SITE NO: 22AL726 OTHER NOS: ____ 7.5 QUAD: Corinth

COUNTY: Alcorn SEC: 13 TWN: 2S RNG: 7E UTM DATA: zone 16N E 362172.42679 N 3864117.0553

OWNERSHIP: private [ ] state [ ] county [ ] city [ ] federal [X]

NAME OF OWNER: TVA RECORDER TVAR DATE: 4/20/2016

NATIONAL REGISTER POTENTIAL: eligible [ ] ineligible [X] unknown [ ] NATURAL SETTING: bluff [ ] bluff shelter [ ] chenier [ ] dune [ ] floodplain [ ] first terrace [ ] knoll on terrace [ ] upland (ridge) [X] estuary [ ] natural levee [ ] backswamp [ ]

VEGETATION COVER: active cultivation [ ] fallow field [ ] pasture [ ] orchard [ ] pine forest [ ] hardwood forest [ ] denuded [ ] garden [ ] other [X]

ESTIMATION OF GROUND COVER: (estimate %) 90 DEGREE OF DISTURBANCE (estimate %) 50

TYPE OF DISTURBANCE: cultivation [ ] natural [X] scientific excavation [ ] unscientific excavation [ ] extensively collected [ ] construction [ ] land levelled [ ] buried site [ ] redeposited site [ ] forestry [ ] periodic flooding [ ] indefinitely flooded [ ] unknown [ ] other [ ]

SOIL TYPE: Providence silt loam SOIL CODE: PdC3

ARTIFACT DENSITY: heavy [ ] medium [X] light [ ] single artifact [ ]

INSTITUTION WHERE ARTIFACTS CURATED: Erskine Ramsay Repository

SURFACE AREA(sq.m.): 1493 max length 51 max width 37 ELEVATION (ft): 440

DEPOSIT DEPTH (m.): .25 CHRONOLOGY: Paleo Indian [ ]

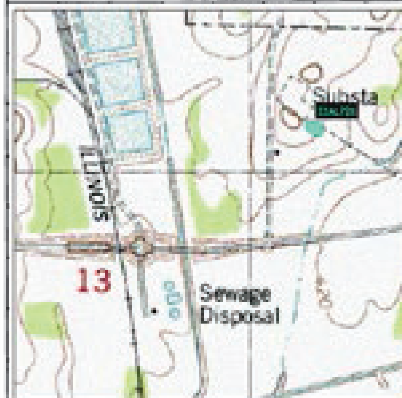
Archaic [ ] early [ ] middle [ ] late [ ] Woodland [X] early [ ] middle [ ] late [ ] Miss. [ ] early [ ] middle [ ] late [ ] Historic Indian [ ]

Contact Indian [ ] Unknown Aboriginal [ ] Historic [ ]

REPORT REFERENCE: Phase I Cultural Resources Surveys of Tennessee Valley Authority's Corinth and Holly Springs Substation Expansions in Alcorn and Marshall Counties, Mississippi

MDAH REPORT NO: ____ USE REVERSE SIDE FOR ADDITIONAL INFORMATION

Place Quad Xerox Here



Mounds
conical [ ]
pyramidal [ ]
indeterminate [ ]

earthworks [ ]

material identified:
3 coarse sand sherdlets, 1 undifferentiated debitage, 1 brick fragment

component – diagnostics
coarse sand sherdlet: Woodland

comments:

This site is a small prehistoric and historic artifact scatter encompassing 1,493 m^2 (16,078 ft^2) located on a northeast-southwest trending ridge 130 m northwest of an unnamed tributary of Bridge Creek. At the time of TVAR's survey, the site was situated in a disturbed area consisting primarily of tall grass and briar's and approximately 7 m southeast of an existing substation.

One structure, located 100 m to the southwest of the site, was present on the USGS 1950 Corinth 15-minute and the 1982 Corinth 7.5-minute topographic quadrangle maps, but that building was not present at the time of this survey. Therefore, it was built sometime before 1950 and destroyed sometime after 1982.

A total of 12 shovel tests were conducted during TVAR's investigation of the site, three of which yielded artifacts (n=5) from maximum depth of 25 cmbs. Shovel testing at the site produced a general profile consisting of a brown (7.5YR 5/4) silty clay loam (0 to 20 cmbs) underlain by a strong brown (7.5YR 5/6) silty clay (20 to 29 cmbs). Soil profiles show that the site is heavily disturbed. Coarse sand tempered sherdlets indicate a post Archaic occupation of the site, and although one historic brick fragment was recovered, it cannot be precisely dated to the time in which a structure was extant near the site.

TVAR recommends this site as not eligible for inclusion in the NRHP.

MDAH USE ONLY

Physiographic Region:
YB[ ], LH[ ], FW[ ], PR[ ], BP[ ], TH[ ], JP[ ], LLPB[ ], CPM[ ], NCH[ ]

National Register Status: NRL [ ], date ____, criteria ____
DOE [ ], date ____, criteria ____
NHL [ ], date ____, criteria ____

Mississippi Landmark [ ], date ____

Response to RERP-GE-RAI 2, Attachment 4

**TVA letter to the Alabama State Historic Preservation Office -
TVA, Limestone Substation Static VAR Compensator Construction, Phase 1
Cultural Resources Survey, Limestone County, Alabama**

Tennessee Valley Authority, 400 West Summit Hill Drive, Knoxville, TN 37902

January 26, 2017

Ms. Lee Anne Wofford
Deputy State Historic Preservation Officer
Alabama Historical Commission
468 South Perry Street
Montgomery, Alabama 36130-0900

Dear Ms. Wofford:

TENNESSEE VALLEY AUTHORITY, LIMESTONE SUBSTATION STATIC VAR COMPENSATOR, LIMESTONE COUNTY, ALABAMA

TVA proposes to construct a Static Var Compensator (SVCCC) at the existing Limestone, AL 500-kV Substation. The proposed project is to support the proposed extended power uprate at Browns Ferry Nuclear Plant. TVA determined the archaeological area of potential effects (APE) to be the 42-acre parcel where ground disturbance may occur and the visual APE to be the 0.5-mile radius surrounding the project area and within the line of sight of the proposed above ground features.

TVA contracted with The University of Alabama, Office of Archaeological Research (OAR) to conduct a Phase I cultural resources survey. Please find enclosed the resulting report titled *A Cultural Resources Survey of the Proposed Limestone Substation Static VAR Compensator Site in Limestone County, Alabama.* No new archaeological resources were documented within the boundaries of the APE. One farm complex was located within the line of sight of the project area. The *Lowe Hereford Farm-Belle Mina Farms* complex includes four cinderblock residential houses, one cinderblock outbuilding, as well as several other wood and metal outbuildings. The construction dates for the structures that comprise the complex range from 1944 to 1970. TVA finds that the farm complex is not eligible for the National Register of Historic Places (NRHP). The property has not been identified as having been associated with any important event (criteria A), or significant people (criteria B) nor does it display distinct characteristics of a type, period, or method of construction (criteria C). TVA finds that no historic properties would be affected by the proposed undertaking.

Pursuant to 36 CFR Part 800.3(f)(2), TVA is consulting with federally recognized Indian tribes regarding properties within the proposed project's APE that may be of religious and cultural significance to them and eligible for the NRHP.

Pursuant to 36 CFR § 800 (4)(d)(1), TVA is seeking your concurrence with TVA's finding that no historic properties listed or eligible for listing in the NRHP would be affected by the proposed undertaking.

Should you have any questions or comments, please contact Michaelyn Harle by email, mharle@tva.gov, or by phone, (865) 632-2248.

Sincerely,

Clinton E. Jones
Manager
Biological and Cultural Compliance

MSH:ABM
Enclosures

INTERNAL COPIES ONLY, NOT TO BE INCLUDED WITH OUTGOING LETTER:

Joseph H. Bashore, PAB 1A-BFN
A. Michelle Cagley, KFP 1T-KST
Michaelyn S. Harle, WT 11D-K
Amy B. Henry, WT 11C-K
Susan R. Jacks, WT 11C-K
M. Susan Smelley, BR 4A-C
Emily P. Willard, MR 4G-C
ECM, WT CA-K

Tennessee Valley Authority, 400 West Summit Hill Drive, Knoxville, TN 37902

January 26, 2017

To Those Listed:

TENNESSEE VALLEY AUTHORITY, LIMESTONE SUBSTATION STATIC VAR COMPENSATOR, LIMESTONE COUNTY, ALABAMA (86°50'57.248"W 34°42'58.457"N)

TVA proposes to construct a Static Var Compensator (SVCCC) at the existing Limestone, Alabama 500-kilovolt (kV) Substation. The proposed project is to support the proposed extended power uprate at Browns Ferry Nuclear Plant. TVA determined the archaeological area of potential effects (APE) to be the 42-acre parcel where ground disturbance may occur and the visual APE to be the 0.5-mile radius surrounding the project area and within the line of sight of the proposed above ground features.

TVA contracted with The University of Alabama, Office of Archaeological Research (OAR) to conduct a Phase I cultural resources survey. Please find attached the resulting report titled *A Cultural Resources Survey of the Proposed Limestone Substation Static VAR Compensator Site in Limestone County, Alabama.* No new archaeological resources were documented within the boundaries of the APE. The *Lowe Hereford Farm-Belle Mina Farms* complex was located within the line of sight of the project area. This farm complex includes four cinderblock residential houses, one cinderblock outbuilding, as well as several other wood and metal outbuildings. The construction dates for the structures that comprise the farm complex range from 1944 to 1970. TVA finds that the farm complex is not eligible for the National Register of Historic Places (NRHP). The property has not been identified as having been associated with any important event (criteria A), or significant people (criteria B) nor does it display distinct characteristics of a type, period, or method of construction (criteria C). TVA finds that no historic properties would be affected by the proposed undertaking.

TVA finds that the proposed undertaking would not affect historic properties. Pursuant to 36 C.F.R. Part 800.3(f)(2), TVA is consulting with the following federally recognized Indian tribes regarding historic properties within the proposed project's APE that may be of religious and cultural significance and are eligible for the NRHP: Cherokee Nation, Eastern Band of Cherokee Indians, United Keetoowah Band of Cherokee Indians, Chickasaw Nation, Coushatta Tribe of Louisiana, Alabama Coushatta Tribe of Texas, Alabama-Quassarte Tribal Town, Muscogee (Creek) Nation of Oklahoma, Kialegee Tribal Town, Thlopthlocco Tribal Town, Poarch Band of Creek Indians, Absentee Shawnee Tribe of Oklahoma, Eastern Shawnee Tribe of Oklahoma, Shawnee Tribe and the Seminole Nation of Oklahoma.

By this letter, TVA is providing notification of these findings and is seeking your comments regarding any properties that may be of religious and cultural significance and may be eligible for listing in the NRHP pursuant to 36CFR § 800.2 (c)(2)(ii), 800.3 (f)(2), and 800.4 (a)(4)(b).

Please respond by February 26, 2017, if you have any comments on the proposed undertaking. If you have any questions, please contact me by phone, (865) 632-6461 or by email, pbezzell@tva.gov.

Sincerely,

Pat Bernard Ezzell

Patricia Bernard Ezzell
Senior Program Manager
Tribal Relations and Corporate Historian

MSH:ABM
Enclosures
cc (Enclosures):

IDENTICAL LETTER MAILED TO THE FOLLOWING ON JANUARY 26, 2017:

Ms. Holly Austin (NHPA)
Federal Cultural Resource Law Liaison
Tribal Historic Preservation Office
Eastern Band of Cherokee Indians
Post Office Box 455
Cherokee, North Carolina 28719

cc: Mr. Russell Townsend
Tribal Historic Preservation Officer
Eastern Band of Cherokee Indians
Post Office Box 455
Cherokee, North Carolina 28719

Ms. Sheila Bird
Cherokee Nation
Post Office Box 948
Tahlequah, Oklahoma 74465

Mr. Ken Blanchard
Tribal Historic Preservation Officer
Absentee Shawnee Tribe of Oklahoma
2025 S. Gordon Cooper
Shawnee, Oklahoma 74801

cc: Mr. Leonard Longhorn
Absentee Shawnee Tribe of Oklahoma
2025 S. Gordon Cooper
Shawnee, Oklahoma 74801

Ms. Karen Brunso
Tribal Historic Preservation Officer
Division of Historic Preservation
Department of Culture and Humanities
The Chickasaw Nation
Post Office Box 1548
Ada, Oklahoma 74821-1548

Ms. RaeLynn Butler
Manager
Historic and Cultural Preservation Department
Muscogee (Creek) Nation
Post Office Box 580
Okmulgee, Oklahoma 74447

cc: Ms. Corain Lowe-Zepeda
Tribal Historic Preservation Officer
Historic and Cultural Preservation Department
Muscogee (Creek) Nation
Post Office Box 580
Okmulgee, Oklahoma 74447

Mr. Bryant Celestine
Tribal Historic Preservation Officer
Alabama-Coushatta Tribe of Texas
571 State Park Road 56
Livingston, Texas 77351

Mr. David Cook
Tribal Administrator
Kialegee Tribal Town
Post Office Box 332
Wetumka, Oklahoma 74883

Ms. Robin Dushane
Tribal Historic Preservation Officer
Eastern Shawnee Tribe of Oklahoma
127 West Oneida
Seneca, Missouri 64865

cc: Ms. Dee Gardner
NAGPRA/Cell Tower Coordinator
Eastern Shawnee Tribe of Oklahoma
127 West Oneida
Seneca, Missouri 64865

Ms. Natalie Harjo
Tribal Historic Preservation Officer
Seminole Nation of Oklahoma
Post Office Box 1498
Wewoka, Oklahoma 74884

Ms. Kim Jumper
Tribal Historic Preservation Officer
Shawnee Tribe
Post Office Box 189
Miami, Oklahoma 74355

Dr. Linda Langley
Tribal Historic Preservation Officer
Coushatta Tribe of Louisiana
Post Office Box 10
Elton, Louisiana 70532

Mr. Eric Oosahwee-Voss
Tribal Historic Preservation Officer
United Keetoowah Band of Cherokee Indians in Oklahoma
Post Office Box 1245
Tahlequah, Oklahoma 74465

cc: Ms. Karen Pritchett
United Keetoowah Band of Cherokee Indians in Oklahoma
Post Office Box 1245
Tahlequah, Oklahoma 74465

Ms. Samantha Robison
Tribal Historic Preservation Officer
Alabama-Quassarte Tribal Town
Post Office Box 187
101 East Broadway
Wetumka, Oklahoma 74883

Mr. Emman Spain
Tribal Historic Preservation Officer
Thlopthlocco Tribal Town
Post Office Box 188
Okemah, Oklahoma 74859

Mr. Robert Thrower
Tribal Historic Preservation Officer
Poarch Band of Creek Indians
5811 Jack Springs Road
Atmore, Alabama 36502

A CULTURAL RESOURCES SURVEY OF THE PROPOSED LIMESTONE SUBSTATION STATIC VAR COMPENSATOR SITE IN LIMESTONE COUNTY, ALABAMA

Joel H. Watkins

PERFORMED FOR:
Tennessee Valley Authority
Biological and Cultural Compliance
11D-K
400 W. Summit Hill Drive
Knoxville, Tennessee 37902

JANUARY 2017

Office of Archaeological Research

THE UNIVERSITY OF ALABAMA®

THE UNIVERSITY OF ALABAMA® | University Museums
Office of Archaeological Research

January 20, 2017

A CULTURAL RESOURCES SURVEY OF THE PROPOSED LIMESTONE SUBSTATION STATIC VAR COMPENSATOR SITE IN LIMESTONE COUNTY, ALABAMA

OAR PROJECT NUMBER: 17-160
TVA PO: 2746811
AHC TRACKING NUMBER: None Assigned

PERFORMED FOR: Tennessee Valley Authority
Biological and Cultural Compliance
11D-K
400 W. Summit Hill Drive
Knoxville, Tennessee 37902
Attn: Dr. Michaelyn Harle

PERFORMED BY: Joel H. Watkins, Cultural Resources Analyst
Trip Smith, Cultural Resources Assistant
The University of Alabama
Office of Archaeological Research
13075 Moundville Archaeological Park
Moundville, Alabama 35474

DATE PERFORMED: January 12-13, 17-18, 2017

for Joel H Watkins

Joel H. Watkins
Cultural Resources Analyst
Office of Archaeological Research

Matthew D. Gage RPA, Director
Office of Archaeological Research
The University of Alabama

A Cultural Resources Survey of the Proposed Limestone Substation Static VAR Compensator Site in Limestone County, Alabama

Joel H. Watkins

Management Summary

The University of Alabama, Office of Archaeological Research (OAR) was contracted by the Tennessee Valley Authority (TVA) to perform a cultural resources survey for the proposed construction of the Limestone Substation Static VAR Compensator. The survey area consists of a single irregular shaped tract of land having a total area of potential effect (APE) of 17 ha (42 ac). The APE is located adjacent to the existing Limestone Substation in Limestone County, Alabama. Field investigations for the project were undertaken on January 13-14, and 17-18, 2017. Joel H. Watkins, Cultural Resources Analyst, serves as the Project Director. The Principal Investigator for the project is Matthew D. Gage RPA, Director of OAR.

The APE consists of a large, fallow field, with a small tract of woods near the northwest border and a few scattered, small, copses of trees further to the south and east. A noticeable rise is present in the eastern portion of the APE, along the border with the existing substation entrance road. This area has been previously mechanically impacted by bulldozing and placement of a dense layer of gravel.

During this cultural resources survey, no new archaeological sites or historic structures were identified or documented, within the boundaries of the APE. Much of the proposed project area was found to be previously disturbed by prior long-term agricultural usage resulting in deep soil deflation. More recently, construction of the adjoining substation and associated transmission line right-of-ways have also impacted the survey area. A total of 127 shovel tests were excavated in the course of this survey, with no cultural material recovery. Soil profiles showed a relatively consistent profile of red (2.5YR 4/6) clay loam, becoming denser with depth, to at least 30 cmbs. Some profiles showed a moderate amount of rounded chert gravel in the soil matrix.

A .5 mile radius around the proposed project area was utilized to locate any potential historic structures that may be visually impacted by this project. A farm complex is located just south and east of the APE. The *Lowe Hereford Farm-Belle Mina Farms* complex includes four cinderblock residential houses, one cinderblock outbuilding, as well as several other wood and metal outbuildings. The construction dates for the structures that comprise the complex range from 1944 to 1970. An evaluation of the complex by Gene A. Ford, Architectural Historian, recommends it to be ineligible for the NRHP.

Based on the results of the field investigations and background research, it is the opinion of this office that construction of the proposed Limestone Substation Static VAR Compensator will not affect any significant historic properties and a finding of no properties is recommended.

TABLE OF CONTENTS

Content Page

Management Summary ... iii
List of Figures ...
Introduction ... 1
Environmental Setting ... 1
Paleoindian Stage (11,500 B.C.- 8500 B.C.) ... 6
Archaic Stage (8500 B.C.-900 B.C.) ... 8
    Early Archaic Period ... 8
    Late Archaic Period ... 10
Gulf Formational Stage (2500 B.C.-100 B.C.) ... 11
    Middle Gulf Formation Period ... 11
    Late Gulf Formational Period ... 12
Woodland Stage (900 B.C.-A.D. 900) ... 12
    Early Woodland Period ... 12
    Middle Woodland Period ... 13
    Late Woodland Period ... 14
Mississippian Stage (A.D. 900-A.D. 1600) ... 14
    Early Mississippian Period ... 14
    Middle (Mature) to Late Mississippian Periods ... 15
Protohistoric to Historic ... 15
Historic Background ... 16
Literature and Document Search ... 19
Table 1. Previous Phase I surveys conducted within a one-mile radius of the APE. ... 21
Table 2. Previously recorded sites within a one-mile radius of the APE (*in APE). ... 21
Field Methods ... 22
Laboratory Methods and Collection Curation ... 28
Results ... 28
Summary and Evaluation ... 39
Recommendations ... 40
References Cited ... 40
Appendix A ... 53
Appendix B ... 55

LIST OF FIGURES

Page

Figure 1. Overview of APE. 2
Figure 2. Soil map of APE. 4
Figure 3. Previously recorded archaeological sites and surveys. 20
Figure 4. Location of shovel tests and location and direction of photographs. 23
Figure 5. General view of the APE. View to east. 24
Figure 6. Plowed field along south border of APE. View to east. 24
Figure 7. Shovel Test 26 showing typical red clay soil profile. 25
Figure 8. Shovel Test 44 showing gravel in soil profile. 25
Figure 9. General area of structure depicted on the topographic map of the area. 26
Figure 10. Wooded tract near west border of APE. View to southwest. 26
Figure 11. Shovel Test 60 showing typical soil profile in wooded area. 27
Figure 12. General area of Site 1Li552. View to northwest. 27
Figure 13. General area of sinkhole depicted on the topographic map of the area. 29
Figure 14. Northeast portion of APE. View to north. 29
Figure 15. Relic meter and pole in eastern portion of APE. 30
Figure 16. Concrete pipe segments near meter and pole. View to east. 30
Figure 17. Aerial depicting the built environment of Resource 1. 31
Figure 18. Resource 1-1960 tenant bungalow. View to southwest. 31
Figure 19. Resource 1-1960 tenant massed plan cottage. View to north. 32
Figure 20. Resource 1-Second 1960 tenant massed plan cottage. View to north. 32
Figure 21. Resource 1-Third 1960 tenant massed plan cottage. View to south. 33
Figure 22. Resource 1-Ca. 1970 horse barn. View to west 33
Figure 23. Resource 1-Ca. 1944 shop. View to south. 34
Figure 24. Resource 1 Outbuildings - Ca. 1944 shed. View to southeast 34
Figure 25. Resource 1 Outbuildings-Ca. 1944 shed foreground, Ca. 1960 shed in rear. 35
Figure 26. Wooded location of Fletcher Cemetery. View to west. 36
Figure 27. Leaf covered surface of cemetery. View to west. 37
Figure 28. Area of depressions in field next to cemetery. View to north. 37
Figure 29. Round shaped depression. View to south. 38
Figure 30. Somewhat rectangular shaped depression. View to north. 38

A Cultural Resources Survey of the Proposed Limestone Substation Static VAR Compensator Site in Limestone County, Alabama

Joel H. Watkins

Introduction

The University of Alabama, Office of Archaeological Research (OAR) was contracted by the Tennessee Valley Authority (TVA) to perform a cultural resources survey for the proposed construction of the Limestone Substation Static VAR Compensator. The survey area consists of a single tract of land, having a total area of potential effect (APE) of 17 ha (42 ac) (Figure 1). The site is located adjacent to the existing Limestone Substation in Limestone County, Alabama.

Field investigations for the project were undertaken on January 13-14, and 17-18, 2017. Joel H. Watkins, Cultural Resources Analyst, serves as the Project Director and was assisted by McCallie Smith III, Cultural Resources Assistant. Map production and Geographic Information Systems (GIS) compilation was conducted by Benjamin Lundberg, Graphics and GIS Analyst. The report was compiled by Tamela K. Wilson, Cultural Resources Technical Writer, and edited by Kristen R. Koors, Cultural Resources Analyst. The Principal Investigator for the project is Matthew D. Gage RPA, Director of OAR.

The lead federal agency for the proposed project is the Tennessee Valley Authority (TVA). Permitting for the project requires compliance with the National Environmental Policy Act and National Historic Preservation Act (NHPA) of 1966 as amended 2006 (16 USC 470) and its implementing regulations (36 CFR 800).

The research design of the cultural resources survey is to locate and identify any archaeological sites and historic standing structures within the APE, assess their significance, and provide recommendation with regard to guidelines set forth by the National Park Service (NPS) for National Register of Historic Places (NRHP) eligibility criteria (NPS 1995). Included in this report is a discussion of the environmental setting of the survey area, cultural chronology, historic background, a literature search of any previously recorded sites or previously conducted surveys within or near the survey area, a description of field and laboratory methods, the results of the cultural resources survey, and conclusions and recommendations based on the findings of this survey. In addition, Traditional Cultural Properties were considered by the field crew with special attention paid during the background research. The findings will be discussed in the Summary and Evaluation section.

Environmental Setting

The project consists of one irregular shaped tract of land, approximately 17 ha (42 ac) in size. The survey area can be seen on the 1975, USGS, 7.5’, Greenbrier, Alabama topographic quadrangle centered in the S ½ of the SE ¼ of Section 4, and extending north into the SW ¼ of the NW ¼ of the SE ¼ of Section 4, T4S, 3W (Figure 1).

The APE lies within the Tennessee Valley district of the Highland Rim physiographic section of Alabama. The district is described as a “plateau of moderate relief with elevations ranging from 600 to 800 ft (183 to 244 m). Chert belt in north, limestone plain along river” (Sapp and Emplaincourt 1975). Typical to this area are Fort Payne chert variations such as Pickwick, as well as a variety of Bangor chert types.

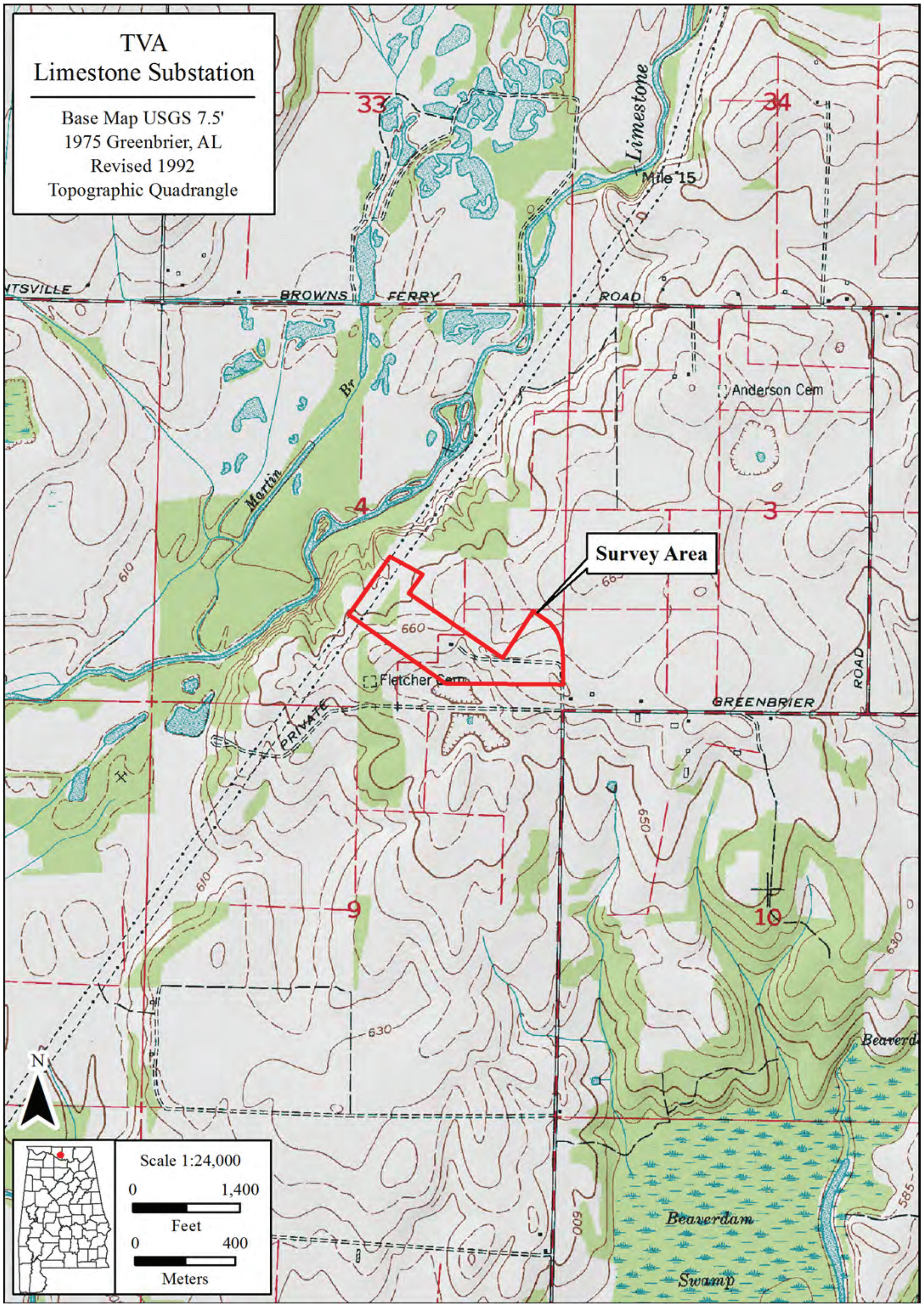


Figure 1. Overview of APE.

The National Cooperative Soil Survey (Soil Survey Staff 2016) for Limestone County, Alabama shows five soil types/associations present within the survey areas (Figure 2). A brief description of each soil, along with a representative soil profile follows (Hasty et al. 1953).

> *Abernathy silt loam, level phase*. This soil occupies mainly basins or depressions in the southeastern, or red lands, part of the county. It is developed from material washed from surrounding soils of high grade limestone. The soil is variable and without distinct layers. In places some variation exists in the depth of the colluvial profile over residual material, and in others are bodies of fine sandy loam. In most places, however, is a 12 inch to 18 inch layer of dark reddish-brown to brown heavy silt loam underlain by a yellowish-brown to reddish-brown heavy silt loam. In many places, at a depth of 24 to 36 inches, is a very dark-colored layer, which was probably the surface soil before the overwash from surrounding land covered it. At a depth of 36 to 48 inches is splotched gray, yellow, and brown silty clay material.
>
> *Decatur silt loam, 2 to 6 percent slope*. Nearly all this well-drained, dark red soil of the red lands is south of the east-west highway through Athens. The towns of Greenbrier, Belle Mina, and Mooresville are on some of the more extensive areas. This soil is derived from high grade limestone of the Tuscumbia (St. Louis and Warsaw) formation. In virgin or unplowed areas the first 5 inches is light brown to reddish-brown friable silt loam that crushes to a granular mass. A considerable content of organic matter is well incorporated with the mineral soil material. From 5 to about 14 inches is a yellowish-red silt loam to silty clay loam of fragmentary or nutlike structure. Below 14 and downward to 30 inches is brownish-red firm silty clay loam of nutlike structure. Extending from 30 to 60 inches is brownish-red to red, firm silty clay, fragmentary in structure, that grades to yellowish-red material at 40 inches. The yellowish-red layer is less firm or compact and it contains a few small chert fragments. In places it may extend downward for several feet, and in others it grades to mottled yellowish-red and gray clay mixed with more chert fragments.
>
> *Decatur silty clay loam, 2 to 6 percent slope*. This well drained dark red soil of the red lands has developed over high-grade limestone, chiefly of the Tuscumbia. (St. Louis and Warsaw) formation, in the southern part of the county. The surface is undulating to gently rolling, the gradient being from 2 to 6 percent. The fairly large separate areas are a part of a smooth landscape that includes Dewey and Abernathy soils and other phases of the Decatur series. All this phase has been eroded, and most of the acreage has lost 50 to 75 percent of the original surface layer. Included also are small severely eroded patches, generally the more sloping parts where the plow layer is almost entirely subsoil material. When typically eroded, the 5 inch to 6 inch plow layer is reddish-brown silty clay loam, a mixture of the original surface soil and the subsoil. Below this is yellowish-red or brownish-red firm silty clay loam or silty clay that has a medium-nut structure. At a depth of about 20 inches the texture is silty clay. A little below this the color is lighter and the consistence a little less firm or compact. Small chert fragments occur below this depth but they are not abundant. Mottled yellowish-red and gray very firm clay mixed with chert is present in places at a depth of 50 inches. Bedrock limestone is 12 to 20 feet below the surface or, in some places, somewhat deeper.
>
> *Decatur silty clay loam, 6 to 10 percent slope, eroded*. A stronger slope is the chief difference between this soil and the (2 to 6 percent) sloping phase. In general, the surface soil is thinner and patches of subsoil are more frequently exposed by erosion. Internal drainage is moderate but runoff is excessive. The soil is distributed through the southern part of the county and is associated with the Dewey and Abernathy soils and with other Decatur phases.
>
> *Dewey-Decatur silty clay loams, severely eroded hilly phase*. Included in this complex are severely eroded hilly areas of Dewey and Decatur soils. The gradient ranges from 12 to 30 percent, and in most places the plow layer consists entirely of subsoil material. The soil profile may have characteristics covering both series or may be predominantly Dewey or Decatur. The variation in characteristics is generally more evident in the complex than it is in areas where it rests on a horizontally bedded high-grade limestone. The Dewy soils differ from

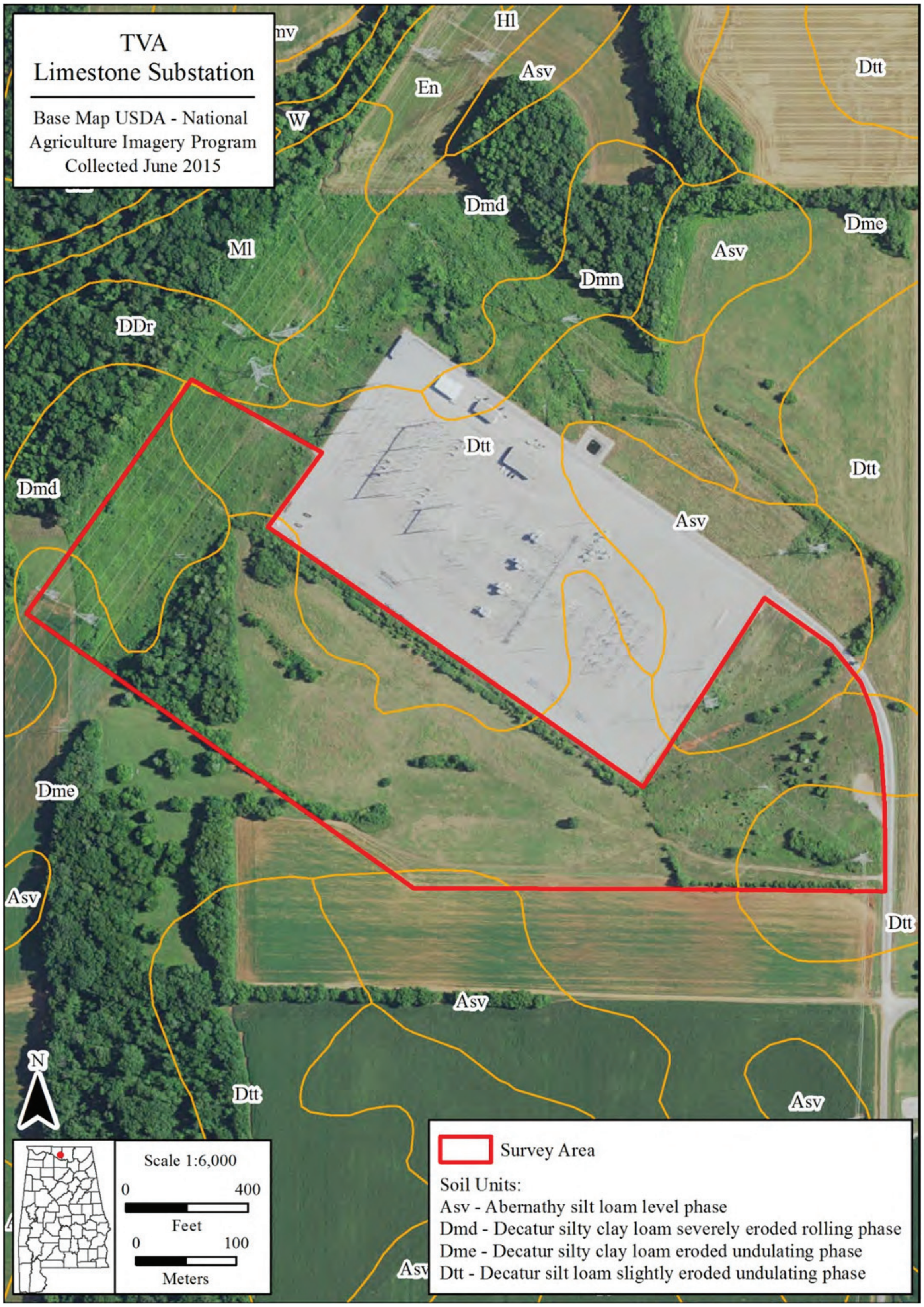


Figure 2. Soil map of APE.

the Decatur soils in having a browner surface layer, and being more friable throughout, and having a less tight and not so intensely red subsoil. Like the Decatur, they are underlain by high-grade limestone. In undisturbed areasthe surface soil is mellow brown or light brown silt loam to a depth of 8 to 12 inches. The subsoil is yellowish-red friable silty clay or silty clay loam; its depth varies from 8 to 20 feet or more, the average being between 12 and 15 feet. The parent material underlying the soil is dense or tough silty clay that is dominantly yellow but splotched with brown, ocher, and gray. Like much of the Decatur soil, the Dewey has in places eroded under cultivation, and in these the present surface soil tends to be brownish red. There are practically no limestone outcrops.

The terrain in the APE is rolling upland, ranging in elevation from a low of 640 ft AMSL along the northwest border, to a high of 670 in the far southeast corner along the substation entrance road. The eastern area of the APE is noticeably higher in elevation and a portion of it along the substation entrance road has been previously impacted by placement of a deep layer of gravel. A local resident noted this area had been utilized as a staging area for heavy equipment and temporary housing utilized after a tornado caused significant damage to the station and transmission lines a few years ago. Two utility roads extend west from the substation entrance road into the interior of the APE. Near the south border of the APE, one of the roads is an unimproved farm road, leading out to the agricultural fields. Further north is a second road, gravel covered, and leads out to a now nonexistent structure depicted on the topographic map (Figure 1). At the northern edge of the rise, just north of the roadbed, is a gravel bordered, channelized drainage, which extends out to the north, into an area of lower lying terrain. Along the southern border of the APE is a large, active agricultural field, recently plowed. A large sinkhole is depicted directly along the southern border of the APE in the field. This sinkhole has apparently been filled in, as no evidence of it was noted during the field survey in that area of the APE.

The APE itself is set in a fallow field, with a vegetative cover of wild grasses weeds, and briars. A scatter of isolated, immature privet, evergreen and cedar trees are present in the field. In the northwest is a small wooded tract primarily comprised of hardwoods. This wooded area was found to be low lying, with evidence of periodic flooding. Further to the northwest, the APE extends out partially across a transmission line right of way, which forms the western border. To the north of the APE stands the existing substation, with the entrance road to the substation forming the east border.

Cultural Chronology

The forest landscape known by the prehistoric residents of the region has changed significantly over the span of human occupation. The pollen records from Anderson Pond and Mingo Pond, both near the eastern margin of the Highland Rim in east-central Tennessee (Delcourt 1978) as well as those from the Blue Ridge of Southwestern Virginia (Whittecar et al. 2007) and northwest Georgia (Watts 1970) reveal a series of climatic shifts and subsequent changes in the arboreal assemblages. Between 23,000 and 14,500 B.C. a tundra zone was present bordering the glacial margin of the lower elevations of the Appalachian Mountains. Arboreal coniferous forests of spruce (Picea sp.), jack pine (Pinus banksiana), and fir (Abies sp.) extended as far south as 34 degrees north latitude. Similar conditions are reported for the Blue Ridge in southwestern Virginia where spruce dominated the mountain slopes and the drainage bottoms and wetlands included sedge (*Carex* sp.), buttercup (*Ranunculus* sp.), thimble berry (*Rubus parviflorus*), grasses (*Gramineae*), pond weed (*Potamogeton* sp.), and peat moss (*Sphaagnum*) (Whittecar et al. 2007). East of the Appalachians a high proportion of cool climate pines and the presence of prairie herbs suggest more open woodlands (Adams 1997; Watts 1970, 1980).

Beginning around 14,500 B.C., mixed coniferous and deciduous forests became more prevalent and by 12,000 B.C., hemlock and chestnut were abundant, as was oak, pine, hickory, and spruce. By the early Holocene, from 10,500 to 6000 B.C., a cool temperature mixed mesic forest prevailed throughout the region between 34 and 37 degrees north latitude (Delcourt 1978). During the warmer and dryer Hypsithermal Interval, the mesic forests diminished and xeric forests, dominated by oak, hickory (*Carya* sp.), and ash (*Fraxinus* sp.) were established.

Following the Hypsithermal, the ecosystem of the Midsouth came to include vegetation resembling modern forests, with an increase in coniferous pines (*Pinus* sp.) resulting from an increased dominance of the tropical maritime air mass rising from the Gulf of Mexico and abundant year-round precipitation (Delcourt 1978).

Paleoindian Stage (11,500 B.C.- 8500 B.C.)

The earliest people to occupy the region are often referred to as small, highly mobile bands of hunter-gatherers. These were exceedingly adaptive groups capable of a sustained nomadic lifestyle that centered on the exploitation of a variety of environments and resources. While in the past, many archaeologists have emphasized the "big-game hunter" perception with a reliance on mega-fauna, we are now becoming more aware of their dependence on a wide range of small animals and plant foods (Chapman 1994; Fagan 2004; Hollenbach 2004; McNutt et al. 1975; Walthall 1980).

During the Paleoindian Stage, sea levels were meters below their current elevations. In the Gulf Coastal region and Atlantic Seaboard, where terrain is relatively level, elevation variation is minimal, and subsidence of former headlands is known, the continental shelf is miles from current shorelines. The lower sea levels would have provided for the exposure of massive tracts of land, now identified as submerged near shore facies.

Several sites in coastal areas have been found in inundated contexts, such as Little Salt Springs and the *Bison antiquus* kill site in the Wacissa River in Florida (Anderson et al. 1996; Walker 2000; Webb et al. 1984). These sites provide direct evidence for interaction of Pleistocene fauna and Paleoindian peoples within areas now under water. However, the perception of the early occupants of the Midsouth as subsisting on megafauna is highly improbable. Mammoths, and the more prevalent mastodon, and giant ground sloth were present in the region, but a diet based on the consumption of these large mammals is unlikely (Chapman 1994; Fagan 2004).

At the end of the Pleistocene, vegetation throughout the Midsouth was shifting from patchy boreal forest/parkland environments to mesic oak-hickory forests believed to have been firmly established by about 8,000 B.C. (Anderson and O'Steen 1992; Anderson et al. 1996). These environments would have provided a much more diverse resource base than that available in the previous 13,000 years. Throughout most of the eastern United States, Paleoindian occupations are limited to scattered sites, generally identified by isolated, fluted-point surface finds. Changing hydrologic regimes associated with the glacial retreat and increased precipitation at the end of the Pleistocene probably destroyed and deeply buried many of the Paleoindian sites along river valleys. Deeply buried sites on the Cumberland River, such as the Johnson-Hawkins site (40DV313) near Nashville and the Puckett site (40SW228) in north-central Tennessee, tend to corroborate this suggestion (Broster and Norton 1996).

The most common diagnostic artifacts of the Paleoindian stage are the lanceolate-shaped or auriculate, fluted and unfluted, basally ground, points such as Clovis, Cumberland, and Redstone types. The Paleoindian tool kit also includes some bifacial and unifacial tools that have been found in asso-

ciation with Clovis projectile points (Williams 1957).

The Paleoindian stage is broken into three, often arbitrarily assigned, periods, Early (circa 10,500 B.C. to 8900 B.C.), Middle (circa 8900 B.C. to 8500 B.C.), and Late (circa 8500 B.C. to 8000 B.C.) (Anderson et al. 1996). Environmentally, the stage marks the end of the Late Glacial era when sea levels were rising and the Gulf shoreline was transgressing towards its present position.

Paleoindian occupations in the Middle Tennessee River Valley, tend to be relatively small and scattered. Noting this, Walthall (1980:35), among others (Anderson and Sassaman 1996; Cable 1996; Johnson 1992:182–202; Kelly and Todd 1988), speculates a pattern of nomadism requiring frequent relocation, facilitating a hunting and foraging economy. Low population density, evidenced archaeologically by sparse surface scatters, would have resulted from the sparse settlement patterns of the nomadic groups. Kelly and Todd (1988:231) suggest a lifeway dependent upon hunting with a high degree of residential mobility (Meeks 1997).

Futato (1982:32) suggests a slightly different settlement pattern based on seasonal movement between upland and lowland areas. Anderson (1996) leans towards yet another model which would hold closely with Kelly and Todd's (1988), except that once these highly mobile groups entered a new area extremely rich in resources, they would have quickly adapted procurement strategies coordinating staging areas within their often extensive territories. The majority of current models (Anderson 1996; Anderson and Hanson 1988) tend to support drainage-based settlement patterns, where band-level groups moved relatively freely up and down a given drainage exploiting certain subsistence resources. These movements likely included only seasonal or limited macroband aggregations facilitating breeding and thus social networks. Daniel (2001:258) suggests that in addition to subsistence resources, lithic resources served as a primary factor in settlement patterns during the Late Pleistocene, promoting not only intra-drainage movement but also cross-drainage interaction within an "aggregation range." O'Steen (1996) also suggests that the availability of stone raw material played a major role in the movement of individuals within and across drainage basins. This is evidenced in the Middle Tennessee Valley by the preference for blue gray Fort Payne chert away from any locally available source.

The occurrences of sites exhibiting fluted points made of exotic raw materials suggest that Paleoindian groups were highly mobile and had large territories or range sizes. These groups incorporated lithic raw material sources in their seasonal rounds and maintained a curated tool kit while away from the source areas.

For the Early Paleoindian period, several types of Clovis sites have been identified, including small camps or habitation sites, quarries, kills, and larger aggregation sites. The difference between the Early, Middle, and Late Paleoindian can be seen artifactually in the shift from Clovis, to Redstone and Cumberland, to Quad and Beaver Lake, to the transitional Dalton point types respectively. In turn, the raw materials utilized for these gradually shifted from predominantly non-local cherts to a greater dependence on locally available stone resources. The increased number of sites with Dalton and even later side-notched points suggests an increase in population density and possibly societal constraints on access to some of the earlier, preferred raw material sources, or possibly an increasing familiarity with the locally available resources.

Paleoindian occupation of the Middle Tennessee River drainage has resulted in one of the densest concentrations of Paleoindian artifacts in North America (Futato 1996). The problem facing our understanding of these occupations is the limited number of controlled excavations of intact sites. The majority of Early Paleoindi-

an period sites are open air occupations identified within plowed and subsequently deflated fields, such as the Belle Mina site, or along eroded shorelines, such as the Quad site. Only at certain sites, namely bluff shelters and caves such as Stanfield Worley, Flint Creek Rock Shelter, Cave Springs Cave, Russell Cave, and Dust Cave, have intact deposits been encountered (Cambron and Waters 1959, 1961; DeJarnette et al. 1962; Driskell 1994; Goldman-Finn 1994; Walker 2000). These sites include occupations dating to the transition between the end of the Late Paleoindian and subsequent Early Archaic, namely the Dalton horizon.

Archaic Stage (8500 B.C.-900 B.C.)

The Archaic stage is marked by a shift in material culture, undoubtedly associated with changes in the ecological setting of the region. With the end of the Pleistocene, the last of the North American megafauna reached extinction. The forest environment north of 33 degrees latitude shifted to mixed hardwoods of the mesic forest (Anderson and O'Steen 1992; Anderson et al. 1996). The result was a shift in exploitable faunal and floral resources. Faunal remains from Stanfield-Worley bluff shelter and Russell Cave indicate white-tailed deer and turkey were the two major sources of meat. Squirrel remains were the most common species identified with raccoon and box turtle rounding out the list of the most commonly found animal remains (Chapman 1985; Futato 1983; Parmalee 1962; Weigel et al. 1974).

Hickory and acorn nuts were the most common plant remains from these sites as well. The changes in available food resources were reflected by shifts in material culture and settlement patterns. A slightly more sedentary lifestyle is evidenced in the archaeological record by larger, more densely occupied sites. The Archaic stage has been divided into three periods: Early (circa 8500 B.C.–6000 B.C.), Middle (circa 6000 B.C.–4000 B.C.), and Late (circa 4000 B.C.–1000 B.C.).

Early Archaic Period

The Early Archaic period coincides with the initiation of the Holocene epoch in the Southeast. Differing, sometimes imperceptibly, from Late Paleoindian period occupation trends, the seasonal dichotomy model has been promoted for much of the middle and lower Southeast. Anderson and Hanson (1988) elaborate on this model suggesting that social organization included band and macroband-level social systems. At the band level, groups of roughly 50 to 150 individuals would have been responsible for seasonal movements within a single drainage basin with some migration into portions of surrounding drainages. At selected seasonal intervals, gatherings of 500 to 1,500 people would have occurred, facilitating mating networks and economic and social interaction (Anderson 1996).

Early Archaic occupation within the Middle Tennessee River Valley continues to suggest a concentration of prehistoric peoples following the end of the Pleistocene. A pattern of occupation, similar to that suggested by Futato (1982) and Hubbert (1989) for the Paleoindian stage, is also suggested for the Early Archaic period. This pattern, based on seasonal habitation of upland and lowland areas, would have mirrored the seasonal availability of exploitable resources. These changes can be identified in the number of sites in both riverine and upland contexts and the density of artifacts. The chronological organization of data from Archaic complexes is the result of excavations of buried deposits in cave and rockshelter sites (DeJarnette et al. 1962; Driskell 1992; 1994; Griffin 1974), well stratified open air sites predominantly situated in riverine environments (Cable 1996; Chapman 1977; Davis 1990; Lewis and Lewis 1961), and surface collections from throughout the Southeast.

Evidence for the Early Archaic diet shows wide variability evidenced by the range of stone implements and faunal and ethnobotanical remains recovered from these sites. Grinding stones, butchering, and hide-

working tools suggest a diversified subsistence pattern that included deer, bear, turkey, raccoon, squirrel, and opossum. Faunal remains from Dust Cave indicate a shift from a Late Paleoindian exploitation pattern heavy on the hunting of avifauna, including passenger pigeon and waterfowl, to a greater reliance on fish and terrestrial mammals during the Early Archaic (Walker 2000). Hickory nuts, acorns, and other nuts were increasingly exploited throughout the period as well (Chapman 1994:43-46; Yarnell and Black 1985). Hollenbach (2004, 2005a, 2005b) completed ethnobotanical analysis of five sites in northwest Alabama. Her examination of the transition between Late Paleoindian and Early Archaic shows relatively little change in the plant foods utilized from one period to the next. Instead, she has highlighted the use of certain sites within different environments for specialized resource acquisition, including acorn, hickory, hazel, chestnut, and various fruits and seeds. The diagnostic artifacts for the Early Archaic include Kirk Corner Notched, Decatur, St. Albans Side Notched, LeCroy Bifurcated Stemmed, and Kanawha Stemmed projectile points. Pitted cobbles, unifacial (thumbnail) scrapers, and drills are also frequently associated with Early Archaic components (Chapman 1994:38-41).

Middle Archaic Period

The Middle Archaic period (6500 B.C.-3000 B.C.) in the Middle Tennessee River Valley coincided with the Mid-Holocene, Hypsithermal or Altithermal Interval, a time of warmer temperatures and drier conditions in the mid-continent. The Hypsithermal (approximately 6000 B.C.-2000 B.C.) considerably altered the environment and likely influenced the settlement and procurement strategies of people living in the region. It was during the Middle Archaic that the massive shell middens along the middle Tennessee River began to appear.

By 4000 B.C., major environmental changes had taken place across the Southeast. The effects of the Hypsithermal are noted from pollen data collected in St. Clair County, Alabama; Georgia; Coastal Alabama; and the Tennessee River Valley. The oak-hickory, mixed hardwood, and mixed-oak hickory and southern pine forests were firmly developed across the area (Delcourt et al. 1983). Even with the changing environment, increased populations evidenced by site density, suggest increased settlement pressures resulting in greater social stress factors. Walthall (1980:57-58) suggests an increase in territorialism and provincial diversity as environments evolved into modern regional patterns.

Atlatl weights appeared for the first time and gave conclusive evidence for the use of the atlatl or spear thrower. Stone net sinkers have been found in the archaeological record and suggest new technologies for fishing (Chapman 1977; Davis 1990). The use of arboreal seed crops remains consistent with that of the Early Archaic period with preserved walnuts often recovered in the botanical record (Chapman 1977:125; Lewis and Lewis 1961:40-43).

Middle Archaic diagnostic projectile points are the Kirk Stemmed, Stanly Stemmed, Morrow Mountain, Halifax Side Notched, Benton, and Sykes/White Springs types (Chapman 1994:49-50; Davis 1990; Kimball 1985:276; Kneberg 1957; Meeks 2000). Container technology includes the advent of stone bowls, often found great distances from the raw material sources. Most of these vessels are made of soapstone, a metamorphic talc found in the eastern face of the Appalachians, particularly in the Piedmont areas of Tennessee, North Carolina, Georgia, and Alabama (Webb and DeJarnette 1942; Wells 2006). Concentrations of steatite bowls in the archaeological record occur as far away as Louisiana and southern Florida (Sassaman 1993; Truncer 2004). The long transport required underscores the importance of extensive trade networks that appeared during the Middle Archaic. These large interaction spheres are also highlighted by the similarity in ceremonialism over broad areas. Complex mortuary practices involving specialized grave goods

such as the large, finely chipped Benton point and blade caches found with burials of the Benton Mortuary Complex; the presence of red ochre; and other "killed" artifacts, such as burned bifaces, found with human interments show similar belief systems integrated into the archaeological record of sites across the Midsouth (Futato 1983; Meeks 2000:36-38).

For the portion of the Middle Tennessee Valley that includes much of Pickwick and lower Wilson Lakes, the Seven Mile Island phase (Futato 1983) has been defined. Futato (1983:417-419) originally subsumed this phase under the Late Archaic period, but it was later pushed back to the Middle Archaic when the date range for Seven Mile Island phase components was found to be between 4500 B.C. and 3600 B.C. (Driskell 1994). Diagnostic artifacts for the Seven Mile Island phase include Benton and Sykes/White Springs cluster projectile points (Meeks 1994). The phase is likely related to the Walnut phase in the upper Tombigbee River drainage where Benton points were also collected (Bense 1983; Futato 1983).

Late Archaic Period

The Late Archaic period (3000 B.C.-900 B.C.) was a time of a rapid population increase resulting in larger and more numerous sites. Chapman (1985:150) refers to Late Archaic sites as "widespread and frequent." Sites interpreted as single-family occupations along the first river terraces are manifested by rock-filled firepits. Larger, multi-family sites, represented by a denser pattern of these firepits, suggest these sites were established on a relatively long-term basis (Chapman 1994:51-53). By the beginning of the Late Archaic, modern climatic conditions were well established. The period is marked by a continued increase in population and evidence for social institutions, more stable settlement patterns, and increased trade interaction. Evidence for increased sedentism is noted by larger sites, such as shell middens with denser occupation deposits (Futato and Solis 1983). Social institutions and ceremonialism are noted with the appearance of monumental architecture in portions of the Southeast and the inclusion of grave goods. The increase in non-local artifacts at large sites hints at regional interaction and trade of material goods.

It is during this time that exploitation of environments became even more specialized with large shell middens appearing along many of the major rivers and increasing harvest of white tailed deer. Hickory nuts continued to dominate the plant remains of Late Archaic sites, but a gradual shift is noted throughout much of the Midsouth and Southeast. Large storage pits filled with nut shells are known from terminal Archaic sites in the Tennessee Valley and Highland Rim (Bentz 1996; Crites 1996; Futato 1983; Oakley 1975). Again, hickory nut dominates the plant remains found in these pits. However, plant remains from the Tennessee Valley, the Cumberland Plateau in eastern Kentucky, and the Coastal Plain suggest that by the Late Archaic the cultivation of at least some seed crops, including sunflower, maygrass, chenopod, and gourd, namely Cucurbita, had occurred (Chapman and Shea 1981; Chapman et al. 1982; Chapman and Watson 1993; Gremillion 1996, 2004; Yarnell 1993; Yarnell and Black 1985). Besides stone vessels and projectile points, stone tool technology of the Late Archaic also included grooved axes and limestone digging implements. Long distance trade is seen in the archaeological record by the presence of non-local artifacts, such as marine shell, copper, and greenstone (Chapman 1994:51-53; Lewis and Kneberg 1958:34).

In the Middle Tennessee Valley, several relatively large, stemmed, hafted, biface types, including Ledbetter, Wade, and Little Bear Creek (Cambron and Hulse 1975; Futato 1983; Little et al. 1997), serve as hallmarks of the Late Archaic material culture. They also serve as markers for the Ledbetter horizon (3000 B.C.-1000 B.C.), the Little Bear Creek horizon (2000 B.C.-1000 B.C.), and the Wade horizon (1700 B.C.-1000 B.C.). Typical Ledbetter horizon

diagnostics include Ledbetter, Pickwick, Mulberry Creek, and Maples points. The Little Bear Creek horizon is marked by the presence of Little Bear Creek points. The terminal Late Archaic period, Wade horizon is typified by Wade, Limestone, and Cotaco Creek points. In southcentral Tennessee and northern Alabama, the Lauderdale culture has been loosely defined by Walthall (1980) and discussed by Krause (1988). Oakley and Futato (1975:102-108) defined the Perry phase as the last preceramic phase of the Late Archaic period. The phase is named for the Perry site (1Lu25) on the east end of Seven Mile Island on Pickwick Lake and is characterized by Little Bear Creek and Flint Creek projectile points. The end of the phase is marked by the appearance of the Wheeler series ceramics in the Pickwick Lake area.

Potential influence from the Poverty Point culture has been suggested for portions of the Middle Tennessee Valley. The presence of steatite vessels within the Wheeler Basin, far from the source area of the raw material in the Piedmont, and the distribution of sandstone bowls likely manufactured in the Basin and distributed as far west as Poverty Point, has been associated with extensive trade networks that spanned the area from western Georgia to northeast Louisiana (Ford and Webb 1956; Newman and Berryman 2003; Sassaman 1993; Wells 2006).

The Late Archaic period marks the end of the Archaic stage and the preceramic occupation of the Southeast. By the end of the Archaic, the environment had again shifted. The Late Holocene environment had fluctuated throughout the Archaic and by the terminal Late Archaic had reached a warmer and wetter trend. Populations within the middle Tennessee River Valley were on the rise, with new areas, previously avoided, being occupied and the number of sites identified with Late Archaic components showing a marked increase from the previous periods (Chapman 1994; Meeks 2003).

Gulf Formational Stage (2500 B.C.-100 B.C.)

The Gulf Formational stage is geographically limited to the Atlantic Coastal Plain of South Carolina, Georgia, and Florida, and the Gulf Coast states of Alabama, Mississippi, and Louisiana. This stage has also been recognized as far north as west Tennessee. The hallmark for the stage is the appearance of early fiber and sand-tempered pottery, the earliest of which appears to be the fiber-tempered, Stallings series from the Savannah River drainage (Sassaman 1993). Walthall and Jenkins (1976) argue that the appearance of fiber-tempered ceramics originated in the east and moved west over time. Rather than follow the trend of referring to the appearance of ceramics as marking the Woodland Stage (Griffin 1952; Hudson 1976), they proposed the term Gulf Formational to differentiate the early fiber-tempered vessels and subsequent sand-tempered wares of the Gulf Coast region from slightly later ceramic traditions from nearby areas (Jenkins et al. 1986; Walthall 1980).

Middle Gulf Formation Period

The Gulf Formational stage is divided into the Early (circa 2500 B.C.-1200 B.C.), Middle (circa 1200 B.C.-500 B.C.), and Late (circa 500 B.C.-100 B.C.) periods. The Early Gulf Formational period occurs along the Atlantic coast and likely began with the Stallings Island pottery (Walthall and Jenkins 1976; Sassaman 1993). In the western Middle Tennessee Valley, the earliest pottery is found in the Pickwick Basin during the Middle Gulf Formational period. The fiber-tempered Wheeler pottery of the Bluff Creek phase appears first in the western portion of the Basin and moves out towards the Wheeler and Guntersville Basins. The lithic technology associated with the Bluff Creek phase includes the typical Late Archaic point types of Little Bear Creek, Wade, and Cotaco Creek.

Late Gulf Formational Period

The Late Gulf Formational period is differentiated based on the appearance of sand-tempered pottery. The sand-tempered Alexander ceramics of the Hardin phase occur throughout the Tennessee River Valley. Graham (1966) reports Alexander ceramics from several sites within the H. Neely Henry Lake area in the Coosa drainage to the southeast and O'Hear (1990) has identified Alexander pottery throughout the upper Tombigbee drainage to the west. Rather than include Alexander in the Late Gulf Formational, Knight (1998:190-191) incorporates these pottery types within the Early Woodland. His logic is based on the fact that the Gulf Formational stage does not represent a drastic change in prehistoric economics, but rather an early pottery tradition. Since no other pottery tradition is given the status of marking the change of stages, he suggests that the Gulf Formational should be subsumed into the Woodland stage.

Dye (1980) assigned the Hardin phase to the Late Gulf Formational occupations of the western Middle Tennessee Valley. An uncalibrated radiocarbon date from the sealed Late Gulf Formational component at the Sakti-Chaha site in Hardin County, Tennessee places the occupation at 400 ± 80 B.C. (Dye and Galm 1986). To the south in the Tombigbee River drainage, Jenkins (1982) identified the Henson Springs phase based on small transitory camps. Further to the east in the Coosa Valley, Walling and Schrader (1983) defined the Dry Branch phase.

Besides the appearance of pottery, Gulf Formational stage occupations are very much consistent with the Late Archaic traditions of the Middle Tennessee Valley. In some instances, fiber-tempered pottery has been found in the same stratified midden context as steatite vessels (Gage et al. 2003), suggesting a temporal and spatial overlap of the different container technologies.

Gulf Formational component sites tend to center around riverine and swampy environments. By the Late Gulf Formational, more permanent occupations are evidenced by the presence of large, often bell shaped, storage pits. These pits were also used for interments of both cremated and flexed burials. The trend towards these types of environments and the presence of large storage pits may correspond with the onset of the Subatlantic period and colder drier conditions.

Woodland Stage (900 B.C.-A.D. 900)

In the Middle Tennessee Valley, the advent of pottery marks the beginning of the Woodland stage. Tempering agents, surface treatments, and vessel forms serve as temporal indicators throughout the Woodland. Settlement patterns indicated by the archaeological record reveal a more sedentary lifestyle with increased dependence on horticulture. The Woodland is broken into Early (circa 600 B.C.-400 B.C.), Middle (circa 400 B.C.-A.D. 500), and Late (circa A.D. 500-A.D. 900).

Early Woodland Period

The conglomeration of cultural and chronological divisions of the Woodland stage is dependent on regional attributes (Brown 1986). The temporal overlap with the Late Gulf Formational period includes approximately 800 years and a regional boundary that separates the east and west Middle Tennessee Valley occupations. The Late Gulf Formational period Alexander culture of the western Middle Tennessee Valley appears contemporaneous with the Early Woodland period Colbert I phase of the eastern Middle Tennessee Valley (Futato 1998). The artifactual difference between the two is the appearance of limestone-tempered Long Branch Fabric Marked pottery in Colbert I phase assemblages. Interestingly, the Late Gulf Formational/Early Woodland boundary (Futato 1998; Walthall 1980) lies in a similar area to that represented by the Late Archaic steatite and Gulf Formational fiber-tempered pottery (Sassaman 1993). This area is Green Mountain,

which is located at the confluence of the Flint and Tennessee Rivers in Madison County, Alabama. The implication is that the ceramic boundary is a direct consequence of a cultural boundary. However, the similarities in some aspects of cultural components from each side of the boundary suggest that this interpretation is much too simplistic to explain the social interactions of the time.

Based on excavations at Camp Creek (Lewis and Kneberg 1957:5), Phipps Bend (Lafferty 1981), and Site 40RE108 (Schroedl 1990:75-77), Woodland subsistence was largely based on white-tailed deer, elk, bear, turkey, raccoon, beaver, and squirrel accompanied by turtles, mollusks, and fish. Nut crops such as acorn, hickory, and walnut were widely exploited. Horticulture was still practiced on a limited basis and some sites produced no cultigens at all (Schroedl 1990:90- 91).

Middle Woodland Period

Again, larger villages and associated middens, as well as monumental architecture and localized artifact assemblages, point to an increase in sedentism throughout the Southeast. Horticulture had become firmly established with small grains being a major diet component (Yarnell and Black 1985). Pan-regional interaction is evident from the trade items brought from the upper Midwest, Atlantic Coastal region, and the Gulf Coast (Walthall 1980). Cranial deformation, nonlocal burial goods, and monumental architecture highlight the intricate ceremonialism associated with the Middle Woodland.

The Middle Woodland period in the Middle Tennessee Valley includes an extremely diverse set of pottery types. The diversity highlights the development of local assemblages with extensive regional interaction (Futato 1998). In the eastern portion of the Wheeler Basin, the Colbert II culture assemblage (300 B.C.-100 B.C.) is dominated by Long Branch Fabric Marked pottery with lesser amounts of Wright Check Stamped. Knight proposed the Green Mountain phase (100 B.C.-A.D. 100) for the area near Hobbs Island. The assemblage includes a majority of Mulberry Creek Plain and lesser amounts of Long Branch Fabric Marked and minor amounts of Pickwick Complicated Stamped and Bluff Creek Simple Stamped (Futato 1998; Heimlich 1952; Knight 1998). The Walling phase (A.D. 100–A.D. 350) followed and includes the most diversified set of types for the period. Mulberry Creek Plain continued as the dominant type, but Flint River Cord Marked became more prevalent with a wide range of other types being found in minor amounts (Knight 1998). The final phase for the region's Middle Woodland period is Bell Hill (A.D. 350-A.D. 500). It is much like Walling in the dominance of Mulberry Creek Plain, but decorated pottery became even less prevalent. In addition, the projectile point types shift from the broad, lanceolate Greeneville cluster and Upper Valley cluster to the Lanceolate Spike cluster (Futato 1983, 1998).

Further to the west in the Pickwick Basin, the initial Middle Woodland occupations are assigned to the end of the Colbert horizon (400 B.C.-100 B.C.). The difference between it and the slightly later assemblages in the Wheeler Basin is the inclusion of Mulberry Creek Plain as well as Long Branch Fabric Marked as the dominant pottery types (Futato 1983, 1998; Jenkins 1981; Jenkins and Krause 1986).

The Colbert II culture and the overall Middle Woodland period in the Middle Tennessee Valley correspond with the Copena Mortuary Complex extending from the Pickwick Basin in the west to Guntersville Basin in the east (Cole 1981). Copena was coined by Webb (1939:201) to refer to a focus of the Hopewellian Phase in which burials were often accompanied by copper and galena artifacts. These burials appear in caves and mound contexts throughout the Middle Tennessee Valley.

Late Woodland Period

The Late Woodland in the Middle Tennessee Valley is divided into two phases: the end of the McKelvey I phase and McKelvey II phase and a single culture isolated to the eastern portion of the Wheeler Basin (the Flint River culture). Again, the McKelvey I and II phases are marked by the appearance of grog (clay-grit)-tempered Baytown Plain, var. McKelvey ceramics and include relatively large proportions of Mulberry Creek Cord Marked (Futato 1998; Knight 1990). McKelvey II assemblages are virtually identical to those of Miller III in the Tombigbee drainage. The Flint River culture's ceramic assemblage is dominated by Mulberry Creek Plain and Flint River Brushed. Diagnostic lithic artifacts from the Late Woodland include a shift to smaller projectile points such as Hamilton and Madison. To the west Late Woodland occupations are assigned to McKelvey I (Walthall 1980). It includes McKelvey Plain and Mulberry Creek Cord Marked ceramics, both of which are grog tempered. In recent years McKelvey Plain has come to be identified as Baytown Plain, var. McKelvey (Futato 1998) as the type is virtually indistinguishable from Baytown Plain. Its identification, as compared to Baytown Plain, is limited to north Alabama and the Tennessee Valley.

Settlement patterns continued to focus on riverine habitation sites with permanent villages located along rivers and creeks (Johannessen 1993). Upland sites are dominated by temporary hunting camps (Walthall 1980). Much emphasis has been placed on shellfish procurement during the Woodland stage (Peacock 2002), in particular during the end of the Middle and beginning of the Late Woodland. In the Middle Tennessee Valley, the number of sites with both Middle and Late Woodland components suggests a continuity of existing lifeways. However, an increase in single-component, Late Woodland sites in different environmental contexts points to a potential diversification of the resource base. What is more, the environmental changes that occurred during the Late Woodland, corresponding to the cooling trend of the Dark Ages Cold Period (Meeks 2003), supports the need for the ever increasing Late Woodland population to have sought new food sources and broaden their subsistence base.

Mississippian Stage (A.D. 900-A.D. 1600)

The Mississippian stage is marked by a distinct shift in political, social, and general cultural conditions in the Southeast. The foundation for Mississippian society is believed to have its source in the Mississippi Valley, but quickly spread east and incorporated local variations. Walthall (1980:185-245) provides a summary of the Mississippian stage for Alabama and portions of the surrounding region. Pottery with shell tempering appeared; small, triangular points (Hamilton and Madison types) were prevalent; and floodplain horticulture centered on the triad of maize, beans, and squash was practiced. The construction of massive ceremonial centers, such as Cahokia and Moundville, occurred and ceremonialism, incorporating aspects of horticulturalism, was practiced. As with the preceding stages, the Mississippian is divided into Early (roughly A.D. 900-A.D. 1100), Middle (roughly A.D. 1100-A.D. 1400), and Late (roughly A.D. 1400-A.D. 1600) periods, each with a variety of regional phases.

Early Mississippian Period

In the Middle Tennessee Valley, the only Early Mississippian components are assigned to the Langston phase. Defined for sites in Guntersville Basin (Krause 1988; Walthall 1980), but having a few recently recognized components as far west as the Pickwick Basin (Futato 1998), the phase is identified by the presence of shell-tempered, plain vessels (Mississippi Plain) often with loop or narrow strap handles, as well as the salt pan wares of Kimmswick Fabric Impressed, var. Langston (Futato 1998:226; Knight 1990). Langston phase sites have been found on high ground and include mounds and associated villages with both single-set post and wall trench with open

corner structures. A stockade, complete with protected entry way and bastions was also present at the Gunters Landing site. Inside the stockade was a large, multi-construction episode, temple mound (Walthall 1980:201-205).

The interaction of the Langston phase inhabitants of the Middle Tennessee Valley with the Hiwassee Island phase of eastern Tennessee is highlighted by the presence of Hiwassee Island Complicated Stamped and Hiwassee Island Red-on-Buff. Indications of contact with Moundville include Moundville Incised and Bell Plain, var. Hale (Futato 1998:226)

Middle (Mature) to Late Mississippian Periods

In the Middle Tennessee Valley, the Mature Mississippian refers to both the Middle (A.D. 1200-A.D. 1400) and Late (A.D. 1400-A.D. 1550) Mississippian defined in the Upper Tennessee River Valley, as the two have yet to be distinguished (Futato 1998:227; Walthall 1980). Mississippian mound sites dot the landscape of the Middle Tennessee Valley, and three phases are now recognized for the Mature Mississippian.

The Kogers Island phase includes single-set, post architecture and single or multiple-mound sites with associated villages on islands (Webb and DeJarnette 1942; Walthall 1980). Although identifiable relation to Moundville is evidenced by several common motifs, Walthall (1980:228-229) suggests that the Kogers Island phase assemblages reflect a closer tie to the Mississippian groups of the Tennessee Cumberland region.

The Hobbs Island phase (Walthall 1980) is concentrated in the central portion of the Wheeler Basin, from Tick Island in the west, to the Flint River and Painted Bluff in the east (Gage and Marcoux 2004). Similar to the Kogers Island phase of the Pickwick Basin, the Hobbs Island phase is also dominated by Mississippi Plain with lesser amounts of decorated wares including Nashville Negative Painted bottles (Gage and Marcoux 2004). The type site for the phase is Hobbs Island, an island just downstream from the mouth of the Flint River. Excavated by the WPA in the 1930s, the island included two burial mounds, a larger platform mound, and an associated village. Similar sites with platform mounds and/or associated platform mounds appear at other sites including Walling II (1Ma31) (Gage and Marcoux 2004) and Tick Island (1La13). Again, the relationship between the Moundville variant and the Hobbs Island phase is evident in the motifs on several Hobbs Island phase vessels, including Moundville Incised, var. Snows Bend and Bell Plain. A single carbon date has been recovered from a Hobbs Island phase site. A date was obtained from a central support post from the Walling II site of cal. A.D. 1070-A.D. 1275.

Protohistoric to Historic

Dramatic shifts occur in regional populations that mark the decline of Mississippian occupation of the western and central portions of the Middle Tennessee Valley by A.D. 1600. To the east in the Ridge and Valley of eastern Tennessee, the shift from the Mississippian to the Historic Cherokee includes local variability within an overarching regional culture.

Ethnographic accounts identify the various tribes, namely the Cherokee in the Ridge and Valley including the Eastern (Upper) Tennessee Valley and the Chickasaw in the Middle and Western Tennessee Valley (Swanton 1979). The first European incursion into the region was the expedition of Hernando DeSoto in 1539 followed twenty years later, in 1559, by an expedition of soldiers dispatched from the Spanish Colony on the Alabama River by Tristan de Luna (Clayton et al. 1993; Hudson 1976; Walthall 1980). While DeSoto's expedition entered the Hiwasssee River and worked their way downstream into the Guntersville Basin, de Luna's forces came north through the Coosa Valley and into the eastern portion of the Middle Tennessee Valley (Hudson 1976).

Within the region, the historically documented tribes occupying the Middle Tennessee Valley, the Ridge and Valley, and the Appalachian Summit include the Chickasaw, Creek, Shawnee, Natchez, and Cherokee. In the Pickwick and Wheeler Basins, Chickasaw sites are known as far east as Hobbs Island, originally called Chickasaw Island (Futato 1998; Swanton 1979; Webb 1939:172, 184-185). The island's original name came from the Chickasaw Old Fields settlement established around 1765 and depopulated around 1769, after a battle with the Cherokee over territorial issues (Swanton 1979:112; Webb 1939:184). A second village was noted near the mouth of the Elk River (Webb 1939:172-174). The Chickasaw reportedly were in conflict with the Cherokee, Shawnee, Choctaw, and Creeks over similar territorial disagreements in the region. Interaction between the Chickasaw and Europeans during the late seventeenth century and into the eighteenth century focused heavily on the fur trade. Aligning themselves with the English, the Chickasaw attacked French traders on the Mississippi and fought alongside the British during the French and Indian War. During the American Revolution, the Chickasaw remained relatively neutral, and in 1786, signed the Treaty of Hopewell opening official relations with the United States. The treaty established the northern boundary of Chickasaw lands as the divide between the Cumberland and Tennessee west to the Ohio. In the following years, American settlers' pressure for land led to the 1832 signing of a treaty in which the Chickasaw ceded all lands east of the Mississippi. The majority, through funds provided by the sale of their lands, removed themselves west to the Indian Territory where they settled among the Choctaw. In 1855, separation between the Choctaw and Chickasaw was established and a separate governing body was recognized. At least two factions separated from the main body of the Chickasaw: one settling within Creek territory and the other settling in South Carolina on the Savannah River under the leadership of Squirrel King (Swanton 1979:117).

The presence of the Natchez in the Middle Tennessee Valley is suggested by Fatherland Incised and Addis Plain var. St. Catherine (Futato 1998:229-230), which likely represent trade items rather than evidence of Natchez occupation that far north and east of the lower Mississippi Valley. With European encroachment into the area, the Natchez had strained relations with the French for more than a century. Later, two groups of Natchez were granted refuge by the Cherokee and the Upper Creek after having been forced from their homelands to the west. A third group moved to South Carolina until 1744 when they left in fear of retribution from the Catawba (Swanton 1979:160).

The Creek, divided into the Upper Creek and the Lower Creek, were limited in their occupation to the south side of the Tennessee River which served as the northern boundary of their territory (Webb 1939:177-178). The central area of the Upper Creek territory was the Coosa and Tallapoosa Rivers in Alabama and Georgia.

Historic Background

Information for the historical context and historic resource evaluations are drawn from a report by Hawsey and Ford of OAR performed for a proposed industrial park situated just south of this project area (Hawsey and Ford 2011).

The history of the landscape that constitutes the Belle Mina Farms area began in the early nineteenth century. "Although most of the area that now comprises Limestone County was not officially opened for settlement until the U.S. government land sales of 1818, a few families had already begun to trickle into the wilderness north of the Tennessee River and east of the winding Elk as early as 1807" (Axford 1978). In that year, settlers from Tennessee, Virginia, and the Carolinas, were lured by inexpensive, virgin land located along Limestone Creek (Avon Burke and O'Neal

1916:7). These squatters did not have legal claim to the occupied lands.

Judging by recorded land patents, a number of planters and speculators capitalized on the U.S. government land sales of 1818. After amassing substantial land holdings, Nicholas Davis and other planters in Limestone County assembled a large labor force of African American slaves to perform work on their plantations. According to census data compiled in *Some Social and Economic Factors Relative to the Antebellum Alabama Large Planter* (Kiger 1947:28), Davis owned 55 slaves in 1830. In 1840, his slave population had increased to 81 (Kiger 1947:43). That number climbed to 115 in 1850 (Kiger 1947:81).

Slaves were an integral part of the plantation setting. They performed all levels of work from menial tasks to skilled labor. The daunting task of clearing the dense primeval forest that characterized the landscape of the Limestone Creek vicinity fell to Davis' and other planters' enslaved laborers. Slaves also planted the first crops of short-staple cotton in the cleared fields and picked the big white bolls at harvest time. Season after season, slaves cultivated the white gold that made their masters wealthy. They cooked, cleaned, and tended livestock. They also cared for the planter's children. Slaves served as master craftsmen and builders on the plantation. They built the single pen cabins that they inhabited. Collections of slave dwellings, typically called the "Quarters", were often located near areas of work such as fields and the domestic complex. A highly organized collection of buildings, the domestic complex featured barns, sheds, animal pens, well houses, a kitchen, and ultimately the planter's residence (Vlach 1993). Slave laborers built all these buildings, including the planter's house. During the frontier period of settlement, even the most affluent of settlers in Alabama occupied dwellings of hewn and unhewn logs constructed by their captive work forces (Gamble 1987; Saunders 1992; Scott 1993). As fortunes improved, planters instructed their masons to craft handmade bricks for foundations and their carpenters to build baronial mansions atop the foundations befitting their aristocratic status. Until his death in 1856, the center of Captain Nicholas Davis' social life was "Walnut Grove", a commodious log house, which his laborers built for him and his family when he first came to Alabama (Axford 1978:62). Located on his plantation Fairview, approximately seven miles north of the project area, Walnut Grove burned to the ground not long after Davis' death. Davis and his wife Martha, who died in 1853, were interred on Fairview.

Topography possibly accounts for the fact that there were/are plantation houses and associated outbuildings in the vicinity, but not within the boundaries of the project area. The plantations identified in *The Lure and Lore of Limestone County* (Axford 1978:178-179) occupy/occupied higher ground along the Huntsville-Browns Ferry Road and in the communities of Belle Mina and Greenbrier while the project area is located amongst the low terraces of Limestone and Beaverdam creeks. These creeks tend to overflow during the rainy season, periodically resulting in wetland environments. Swampland did/does not make an ideal location for the construction of a planter's house. Many planters in Limestone County and the South in general endured a number of hardships during and after the Civil War. Author John B. Scott, Jr. (1993) summed up some of the problems facing the landed gentry:

> The cotton planters, already impoverished by the war, were crushed by new taxes imposed by the federal government and the carpetbag legislature. Taxes on land and personal property were raised to levels amounting to con-

> fiscation. Hundreds of farms and plantations in the county were sold for taxes. Once sold, the land could only be redeemed by paying double taxes owed, which the landowner had not been able to raise in the first place. Additionally, the U.S. Congress imposed a federal tax of 2.5 cents a pound on all cotton raised in former Confederate states.

Perhaps the most significant outcome of the war for plantation owners involved the restructuring of the relationship between the planter and his captive work force. The Emancipation Proclamation of 1863 freed the slaves; the Thirteenth Amendment to the Constitution of the United States abolished slavery and involuntary servitude in the United States and places subject to its jurisdiction; and the Fourteenth Amendment granted all people born or naturalized in the United States citizenship and equal protection of the laws. The abolition of slavery forced planters to reorganize agricultural practices.

Unfortunately for former slaves, a number of socio-economic circumstances prevailed that led to the development of sharecropping and tenant farming, which basically amounted to the perpetuation of the traditional plantation economy. Many slaves remained on or returned to their former places of enslavement. Some slaves believed they would receive a portion of their former master's property; other slaves, realizing that they were uneducated and poorly trained for work outside of farming, believed they could not sustain themselves in a different environment; others believed there would be reprisals for leaving the plantation (Bailey 1995). These factors and the failure to provide freed slaves with their own land led to the re-establishment of a post-slavery plantation economy in the South (Mandle 1983; McIntyre 1994).

Thus it was in this environment that post-bellum planters adopted the tenant-sharecropper system. Large landholders subdivided former plantations into tenant farms and enforced one of four types of tenant farming; cash-tenants paid the landlord outright for use of his land; share- cash tenants paid for part of their rental in money at the time of initial tenancy and the additional sum as a share of crop or livestock production at the end of the season; crop-share tenants furnished their own equipment in return for paying a share of their crop to the owner; and another class of crop-share tenants who used their landowner's equipment (Holley et al. 1940; McIntyre 1994; Rothman 1971). Tenants were provided housing and fuel, and subsistence was included and guaranteed by a lien on the crops. Liens and work contracts secured the hegemony of the old planter class over their tenants. Ultimately, tenant and sharecrop farming left the majority of black sharecroppers "in a state of permanent indebtedness, restricting their mobility, adding to their economic dependence, and culminating in a system of debt peonage that persisted for decades" (McIntyre 1994; Royce 1993).

As before with the plantation economy, cotton held sway over the tenant-sharecropper farm system. The influence that cotton exerted over the agriculture of the South in the post bellum period is described in Thomas W. Oliver's *A Narrative History of Cotton in Alabama* (1992):

> With the lenders, cotton was the basis for credit. No other farm product was acceptable to them in the payment of debt. Only upon the agreement to produce cotton, could credit be had. For the farmer without credit, it was cotton or starvation. To raise cotton, fertilizer was required. To obtain fertilizer, a debt was incurred, payable only in cotton.

The economic dependence on cotton governed the life of the planter and tenant farmer (Scott 1993). After a century of agricultural primacy, King Cotton lost its crown. Regarding Limestone County agricultural production, Hasty et al. wrote, "In 1929 the cotton acreage almost doubled that of corn, the crop of second importance. Since then cotton acreage has greatly decreased, largely because of Federal control, while that of corn has increased. In 1944 the total cotton acreage was only 60,589, as compared with the 106,844 acres planted in 1929" (Hasty et al. 1953:12).

By "Federal control", Hasty et al. meant the Tennessee Valley Authority (TVA). In the 1930s, the TVA instituted management procedures to restore soil depleted of nutrients by cotton. Among the procedures implemented were crop rotation, diversification, hence corn's emphasis, and the removal of poorer soil from cultivation. Limestone County farmers also began conversion of land into pastures for the breeding of dairy and beef cattle. Chief among the beef cattle breeds growing in importance in Limestone County were Hereford, Shorthorn, and Angus (Hasty et al. 1953:19).

Numerous factors contributed to a sharp decrease in the number of tenant farmers in the area. Stifled by the systematic perpetuation of servitude imposed by segregation and sharecropping, many African Americans departed from Limestone County and the South in general, in what has come to be known as the Great Migration, and headed North looking for better opportunities (McIntyre 1994). In all Southern States, the percentage of rural farm dwelling African Americans declined from 56.9% in 1920 to 45.3% in 1940 (McIntyre 1994). The figure dropped to 30.8% in 1950 as African Americans answered the call of defense industry jobs. Cattle farming required fewer workers than picking cotton by hand. Families often had enough help to manage their farms without outside assistance. In addition, advances in farming machinery eliminated most labor, and much of the farm work population became unnecessary (Fite 1984; McIntyre 1994).

Literature and Document Search

For prior archaeological surveys conducted in the general area, the Alabama Cultural Resources Online Database, housed at OAR and consisting of the National Archaeological Database Bibliography and the Alabama Phase I Surveys Website (OAR 2014) were reviewed. The results show four surveys conducted within a one-mile radius of the project area (Figure 3). Three of the surveys were associated with proposed industrial development sites, which bracket this survey area to the north and south. The fourth project was conducted in association with a proposed pipeline project (Table 1). All the sites listed below were discovered as a result of these four projects.

The Alabama State Site File (ASSF) (OAR 2016) shows 18 sites within a one-mile radius of the project area (Figure 3). Pertinent information for these sites is presented in Table 2.

The NRHP (NPS 2015) and the *Alabama Register of Landmarks and Heritage* and related supplements (AHC 1978, 2016) list no eligible properties located within a one mile radius of the APE. A review of the 1931, Lauderdale County, Alabama Soil Map shows one structure located in the northwest corner of the APE, on the south side of Lauderdale County Road 14. The 1936, 7.5', Wright, AL topographic quadrangle also depicts a structure at the same location in the APE. The 1937 edition of the Lauderdale County, Alabama Highway Maps shows a structure at this location, by the 1949 edition, the structure is no longer present. Finally, *Cemetery Locations by County* lists no historic cemeteries located within any of the survey area (Remington 2008). However, Fletcher Cemetery lies to the southwest approximately 150 m (492 ft).

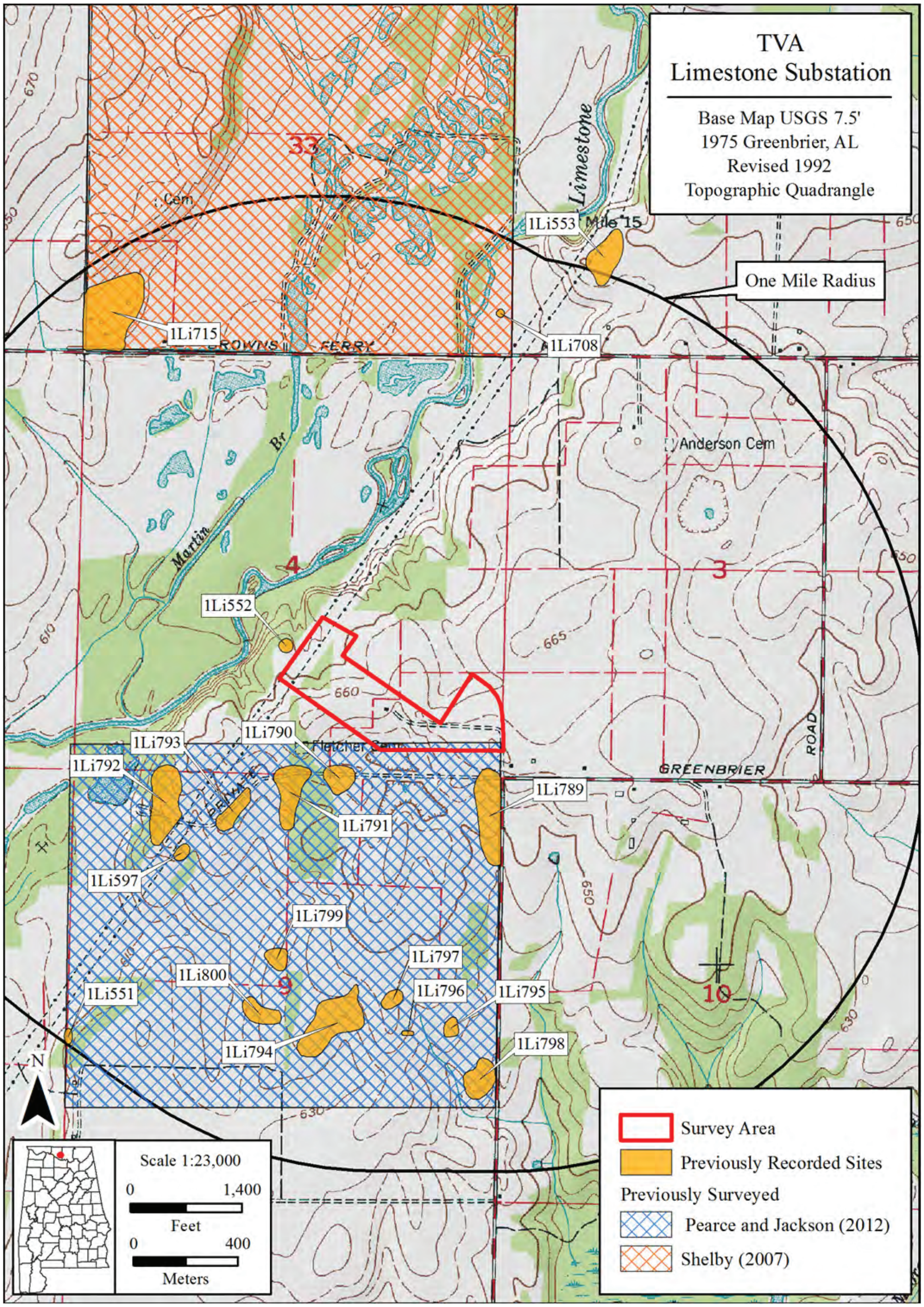


Figure 3. Previously recorded archaeological sites and surveys.

Table 1. Previous Phase I surveys conducted within a one-mile radius of the APE.

Author/Date	Title	Size
David R. George et al. (2000)	*Phase I Cultural Resources Survey and Archeological Inventory of the Alabama Portion of the Proposed Colonial Pipeline Project Corridor, Talladega, Calhoun, St. Clair, Blount, Cullman, Marshall, Morgan, Madison, and Limestone Counties, Alabama*	Multi-mile
Kareen Hawsy and Gene Ford (2011)	*A Phase I Cultural Resources Reconnaissance of the Proposed Sewell Industrial Park at Belle Mina Farms near Greenbrier in Limestone County, Alabama*	1500 ac (607 ha)
Kenny Pearce and Paul Jackson (2012)	*A Phase I Cultural-Resources Survey for a Proposed Industrial Development Project (Megalite Property) near Greenbrier in Limestone County, Alabama*	569 ac (230.2 ha)
Thomas R. Shelby (2007)	*A Phase I Cultural Resources Reconnaissance of Potential Development Property near Madison, Limestone County, Alabama*	640 ac (259 ha)

Table 2. Previously recorded sites within a one-mile radius of the APE (*in APE).

ASSF #	Cultural Affiliation	Size (m)	Remarks	NRHP eligibility
1Li551	20^{th} Century Historic	51 x 20	Former house site	Ineligible
1Li552	Unknown Aboriginal	50 x 30	Sparse subsurface scatter	Ineligible
1Li553	Unknown Aboriginal	200 x 90	Subsurface scatter	Ineligible
1Li597	Unknown Aboriginal/Early 20^{th} Century Historic	130 x 65	Sparse surface/subsurface scatter	Ineligible
1Li708	Unknown Aboriginal	200 x 60	Sparse plowzone scatter	Ineligible
1Li715	Unknown Aboriginal/Early 20^{th} Century Historic	270 x 250	Dense historic/sparse prehistoric surface scatter	Ineligible
1Li789	20^{th} Century Historic	370 x 95	Former house site	Ineligible
1Li790	Unknown Aboriginal	110 x 90	Sparse surface/subsurface scatter	Ineligible
1Li791	Unknown Aboriginal/Late 19^{th}-Early 20^{th} Century Historic	225 x 145	Moderate surface scatter	Ineligible
1Li792	Unknown Aboriginal/20^{th} Century Historic	270 x 120	Former house site-plowzone scatter	Ineligible
1Li793	Unknown Aboriginal/20^{th} Century Historic	145 x 30	Former house site-plowzone scatter	Ineligible
1Li794	Unknown Aboriginal/Late 19^{th}-Early 20^{th} Century Historic	340 x 160	Former house site-plowzone scatter	Ineligible
1Li795	Unknown Aboriginal/20^{th} Century Historic	90 x 60	Sparse surface scatter	Ineligible
1Li796	Unknown Aboriginal/Late 19^{th}-Early 20^{th} Century Historic	40 x 15	Sparse surface scatter	Ineligible
1Li797	Unknown Aboriginal/20^{th} Century Historic	85 x 50	Sparse surface scatter	Ineligible
1Li798	Unknown Aboriginal/20^{th} Century Historic	140 x 95	Sparse surface scatter	Ineligible
1Li799	Unknown Aboriginal/Late 19^{th}-Early 20^{th} Century Historic	80 x 70	Sparse surface scatter	Ineligible
1Li800	Unknown Aboriginal/Early 20^{th} Century Historic	145 x 75	Sparse surface scatter	Ineligible

Field Methods

Field investigations consisted of a pedestrian walkover of the proposed project area employing visual inspection of exposed ground surface augmented with subsurface testing. Where exposed ground surface was present, initial investigations consisted of visual inspection. Due to the limited surface exposure, shovel tests were excavated at general 30 m intervals in a series of walked transects. Per AHC guidelines, all shovel tests had a minimum diameter of 30 cm and were excavated to recognizable, culturally sterile subsoil. All excavated soil was screened through 6.35 mm (.25 in) hardware cloth in an effort to recover cultural materials. Soil profiles were recorded for each shovel test noting soil colors, textures, and depths of soil texture/color changes and horizon boundaries. All shovel test locations were documented using global positioning systems units rated for sub-decimeter accuracy. A total of 127 shovel tests were excavated in the course of this survey (Figure 4). Appendix B contains a soil profile log for all 127 shovel tests. Photographic documentation was undertaken to provide evidence of the varying environments and disposition of the proposed project area. These photographs (Figures 5-16 and 18-30) are keyed to the topographic map and aerial (Figures 4 and 17) showing their location and direction of capture.

Virtually the entire APE has a vegetative cover of wild grasses and weeds, limiting surface visibility to isolated patches of surface exposure (Figure 5). Only along the southern border is there a recently plowed field that allowed for near unobscured surface visibility (Figure 6). The extensive impact from prior agriculture and inherent deep erosion of upper soil zones is apparent and has greatly reduced or even negated the potential for many areas of the APE to contain intact subsurface or even surficial evidence of prior aboriginal or historic occupation. Shovel test soil profiles were relatively consistent across the APE, with all showing culturally sterile, red clay subsoil directly underlying, or intermixed with the initial plow zone. This essentially negates any potential for deeply buried soils to be present. A general soil profile showed dark red (2.5YR 3/6) silty clay loam (plow zone) to an average depth of 14 cmbs, underlain by red (2.5YR 4/6) silty clay to least 30 cmbs (Figure 7). Some of the shovel tests had no darker red initial soil zone, rather, the initial soil was red, and had a dense amount of rounded chert gravel in the soil matrix. Along the eastern border, many of the soil profiles had an additional layer of gravel, averaging 6 to 10 cm in thickness, apparently laid down for heavy equipment storage (Figure 8).

The APE has one structure depicted on the 1975 topographic map of the area (Figure 1). A gravel topped roadbed extends partially out to the location from the east. While there is grass cover, surface visibility was moderate in this particular area (Figure 9). A walkover of the location resulted in no cultural material recovery, or any visual evidence of features related to a former house site. Twelve shovel tests were excavated in close proximity to the location and all were negative for cultural material recovery. Soil profiles remained consistent showing red silty clay at the surface, to at last 30 cmbs.

Further west, a small copse of trees is present. The terrain is low lying within the wooded area, likely utilized for drainage run off from the fields (Figure 10). Shovel testing in the woods showed a similar soil profile to those in the field, with the addition of a 3 to 4 cm thick initial layer of dark reddish-brown rootmat/humus (Figure 11)

At the western border of the APE is a large transmission line right of way. Site 1Li552 lies just west of the right of way, situated in an open game plot, currently covered with grass (Figure 12). A walkover of the site location resulted in no cultural material recovery in scattered patches of exposed ground surface. Shovel testing along the border of the APE in close proximity to the site also resulted in no cultural material recovery.

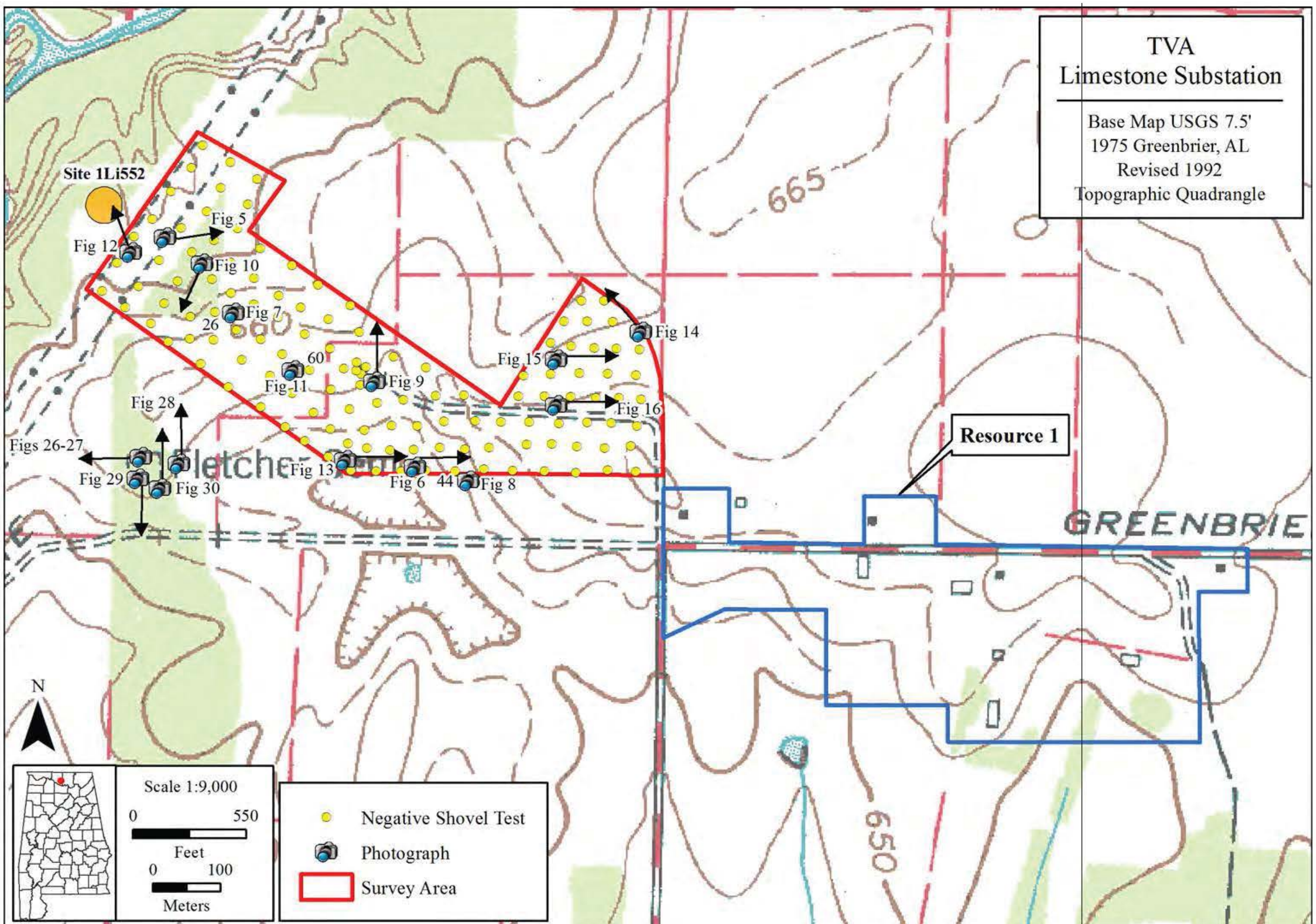


Figure 4. Location of shovel tests and location and direction of photographs.

Figure 5. General view of the APE. View to east.

Figure 6. Plowed field along south border of APE. View to east.

Figure 7. Shovel Test 26 showing typical red clay soil profile.

Figure 8. Shovel Test 44 showing gravel in soil profile.

Figure 9. General area of structure depicted on the topographic map of the area.

Figure 10. Wooded tract near west border of APE. View to southwest.

Figure 11. Shovel Test 60 showing typical soil profile in wooded area.

Figure 12. General area of Site 1Li552. View to northwest.

To the south, a large sinkhole is depicted on the topographic map along the south border of the APE. The sinkhole is located in an active agricultural field. A walkover of the field showed no evidence of a depression related to a sinkhole feature (Figure 13). Soil profiles from shovel testing showed dark red clay loam at the surface, intermixed with red clay subsoil to at least 14 cmbs, with red clay subsoil beneath. The sinkhole has been filled and leveled for agricultural purposes.

To the northeast, the terrain is lower in elevation (Figure 14). Testing in this area showed similar soil profiles to the other portion of the APE, but with considerably more rounded chert gravel in the soil matrix.

As noted earlier in the report, the eastern area of the APE along the bordering road was utilized as a storage area for equipment and temporary housing associated with storm damage repairs. This is evident by the dense layer of granite gravel observed on the surface and in shovel test. A relic utility meter box on a pole is still present, along with a scatter of concrete pipes (Figures 15-16)

Laboratory Methods and Collection Curation

While no cultural materiel was recovered, all photographs, field notes, maps, and documentation pertinent to the survey will be curated at the Erskine Ramsay Archaeological Repository located at Moundville Archaeological Park. This repository meets Department of the Interior Curation standards as defined under 36 CFR Part 79 and required by Chapter 460-x-9 of the Administrative Code of Alabama. A letter agreement for curation, as required by the AHC, has been included as Appendix A.

Results

As a result of the field investigations no archaeological sites were documented within the APE. The soil within the APE is highly deflated, resulting from long-term agricultural usage. No semblance of intact topsoil was noted in shovel testing within the APE. The location of a structure in the center of the APE as depicted on the topographic map was relocated. However, surface observation and subsurface testing at the location yielded no evidence of the house.

A .5 mile radius around the project area was established for potential visual impact on any historic standing structures resulting from this project. Two resources were identified, a farm complex and a cemetery. The farm complex is located just southeast of the APE, situated along Greenbrier Road. The farm complex has been previously evaluated by Gene A. Ford, Architectural Historian, as an aspect of the aforementioned Hawsey and Ford (2011) project. His findings follow:

Resource 1 – Lowe Hereford Farm-Belle Mina Farms

Greenbrier Quadrangle (Figure 1, 17). Greenbrier Road. Ca. 1900, 1944, 1960, 1970, 1990.
Farm complex with the following components:
Four tenant houses consisting of the following two types:
-One 1960 concrete block bungalow having a front gable roof of asphalt shingles, partial width porch with gable roof and posts, off center single leaf door, flanking 1/1 double hung sash windows, concrete slab foundation (Figure 18)
-Three 1960 concrete block massed plan cottages each with a side gable roof of asphalt shingles, off center single leaf door, flanking 1/1 double hung sash windows, partial width porch with shed roof and wood posts, concrete slab foundation (Figures 19-21).
Domestic complex with multiple outbuildings (Figures 22-25).
-Ca. 1960 Concrete block shop with metal gable roof

Figure 13. General area of sinkhole depicted on the topographic map of the area.

Figure 14. Northeast portion of APE. View to north.

Figure 15. Relic meter and pole in eastern portion of APE.

Figure 16. Concrete pipe segments near meter and pole. View to east.

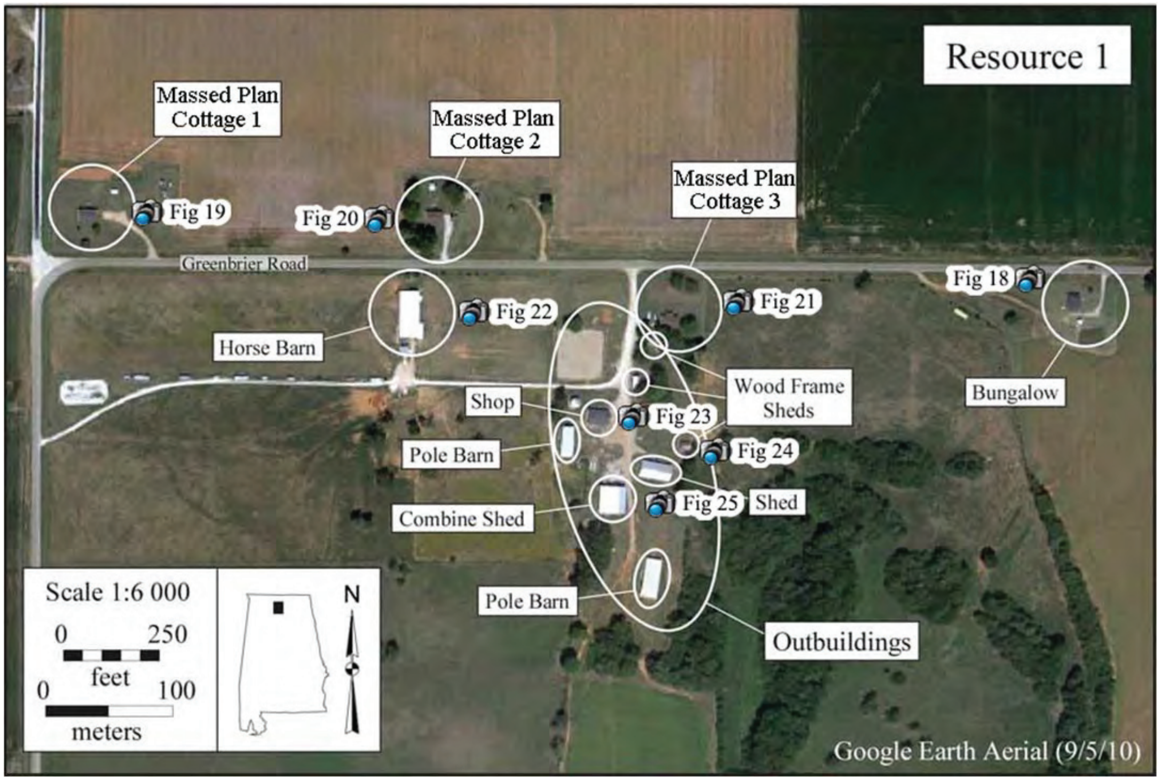


Figure 17. Aerial depicting the built environment of Resource 1.

Figure 18. Resource 1-1960 tenant bungalow. View to southwest.

Figure 19. Resource 1-1960 tenant massed plan cottage. View to north.

Figure 20. Resource 1-Second 1960 tenant massed plan cottage. View to north.

Figure 21. Resource 1-Third 1960 tenant massed plan cottage. View to south.

Figure 22. Resource 1-Ca. 1970 horse barn. View to west

Figure 23. Resource 1-Ca. 1944 shop. View to south.

Figure 24. Resource 1 Outbuildings - Ca. 1944 shed. View to southeast

Figure 25. Resource 1 Outbuildings-Ca. 1944 shed foreground, Ca. 1960 shed in rear. View to south.

-Ca. 1944 wood frame shed with metal gable roof, board and batten siding, and off center single leaf door.
-Ca. 1944 vehicle shed with gable roof of metal, board and batten siding, and vehicular bay.
-Ca. 1944 vehicle shed with gable roof of metal, metal and board and batten siding, transverse passage, and open vehicular bay.
-Ca. 1960 open air pole barn with metal gable roof and poles.
-Ca. 1990 metal combine shed with metal roof, metal support frame, and side shed.
-Ca. 1944 concrete block shop with gable roof of asphalt shingles, vehicular bay, interior concrete block foundation, and concrete slab foundation.
-Ca. 1960 open air pole barn with metal gable roof and poles.
-Ca. 1970 metal cylindrical silo.
-Ca. 1970 horse barn with metal gable roof and metal siding.
-Ca. 1990 shed with shed roof of metal and metal siding.

The construction dates of the dwellings, which are listed as 1960, derive from a Limestone County Property Record Card on file at the Limestone County Tax Assessor's Office in the Courthouse Annex (2010). The construction dates of the farm outbuildings, which are given as 1944, 1960, and 1970, are based on soil and highway maps, aerial photographs, construction materials, and property ownership eras.

Resource 2-Ca. 1900 Fletcher Cemetery

This is a small community burial ground with an unknown number of graves due to the absence of markers and dense vegetation. W. Craig Remington's *Historical Atlas of Alabama: Volume 2, Cemetery Locations by County* (1999), described the cemetery as "a black cemetery with Helen Jones (1838-1908) as the only stone remaining."

The cemetery was relocated based on the topographic mapped location. The cemetery as mapped, is situated in a wooded area, bordered on the east by an open field (Figure 26). The woods have a dense cover of fallen leaves, but still allowed for discerning any depressions or other evidence of a cemetery (Figure 27). A thorough walkover of the general location yielded no evidence of the cemetery. The stone noted in the description of the cemetery was also not located. In the open field directly adjacent to the mapped location, two depressions were noted, although their association is suspect (Figure 28). One depression was approximately 1.3 m in diameter and was round in shape, rather than rectangular (Figure 29). Approximately 2 m to the north, the second depression was slightly more rectangular, measuring approximately 1.4 m by 70 m in size (Figure 30). However, the long axis is set N-S, rather than the traditional E-W orientation of a grave shaft.


Figure 26. Wooded location of Fletcher Cemetery. View to west.

Figure 27. Leaf covered surface of cemetery. View to west.

Figure 28. Area of depressions in field next to cemetery. View to north.

Figure 29. Round shaped depression. View to south.

Figure 30. Somewhat rectangular shaped depression. View to north.

Summary and Evaluation

OAR was contracted by TVA to perform a cultural resources survey for proposed construction of the Limestone Substation Static VAR Compensator. The survey area consists of one tract of land totaling 17 ha (42 ha) in size. Field investigations for the project were undertaken on January 12-13, and 17-18, 2017.

A total of 127 shovel tests were excavated in the course of this survey, with no cultural material recovery. While Site 1Li552 lies in close proximity to the APE, no cultural material was recovered from shovel testing along the border of the APE at this location. A structure identified on the 1975 topographic quadrangle in the center of the APE (Figure 1) was relocated, but no evidence of associated material was found in either surface observation or shovel testing.

The Tennessee Valley exhibits evidence of occupation for over 13,500 years with a diverse cultural landscape strongly influenced by anthropogenic activities. Many areas held special meaning to its past inhabitants and continue to do so for their descendants. A *Traditional Cultural Property* (TCP) is defined as a property, that is eligible for inclusion on the National Register of Historic Places 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).

Although the preliminary records search failed to identify any previously identified TCPs within the APE, The field crew was aware that they could be located within or near the project area. During field investigations, the APE was scrutinized for unique landscape features such gathering locations, cedar glades, rock cairns and visually inspected all surfaces for any evidence of cultural activity. While cedar glades are present within the survey area, they represent recent natural reforestation of fallow farmlands and are not representative of vegetation continuity. No sites were identified during the survey that may have indicated the presence of a TCP. TVA does recognize that Indian tribes possess special expertise in assessing historic properties that may retain religious and cultural significance to them and in accordance with 36 CFR Part 800.4(c)(1), TVA is consulting with federally recognized tribes that have an interest in the region.

For historic structures with potential for visual impact resulting from construction of this project, the identified Lowe Hereford Farm-Belle Mina Farms does not meet the eligibility criteria for listing in the NRHP due to integrity and historical significance issues. The Lowe Hereford Farm-Belle Mina Farms does not retain integrity from any of its three periods of significance: the plantation era from settlement, 1818 to 1861, the start of the Civil War; the tenant farm era from 1865 to 1940, the onset of World War II and mechanization; and the Lowe Hereford cattle farm era from 1944 to 1961 (Hawsey and Ford 2011). The Bell Mina Farms era, which began in 1995, does not meet the criteria for designation as historic as it is less than fifty years old. The built environments, buildings and outbuildings, are no longer present from the first two eras of agricultural use. Although four circa 1944 sheds and a concrete block shop remain from the cattle farm era, the associated pastures are no longer intact having been converted back into row crop fields.

In terms of historical significance, the identified bungalow and massed plan cottages associated with the third decade of the Lowe Hereford Farm operation barely qualify as historic according to the definition established by the National Park Service. Built in 1960, according to a Limestone County property record card (2010), these dwellings marginally meet the basic threshold definition for listing in the NRHP. "Generally properties must be fifty years of age or more to be consid-

ered historic places" (McClelland 1997:1). Hitting the fifty year old mark in 2010, the concrete block dwellings just fall within the period of significance of the Lowe- Hereford Farm, 1944 to 1961. When viewed in the context of the century and a half epoch that is the agricultural history of this setting, the dwellings are late arrivals on the scene. They were built in the 1960s and do not represent the antiquity of the plantation period in the region. The dwellings did not house the slaves who toiled in the soil during the pre-Civil War King Cotton days; they did not house the tenants, likely the descendants of the slaves, who continued to plant and harvest cotton between the wars; they did not even house farm workers during the first two decades of the operation of the Lowe Hereford Farm. In these contextual terms, the concrete block bungalow and massed plan cottages do not meet significance criteria; consequently, they do not meet the eligibility criteria for listing in the NRHP.

Recommendations

No cultural resources were identified within the APE and the nearby Lowe Hereford Farm-Belle Mina Farms has been recommended as ineligible for NRHP nomination (Hawsey and Ford 2011). Construction of the proposed Limestone Substation Static VAR Compensator will not have an adverse effect on any significant historic properties within the APE or its surrounding environs, and a finding of no properties is recommended.

References Cited

Adams, J. M.

1997 North America During the Last 150,000 Years. Environmental Science Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee. Electronic document, http://www.esd.ornl.gov /projects/qen/nercNORTHAMERICA.html.

Alabama Historical Commission (AHC)

1978 *Alabama's Tapestry of Historic Places: An Inventory*. Alabama Historical Commission, Montgomery.

2016 The Alabama Register of Landmarks and Heritage. Electronic document, http://preserveala.org/pdfs/AR/Alabama%20Register%20of%20Landmarks%20&%20 Heritage%20Property%20Listing%20(June%2024,%202016).pdf. Last updated June 23, 2016. Accessed January 11, 2017.

Anderson, David G.

1996 Models of Paleoindian and Early Archaic Settlement in the Lower Southeast. In *The Paleoindian and Early Archaic Southeast*, edited by David G. Anderson and Kenneth E. Sassaman, pp. 29-57. The University of Alabama Press, Tuscaloosa.

Anderson, David G., and Glen T. Hanson

1988 Early Archaic Settlement in the Southeastern United States: A Case Study from the Savannah River Valley. *American Antiquity* 53(2):262-286.

Anderson, David G., and Lisa D. O'Steen

1992 Late Pleistocene/Early Holocene Environmental Conditions in the South Carolina Area. In *Paleoindian and Early Archaic Period Research in the Lower Southeast: A South Carolina Perspective*, edited by David G. Anderson, Kenneth E. Sassaman, and Christopher Judge, pp. 3-6. Council of South Carolina Professional Archaeologists, Columbia.

Anderson, David G., and Kenneth E. Sassaman
1996 Modeling Paleoindian and Early Archaic Settlement in the Lower Southeast: A Historical Perspective. In *The Paleoindian and Early Archaic Southeast*, edited by David G. Anderson and Kenneth E. Sassaman, pp. 16-28. The University of Alabama Press, Tuscaloosa.

Anderson, David G., Lisa D. O'Steen, and Kenneth E. Sassaman
1996 Environmental and Chronological Considerations. In *The Paleoindian and Early Archaic Southeast*, edited by David G. Anderson and Kenneth E. Sassaman, pp. 3-15. The University of Alabama Press, Tuscaloosa.

Avon Burke, R. T., and A. M. O'Neal, Jr.
1916 *Soil Survey of Limestone County, Alabama*. United States Department of Agriculture, Washington.

Axford, Faye A.
1978 *The Lure and Lore of Limestone County*. Portals Press, Tuscaloosa.

Bailey, Richard
1995 *Neither Carpetbaggers nor Scalawags: Black Officeholders during the Reconstruction of Alabama, 1867-1878*. Richard Bailey, Montgomery.

Bense, Judith A. (Editor)
1983 *Archaeological Investigations in the Upper Tombigbee Valley, Mississippi: Phase I*. 4 vols. Report submitted to the United States Army Corps of Engineers, Mobile by the Office of Cultural and Archaeological Research, University of West Florida, Pensacola. Report of Investigations 3. Office of Cultural and Archaeological Research, University of West Florida, Pensacola.

Bentz, Charles, Jr. (Editor)
1996 *The Bailey Site (40GL26): Late Archaic, Middle Woodland, and Historic Settlement and Subsistence in the Lower Elk River Drainage of Tennessee*. Publication in Archaeology 2. Tennessee Department of Transportation, Nashville.

Broster, John B. and Mark R. Norton
1996 Recent Paleoindian Research in Tennessee. In *The Paleoindian and Early Archaic Southeast*, edited by David G. Anderson and Kenneth E. Sassaman, pp. 288-297. The University of Alabama Press, Tuscaloosa.

Brown, James A.
1986 Early Ceramics and Culture: A Review of Interpretations. In *Early Woodland Archaeology,* edited by Kenneth B. Farnsworth and Thomas E. Emerson, pp. 598–608. Center for American Archaeology, Kampsville Seminars in Archaeology, Volume 2. Center for American Archaeology Press. Kampsville, Illinois.

Cable, John S.
1996 Haw River Revisited: Implications for Modeling Terminal Late Glacial and Early Holocene Hunter-Gatherer Settlement Systems in the Southeast. In *The Paleoindian and Early Archaic Southeast*, edited by David G. Anderson and Kenneth E. Sassaman, pp. 107-148. The University of Alabama Press, Tuscaloosa.

Cambron, James W., and David C. Hulse

1975 *Handbook of Alabama Archaeology: Part I Point Types*. Alabama Archaeological Society, Tuscaloosa.

Cambron, James W., and Spencer A. Waters

1959 Flint Creek Rock Shelter (Part I). In *Tennessee Archaeologist* 15(2):73-87.

1961 Flint Creek Rock Shelter (Part II). In *Journal of Alabama Archaeology* 7(1):1-46.

Chapman, Jefferson

1977 *Archaic Period Research in the Lower Little Tennessee River Valley – 1975: Icehouse Bottom, Harrison Branch, Thirty Acre Island, Calloway Island*. Report submitted to the National Park Service, Atlanta by the Department of Anthropology, University of Tennessee, Knoxville. Report of Investigations 18. Department of Anthropology, University of Tennessee, Knoxville.

1985 Archaeology and the Archaic Period in the Southern Ridge-and-Valley Province. In *Structure and Process in Southeastern Archaeology*, edited by Roy S. Dick ens, Jr., and H. Trawick Ward, pp. 137-153. The University of Alabama Press, Tuscaloosa.

1994 *Tellico Archaeology: 12,000 Years of Native American History*. Report submitted to the Tennessee Valley Authority, Norris by the Department of Anthropology, University of Tennessee, Knoxville. Report of Investigations 43. Department of Anthropology, University of Tennessee, Knoxville.

Chapman, Jefferson, Paul A. Delcourt, Patricia A. Cridlebaugh, Andrea B. Shea, and Hazel R. Delcourt

1982 Man-Land Interaction: 10,000 Years of American Indian Impact on Native Ecosystems in the Lower Little Tennessee River Valley, Eastern Tennessee. *Southeastern Archaeology* 1(2):115-121.

Chapman, Jefferson, and Andrea B. Shea

1981 The Archaeobotanical Record: Early Archaic to Contact in the Lower Little Tennessee River Valley. *Tennessee Anthropologist* 6(1):61-84.

Chapman, Jefferson, and Patty J. Watson

1993 The Archaic Period and the Flotation Revolution. In *Foraging and Farming in the Eastern Woodlands*, edited by C. Margaret Scarry, pp. 27-38. University Press of Florida, Gainesville.

Clayton, Lawrence A., Vernon J. Knight, Jr., and Edward C. Moore (Editors)

1993 *The De Soto Chronicles: The Expedition of Hernando De Soto to North America in 1539-1543*. 2 vols. The University of Alabama Press, Tuscaloosa.

Cole, Gloria G.

1981 *The Murphy Hill Site (1Ms300): The Structural Study of a Copena Mound and Comparative Review of the Copena Mortuary Complex*. Report submitted to the Tennessee Valley Authority, Chattanooga by the Office of Archaeological Research, University of Alabama, University. Research Series 3. Office of Archaeological Research, University of Alabama, University.

Crites, Gary D.

1996 *Plant Remains. In* The Bailey Site (40GL26): Late Archaic, Middle Woodland, and Historic Settlement and Subsistence in the Lower Elk River Drainage of Tennessee, edited by Charles Bentz, Jr. pp. 279-283. Publication in Archaeology 2. Tennessee Department of Transportation, Nashville.

Daniel, I. Randolph, Jr.

2001 Stone Raw Material Availability and Early Archaic Settlement in the Southeastern United States. *American Antiquity* 66(2):237-265.

Davis, R. P. Stephen, Jr.

1990 *Aboriginal Settlement Patterns in the Little Tennessee River Valley*. Report of Investigations 50. Department of Anthropology, University of Tennessee, Knoxville.

DeJarnette, David L., Edward B. Kurjack, and James W. Cambron

1962 Stanfield-Worley Bluff Shelter Excavations. In *Journal of Alabama Archaeology* 8.

Delcourt, Hazel R.

1978 Late Quarternary Vegetation History of the Eastern Highland Rim and Adjacent Cumberland Plateau of Tennessee. PhD dissertation, University of Minnesota, Minneapolis.

Delcourt, Hazel R., Paul A. Delcourt, and Elliott C. Spiker

1983 A 12,000-Year Record of Forest History from Cahaba Pond, St. Clair County, Alabama. In *Ecology* 64(4):874-887.

Driskell, Boyce N.

1992 Stratified Early Holocene Remains at Dust Cave, Alabama. In *Paleoin dian and Early Archaic Period Research in the Lower Southeast: A South Carolina Perspective*, edited by David G. Anderson, Kenneth E. Sassaman, and Christopher Judge, pp. 273-278. Council of South Carolina Professional Archaeologists, Columbia.

1994 Stratigraphy and Chronology at Dust Cave. Preliminary Archaeological Papers on Dust Cave, Northwest Alabama, edited by Nurit S. Goldman-Finn and Boyce N. Driskell, pp. 17-34. *Journal of Alabama Archaeology* 40(1-2).

Dye, David H.

1980 Primary Forest Efficiency in the Western Middle Tennessee Valley. Ph.D. Dissertation, Department of Anthropology, Washington University, St. Louis.

Dye, David H., and Jerry R. Galm

1986 Alexander, Tchefuncte, and Black Sand: An Early Gulf Tradition in The Mississippi Valley. In *The Tchula Period in the Mid-South and Lower Mississippi Valley*, edited by David H. Dye and Ronald C. Brister, pp. 28-39. Archaeological Report 17. Mississippi Department of Archives and History, Jackson.

Fagan, Brian

2004 *The Long Summer: How Climate Changed Civilization.* Basic Books, New York.

Fite, Gilbert C.

1984 *Cotton Fields No More: Southern Agriculture 1865-1980*. The University Press of Kentucky, Lexington.

Ford, James A. and Clarence H. Webb

1956 *Poverty Point, a Late Archaic Site in Louisiana*. Anthropological Paper 46(1). American Museum of Natural History, New York.

Futato, Eugene M

1982 Some Notes on the Distribution of Fluted Points in Alabama. *Archaeology of Eastern North America* 10:30-33.

1983 *Archaeological Investigations in the Cedar Creek and Upper Bear Creek Reservoirs*. Report submitted to the Tennessee Valley Authority, Norris by the Office of Archaeological Research, University of Alabama, University. Report of Investigations 29. Office of Archaeological Research, University of Alabama, University.

1996 A Synopsis of Paleoindian and Early Archaic Research in Alabama. In *The Paleoindian and Early Archaic Southeast*, edited by David G. Anderson and Kenneth E. Sassaman, pp. 298-314. The University of Alabama Press, Tuscaloosa.

1998 Ceramic Complexes of the Tennessee River Drainage, Alabama. *Journal of Alabama Archaeology* 44(1-2):208-241.

Futato, Eugene M. and Carlos Solis

1983 Archaeology at Site 1Ja78, the B.B. Comer Bridge Site, Jackson County, Alabama. *Journal of Alabama Archaeology* 29(1).

Gage, Matthew D., Ellen M. Mussleman, and Sarah C. Sherwood

2003 The Archaeology of the Whitesburg Bridge Site: A Stratified Shell Midden on the Tennessee River. Paper presented at the 60th Southeastern Archaeological Conference, Charlotte.

Gage, Matthew D., and Jon B. Marcoux

2004 Walling II Revisited: Mature Mississippian in the Middle Tennessee Valley. Paper presented at the 50th Midwest Archaeological Conference and the 61st Southeastern Archaeological Conference, St. Louis.

Gamble, Robert

1987 *The Alabama Catalog: Historic American Buildings Survey: A Guide to the Early Architecture of the State*. The University of Alabama Press, Tuscaloosa.

George, David R., Catherine M. Labadia, Alicia Ventresca, Susan B. Smith, Jeremy P. Pincoske, Kari L. Krause, and William P. Athens

2000 *Phase I Cultural Resources Survey and Archeological Inventory of the Alabama Portion of the Proposed Colonial Pipeline Project Corridor, Talladega, Calhoun, St. Clair, Blount, Cullman, Marshall, Morgan, Madison, and Limestone Counties, Alabama*. Report submitted to Colonial Pipeline, Ringgold, Georgia by R. Christopher Goodwin and Associates, New Orleans.

Goldman-Finn, Nurit S.

1994 Dust Cave in Regional Context. Preliminary Archaeological Papers on Dust Cave, Northwest Alabama, edited by Nurit S. Goldman-Finn and Boyce N. Driskell, pp. 212-231. *Journal of Alabama Archaeology* 40(1-2).

Graham, J. Bennett
1966 An Archaeological Local Sequence Chronology in the Lock 3 Reservoir. M.A. Thesis, Department of Sociology and Anthropology, The University of Alabama, University.

Gremillion, Kristen J.
1996 The Paleoethnobotanical Record for the Mid-Holocene Southeast. In *Archaeoogy of the Mid-Holocene Southeast*, edited by Kenneth E. Sassaman and David G. Anderson, pp. 99-114. University Press of Florida, Gainesville.

2004 Seed Processing and the Origins of Food Production in Eastern North America. *American Antiquity* 69(2):215-233.

Griffin, James B. (Editor)
1952 *Archeology of Eastern United States*. The University of Chicago Press, Chicago.

Griffin, John W.
1974 *Investigations in Russell Cave, Russell Cave National Monument, Alabama*. Publication in Archeology 13. National Park Service, Washington.

Hasty, A. H., K. V. Goodman, Robert Wildermuth, Hoyt Sherard, E. D. McCall, H. R. Benford, and H. J. Wesson
1953 *Soil Survey of Limestone County, Alabama*. United States Department of Agriculture, Washington.

Hawsey, Kareen L., and Gene A. Ford
2011 *A Phase I Cultural Resources Reconnaissance of the Proposed Sewell Industrial Park at Belle Mina Farms near Greenbrier in Limestone County, Alabama*. Report submitted to the City of Huntsville, Alabama by the Office of Archaeological Research, University of Alabama Museums, Tuscaloosa.

Heimlich, Marion D.
1952 *Guntersville Basin Pottery*. Museum Paper 32. Geological Survey of Alabama, The University of Alabama, University.

Hollenbach, Kandace D.
2004 Gathering Implications: Late Paleoindian and Early Archaic Plant Use in Northwest Alabama. Paper presented at the 69th Annual Meeting of the Society for American Archaeology, Montreal.

2005a Beyond Nuts and Fruits: The Role of Gatherers in Late Paleoindian and Early Archaic Foraging Groups in Northwest Alabama. Paper presented at the 70th Annual Meeting of the Society for American Archaeology, Salt Lake City.

2005b Gathering in the Late Paleoindian and Early Archaic Periods In the Middle Tennessee River Valley, Northwest Alabama. PhD Dissertation, Department of Anthropology, University of North Carolina, Chapel Hill.

Holley, William C., Ellen Winston, and Thomas J. Woofer, Jr.
1940 *The Plantation South, 1934-1937*. United States Government Printing Office, Washington.

Hubbert, Charles M.
1989 Paleo-Indian Settlement in the Middle Tennessee Valley: Ruminations from the Quad Paleo-Indian Locale. In *Tennessee Anthropologist* 14(2):148-164.

Hudson, Charles M.
1976 *The Southeastern Indians*. The University of Tennessee Press, Knoxville.

Jenkins, Ned J.
1981 *Gainesville Lake Area Ceramic Description and Chronology*. Archaeological Investigations in the Gainesville Lake Area of the Tennessee-Tombigbee Waterway, vol. 2. Report submitted to the United States Army Corps of Engineers, Mobile by the Office of Archaeological Research, The University of Alabama, University. Report of Investigations 12. Office of Archaeological Research, University of Alabama, University.

1982 *Archaeology of the Gainesville Lake Area: Synthesis*. Archaeological Investigations in the Gainesville Lake Area of the Tennessee-Tombigbee Waterway, vol. 5. Report submitted to the United States Army Corps of Engineers, Mobile by the Office of Archaeological Research, University of Alabama, University. Report of Investigations 23. Office of Archaeological Research, University of Alabama, University.

Jenkins, Ned J., and Richard A. Krause
1986 *The Tombigbee Watershed in Southeastern Prehistory.* The University of Alabama Press, University.

Jenkins, Ned J., David H. Dye, and John A. Walthall
1986 Early Ceramic Development in the Gulf Coastal Plain. In *Early Woodland Archaeology*, edited by Kenneth B. Farnsworth and Thomas E. Emerson, pp. 546-563. Kampsville Seminar in Archeology 2. Center for American Archeology, Kampsville.

Johannessen, Sissel
1993 Farmers of the Late Woodland. In *Foraging and Farming in the Eastern Woodlands*, edited by C. Margaret Scarry, pp. 57-77. University Press of Florida, Gainesville.

Johnson, Michael F.
1992 An Analogy between Eastern Paleoindian and Historic Caribou Hunters: A Broad Perspective from Virginia. In *Paleoindian and Early Archaic Period Research in the Lower Southeast: A South Carolina Perspective*, edited by David G. Anderson, Kenneth E. Sassaman, and Christopher Judge, pp. 182-202. Council of South Carolina Professional Archaeologists, Columbia.

Kelly, Robert L., and Lawrence C. Todd
1988 Coming into the Country: Early Paleoindian Hunting and Mobility. *American Antiquity* 53(2):231-244.

Kiger, Joseph C.
1947 *Some Social and Economic Factors Relative to the Antebellum Alabama Large Planter*. Thesis, University of Alabama, Tuscaloosa.

Kimball, Larry R. (Editor)
1985 *The 1977 Archaeological Survey: An Overall Assessment of the Archaeological Resources of Tellico Reservoir*. Report submitted to the National Park Service, Atlanta by

the Department of Anthropology, University of Tennessee, Knoxville. Report of Investigations 40. Department of Anthropology, University of Tennessee, Knoxville.

Kneberg, Madeline
1957 Chipped Stone Artifacts of the Tennessee Valley Area. *Tennessee Archaeologist* 13(1):55-66.

Knight, Vernon J., Jr.
1990 *Excavation of the Truncated Mound at the Walling Site: Middle Woodland Culture and Copena in the Tennessee Valley*. Report submitted to the City of Huntsville, Alabama by the Office of Archaeological Research, Alabama State Museum of Natural History, University of Alabama, Tuscaloosa. Report of Investigations 56. Division of Archaeology, Alabama State Museum of Natural History, University of Alabama, Tuscaloosa.

1998 Aboriginal Pottery of the Coosa and Tallapoosa River Valleys, Alabama. *Journal of Alabama Archaeology* 44(1-2):188-207.

Krause, Richard A.
1988 *The Snodgrass Small Mound and Middle Tennessee Valley Prehistory*. Report submitted to the Tennessee Valley Authority, Norris by the Department of Anthropology, University of Alabama, Tuscaloosa. Publication in Anthropology 52. Tennessee Valley Authority, Knoxville.

Lafferty, Robert H., III
1981 *The Phipps Bend Archaeological Project*. Report submitted to the Tennessee Valley Authority, Chattanooga by the Office of Archaeological Research, University of Alabama, University. Research Series 4. Office of Archaeological Research, University of Alabama, University.

Lewis, Thomas M.N., and Madeline K. Lewis
1961 *Eva: An Archaic Site*. The University of Tennessee Press, Knoxville.

Lewis, Thomas M. N., and Madeline Kneberg
1957 The Camp Creek Site. *Tennessee Archaeologist* 13(1):1-48.

1958 *Tribes That Slumber: Indian Times in the Tennessee Region.* University of Tennessee Press, Knoxville.

Little, Keith J., Harry O. Holstein, Curtis E. Hill, and Pearl Jones
1997 *Archaeological Investigations of the Dry Creek Site*. Research Series 2. Archaeological Resource Laboratory, Jacksonville State University, Jacksonville.

Mandle, Jay R.
1983 Sharecropping and the Plantation Economy in the United States South. *The Journal of Peasant Studies* 10(2):120-129.

McClelland, Linda F.
1997 *Guidelines for Completing National Register of Historic Places Forms: Part A, How to Complete the National Register Form*. National Park Service, Washington.

McDonald, William Lindsey
1997 *A Walk Through the Past.* People and Places of Florence and Lauderdale County. Bluewater Publications, USA.

McIntyre, Patrick
1994 *African American Tenant Houses in Alabama and the Southeast (1900-1940)*. Paper submitted as part of course requirements for American Studies 570 at the University of Alabama, Tuscaloosa.

McNutt, L. W., Jr., S. B. Marshall, and E. E. McDowell
1975 *Second Season of the Upper Delaware Valley Early Man Project*. Report submitted to the National Geographic Society and National Science Foundation, Washington by the Department of Anthropology, American University, Washington.

Meeks, Scott C.
1994 Lithic Artifacts from Dust Cave. *In* Preliminary Archaeological Papers on Dust Cave, Northwest Alabama, edited by Nurit S. Goldman-Finn and Boyce N. Driskell, pp. 79-106. *Journal of Alabama Archaeology* 40(1-2).

1997 *Archaeological Test Excavations at Lithic Shoals (1Lu342): A Multicomponent Site in the Seven Mile Island Wildlife Management Area, Lauderdale County, Alabama*. Report submitted to the City of Florence, Alabama, by the Office of Archaeological Services, University of Alabama Museums, Tuscaloosa.

2000 *The Use and Function of Late Middle Archaic Projectile Points in the Midsouth*. Report of Investigations 77. Office of Archaeological Services, University of Alabama Museums, Tuscaloosa.

2003 Prehistoric Land-Use Patterns during the Late Holocene: A View from the Tennessee Drainage Basin, Alabama. Paper presented at the 60th Southeastern Archaeological Conference, Charlotte.

National Park Service (NPS)
1995 *How to Apply the National Register Criteria for Evaluation*. National Register Bulletin 15. National Park Service, Washington.

2015 National Register of Historic Places. Electronic document, http://www.nps.gov /nr/research/. Last updated September 2015. Accessed January 12, 2017.

Newman, John B., and Darryll R. Berryman
2003 Ground Stone Vessels from the Whitesburg Bridge Site. Paper presented at the 60th Southeastern Archaeological Conference, Charlotte.

Oakley, Carey B.
1975 Flora of the Bear Creek Watershed. In *Archaeological Investigations in the Little Bear Creek Reservoir*, by Carey B. Oakley and Eugene M. Futato, pp. 286-290. Report submitted to the Tennessee Valley Authority, Chattanooga by the Office of Archaeological Research, The University of Alabama, University. Research Series 1. Office of Archaeological Research, University of Alabama, University.

Oakley, Carey B., and Eugene M. Futato
1975 *Archaeological Investigations in the Little Bear Creek Reservoir*. Report submitted to the Tennessee Valley Authority, Chattanooga by the Office of Archaeological Research, The University of Alabama, University. Research Series 1. Office of Archaeological Research, University of Alabama, University.

Office of Archaeological Research, University of Alabama Museums (OAR)
2014 Phase I Surveys. Secure electronic document, accessed January 12, 2017.

2016 Alabama State Site File. Secure electronic document, accessed January 12, 2017.

O'Hear, John W.
1990 *Archaeological Investigations at the Sanders Site (22Cl917), an Alexander Midden on the Tombigbee River, Clay County, Mississippi*. Report submitted to the United States Army Corps of Engineers, Mobile by the Cobb Institute of Archaeology, Mississippi State University, Mississippi State. Report of Investigations 6. Cobb Institute of Archaeology, Mississippi State University, Mississippi State.

Oliver, Thomas W.
1992 *A Narrative History of Cotton in Alabama, and a Tour of the Old Alabama Town Gin*. Landmarks Foundation of Montgomery, Montgomery.

O'Steen, Lisa D.
1996 Paleoindian and Early Archaic Settlement along the Oconee Drainage. In *The Paleoindian and Early Archaic Southeast*, edited by David G. Anderson and Kenneth E. Sassaman: 92-106. The University of Alabama Press, Tuscaloosa.

Parker, Patricia L. and Thomas F. King
1998 *Guidelines for Evaluating and Documenting Traditional Cultural Properties.*. National Register Bulletin. National Park Service, Washington.

Parmalee, Paul W.
1962 Faunal Remains from the Stanfield-Worley Bluff Shelter, Colbert County, Alabama. *Stanfield-Worley Bluff Shelter Excavations*, by David L. DeJarnette, Edward B. Kurjack, and James W. Cambron, pp. 112-114. In *Journal of Alabama Archaeology* 8(1-2).

Peacock, Evan
2002 Shellfish Use during the Woodland Period in the Middle South. In *The Middle Woodland Southeast*, edited by David G. Anderson and Robert G. Mainfort, Jr., pp. 440-460. The University of Alabama Press, Tuscaloosa.

Pearce, Kenny R., and Paul D. Jackson
2012 *A Phase I Cultural-Resources Survey for a Proposed Industrial Development Project (Megalite Property) near Greenbrier in Limestone County, Alabama*. Report submitted to Barge, Waggoner, Sumner, and Cannon, Huntsville by TerraXplorations, Tuscaloosa.

Remington, W. Craig (Editor)
1999 *Cemetery Locations by County*. Historical Atlas of Alabama, vol. 2. Department of Geography, University of Alabama, Tuscaloosa.

2008 *Cemetery Locations by County.* Historical Atlas of Alabama, vol. 2. 2nd ed. Department of Geography, The University of Alabama, Tuscaloosa, Alabama.

Rothman, David J. (Editor)
1971 *Farm Tenancy: Black and White*. Arno Press, New York.

Royce, Edward
1993 *The Origins of Southern Sharecropping*. Temple University Press, Philadelphia.

Sapp, C. Daniel, and Jacques Emplaincourt
1975 *Physiographic Regions of Alabama*. Map 168. Geological Survey of Alabama. University.

Sassaman, Kenneth E.
1993 *Early Pottery in the Southeast: Tradition and Innovation in Cooking Technology.* The University of Alabama Press, Tuscaloosa.

Saunders, Col. James E.
1992 *Early Settlers of Alabama*. Originally published 1899. Southern Historical Press, Greenville.

Schroedl, Gerald F.
1990 *Archaeological Research at 40RE107, 40RE108, and 40RE124 in the Clinch River Breeder Reactor Plant Area, Tennessee*. Report submitted to the Tennessee Valley Authority, Norris by the Department of Anthropology, University of Tennessee, Knoxville. Report of Investigations 49. Department of Anthropology, University of Tennessee, Knoxville.

Scott, John B., Jr.
1993 *Memories of the Mount: The Story of Mt. Meigs, Alabama*. Black Belt Press, Montgomery.

Shelby, Thomas M.
2007 *A Phase I Cultural Resources Reconnaissance of Potential Development Property near Madison, Limestone County, Alabama*. Report submitted to Robinsong Ecological Resources, Madison by the Office of Archaeological Research, University of Alabama Museums, Tuscaloosa.

Soil Survey Staff (SSS), Natural Resources Conservation Service
2016 Official Soil Series Descriptions. Electronic document, https://soilseries.sc.egov.usda.gov/osdname.asp, accessed January 12, 2017.

Swanton, John R.
1979 *Indians of the Southeastern United States.* Smithsonian Institution Press, Washington.

Truncer, James
2004 Steatite Vessel Age and Occurrence in Temperate Eastern North America. *American Antiquity* 69(3):487-513.

Vlach, John M.
1993 *Back of the Big House: The Architecture of Plantation Slavery*. The University of North Carolina Press, Chapel Hill.

Walker, Renee B.
2000 *Subsistence Strategies at Dust Cave: Changes from the Late Paleoindian through Middle Archaic Occupations*. Report of Investigations 78. Office of Archaeological Services, Moundville.

Walling, Richard, and Bonnie Schrader
1983 The Dry Branch Site, 1Sh42, and the Late Gulf Formational in the Central Coosa River Drainage. *Journal of Alabama Archaeology* 29(2):154-173.

Walthall, John A.
1980 *Prehistoric Indians of the Southeast: Archaeology of Alabama and the Middle South*. The University of Alabama Press, Alabama.

Walthall, John A., and Ned J. Jenkins
1976 The Gulf Formational Stage in Southeastern Prehistory. *Southeastern Archaeological Conference, Bulletin* 19:43-49.

Watts, W. A.
1970 The Full-Glacial Vegetation of Northwestern Georgia. *Ecology* 51(1):17-33.

1980 The Late Quarternary Vegetation History of the Southeastern United States. *Annual Review of Ecology and Systematics* 11:387-409.

Webb, William S.
1939 *An Archeological Survey of Wheeler Basin on the Tennessee River in Northern Alabama*. Bulletin 122. Bureau of American Ethnology, Washington.

Webb, William S., and David L. DeJarnette
1942 *An Archeological Survey of Pickwick Basin in the Adjacent Portions of the States of Alabama, Mississippi and Tennessee*. Bulletin 129. Bureau of American Ethnology, Washington.

Webb, S. David, Jerald T. Milanich, Roger Alexon, and James S. Dunbar
1984 A *Bison Antiquus* Kill Site, Wacissa River, Jefferson County, Florida. In *American Antiquity* 49(2):384-392.

Weigel, Robert D., J. Alan Holman, and Andreas A. Paloumpis
1974 Vertebrates from Russell Cave. In *Investigations in Russell Cave, Russell Cave National Monument, Alabama*, by John W. Griffin, pp. 81-85. Publication in Archeology 13. National Park Service, Washington.

Wells, Edward William, III
2006 Soapstone Vessel Chronology and Function in the Southern Appalachians of Eastern Tennessee. M.A. Thesis, Department of Anthropology, University of Tennessee, Knoxville.

Whittecar, G. Richard, Thomas C. Wynn, and Charles S. Bartlett, Jr.
2007 Paleoenvironmental Analysis of a Middle Wisconsinan Biota Site, Southwestern Virginia, U.S.A. In *Quarternary Research* 68(1):133-140.

Williams, Stephen

1957 The Island 35 Mastodon: Its Bearing on the Age of Archaic Cultures in the East. In *American Antiquity* 22(4):359-372.

Yarnell, Richard A.

1993 The Importance of Native Crops during the Late Archaic and Woodland Periods. In *Foraging and Farming in the Eastern Woodlands*, edited by C. Margaret Scarry, pp. 13-26. University Press of Florida, Gainesville.

Yarnell, Richard A., and M. Jean Black

1985 Temporal Trends Indicated by a Survey of Archaic and Woodland Plant Food Remains of Southeastern North America. *Southeastern Archaeology* 4(2):93-106.

APPENDIX A

THE UNIVERSITY OF ALABAMA | University Museums
Office of Archaeological Research

January 5, 2017

Matthew D. Gage, Director
Office of Archaeological Research
University of Alabama Museums
13075 Mound State Parkway
Moundville, AL 35474

Dear Matt:

As per your request, this letter is to establish an agreement with you to provide you with curation services on an as-needed basis. We are recognized by a variety of Federal agencies as a repository meeting the standards in 36 CFR Part 79 and have formal agreements to provide curation under these guidelines to agencies such as the Department of Defense, National Park Service, U.S. Fish and Wildlife Service, U.S. Soil Conservation Service, U.S. Army Corps of Engineers, Tennessee Valley Authority, National Forest Service, etc.

Please be advised that once a year we must be notified of all reports in which we were named as the repository. Project collections must be submitted within one calendar year of completion. Small projects may be compiled for periodic submission. For Alabama, the AHC survey policy specifies which materials must be curated (Administrative Code of Alabama, Chapter 460-X-9). Archaeological documentation must be curated even if no artifacts are recovered. Renewal of this agreement is contingent upon compliance.

We appreciate having the opportunity to assist you with curation services and look forward to working with you whenever we can be of service.

Sincerely,

Eugene Futato

Eugene M. Futato RPA
Deputy Director

13075 Moundville Archaeological Park | Moundville, AL 35474 | 205-371-2266 | Fax 205-371-2494

APPENDIX B

Shovel Test Soil Profile Log

key: H-Reddish-blach humus/rootmat; DR-Dark red clay loam; R-Red clay; g-Gravel; ch-Rounded natural chert gravel inclusions

Number	Location	Profile	Pos/Neg
1	Field-at house location	30-R	Neg
2	Field-at house location	30-R	Neg
3	Field-at house location	35-R	Neg
4	Field-at house location	33-R	Neg
5	Transmission line ROW	8-DR, 33-R-ch	Neg
6	Transmission line ROW	8-DR, 36-R-ch	Neg
7	Transmission line ROW	6-DR, 39-R-ch	Neg
8	Transmission line ROW	9-DR, 32-R-ch	Neg
9	Transmission line ROW	11-DR, 34-R-ch	Neg
10	Transmission line ROW	7-DR, 33-R-ch	Neg
11	Transmission line ROW	7-DR, 34-R-ch	Neg
12	Transmission line ROW	12-DR, 40-R-ch	Neg
13	Transmission line ROW	10-DR, 30-R-ch	Neg
14	ROW at 1Li552	9-Dr, 30-R-ch	Neg
15	ROW at 1Li552	8-DR, 36-R-ch	Neg
16	ROW at 1Li552	8-DR, 33-R-ch	Neg
17	ROW at 1Li552	8-DR, 34-R-ch	Neg
18	Transmission line ROW	6-DR, 30-R-ch	Neg
19	Transmission line ROW	7-DR, 32-R-ch	Neg
20	Transmission line ROW	7-DR, 30-R-ch	Neg
21	Transmission line ROW	6-DR, 34-R-ch	Neg
22	Transmission line ROW	6-DR, 30-R-ch	Neg
23	Wooded area	4-H, 11-DR, 30-R	Neg
24	Wooded area	4-H, 12-DR, 32-R	Neg
25	Wooded area	5-H, 11-DR, 35-R	Neg
26	Wooded area	4-H, 13-DR, 32-R	Neg
27	Wooded area	5-H, 11-DR, 32-R	Neg
28	Wooded area	4-H, 11-DR, 33-R	Neg
29	Wooded area	4-H, 13-DR, 34-R	Neg
30	Wooded area	4-H, 9-DR, 30-R	Neg
31	Field	33-R	Neg
32	Field	34-R	Neg
33	Field	32-R	Neg
34	Field	33-R	Neg
35	Field	35-R	Neg
36	Field	30-R	Neg
37	Field	30-R	Neg
38	Plowed field	30-R, ch	Neg
39	Plowed field	30-R, ch	Neg
40	Plowed field	30-R, ch	Neg

Number	Location	Profile	Pos/Neg
41	Plowed field	32-R, ch	Neg
42	Plowed field	32-R, ch	Neg
43	Plowed field	30-R, ch	Neg
44	Plowed field	30-R, ch	Neg
45	Plowed field	30-R, ch	Neg
46	Plowed field	32-R, ch	Neg
47	Plowed field	32-R, ch	Neg
48	Plowed field	30-R, ch	Neg
49	Plowed field	30-R, ch	Neg
50	Plowed field	30-R, ch	Neg
51	Plowed field	32-R, ch	Neg
52	Plowed field	32-R, ch	Neg
53	Plowed field	30-R, ch	Neg
54	Plowed field	30-R, ch	Neg
55	Field	33-R	Neg
56	Field	31-R	Neg
57	Field	30-R	Neg
58	Field	33-R	Neg
59	Field	30-R	Neg
60	Field	30-R	Neg
61	Field	30-R	Neg
62	Field	33-R	Neg
63	Field	30-R	Neg
64	Field	32-R	Neg
65	Field	33-R	Neg
66	Field	35-R	Neg
67	Field	30-R	Neg
68	Field	30-R	Neg
69	Field	33-R	Neg
70	Field	30-R	Neg
71	Field	32-R	Neg
72	Field	33-R	Neg
73	Field	30-R	Neg
74	Field	30-R	Neg
75	Field	31-R	Neg
76	Field	33-R	Neg
77	Field	34-R	Neg
78	Field	32-R	Neg
79	Field	30-R	Neg
80	Field	30-R	Neg
81	Field	32-R	Neg
82	Field	30-R	Neg
83	Field	33-R	Neg
84	Field	32-R	Neg
85	Field	32-R	Neg

Number	Location	Profile	Pos/Neg
86	Field	33-R	Neg
87	Field	30-R	Neg
88	Field	30-R	Neg
89	Field	30-R	Neg
90	Field	33-R	Neg
91	Field	30-R	Neg
92	Plowed field	30-R, ch	Neg
93	Plowed field	30-R, ch	Neg
94	Plowed field	32-R, ch	Neg
95	Plowed field	32-R, ch	Neg
96	Plowed field	30-R, ch	Neg
97	Field	30-R,g	Neg
98	Field	33-R, g	Neg
99	Field	34-R, g	Neg
100	Field	30-R	Neg
101	Field	33-R	Neg
102	Field	35-R	Neg
103	Field	30-R	Neg
104	Field	30-R, g	Neg
105	Field	33-R, g	Neg
106	Field	30-R, g	Neg
107	Field	32-R, g	Neg
108	Field	33-R, g	Neg
109	Field	35-R, g	Neg
110	Field	30-R, ch	Neg
111	Field	30-R, ch	Neg
112	Field	33-R, ch	Neg
113	Field	34-R, ch	Neg
114	Field	32-R, ch	Neg
115	Field	33-R, ch	Neg
116	field	35-R, ch	Neg
117	Field	30-R, ch	Neg
118	Field	31-R, ch	Neg
119	Field	33-R, ch	Neg
120	Field	34-R, ch	Neg
121	Field	32-R, ch	Neg
122	Field	33-R, ch	Neg
123	Field	35-R, ch	Neg
124	Field	32-R, ch	Neg
125	Field	30-R, ch	Neg
126	Field	33-R, ch	Neg
127	Field	34-R, ch	Neg

RERP-GE-RAI 3

On page 12 of the Interconnection System Impact Study, TVA estimates that transmission-related upgrades and modifications would be completed 7 to 10 years after TVA receives authorization to begin work. Given this timeline and assuming the EPU is approved, would BFN be able to operate at EPU levels prior to the transmission upgrades being completed? If not, please provide revised estimates of when each unit would begin operating at EPU levels, included revisions to the EPU outage schedules, if applicable.

TVA-BFN Response

~~a. The~~ Revision 3 of the Interconnection System Impact Study (SIS) identified six breaker failure relays requiring upgrade. Installation of relay upgrades will not preclude or delay the Browns Ferry Nuclear Plant (BFN) operating at extended power uprate (EPU) conditions. All six relays must be upgraded prior to BFN operating at EPU conditions. All six relays are scheduled to be replaced prior to the first unit uprate (Unit 3) in the Spring of 2018. Therefore, the relay replacement schedule will not affect the EPU schedule.

~~b. The~~ Revision 3 of the Interconnection SIS~~.~~, determined that the TVA transmission system would require ~~incremental installation of~~ a minimum of 764 megavolt-amp reactive (MVAR) ~~capacitor banks~~reactive compensation in five locations throughout the TVA transmission system. The additional reactive compensation will consist of one static VAR compensator (SVC) and multiple capacitor banks. The proposed locations are the Clayton Village ~~Substation~~ substation located in Oktibbeha County Mississippi, Holly Springs ~~Substation~~ substation located in Marshall County Mississippi, Corinth ~~Substation~~ substation located in Alcorn County Mississippi, East Point ~~Substation~~ substation located in Cullman County, Alabama, and the ~~Wilson~~ Limestone ~~Substation~~ substation located in ~~Wilson~~ Limestone County ~~Tennessee~~Alabama. The preliminary estimated completion of the final capacitor bank is ~~Spring~~ December of ~~2019~~2018 and the preliminary estimated completion of the SVC is Spring of 2020. TVA's transmission system operator does not preclude BFN operating at EPU levels during the SVC and capacitor bank installations. Therefore, the EPU schedule will not be affected by the SVC and~~MVAR~~ capacitor bank installation.

~~c. The revised~~Revision 3 of the Interconnection SIS determined that the BFN main generator excitation system would require modification to support the EPU of all three BFN units. The excitation system modifications mitigates a transient stability issue that could arise if a 3-phase fault develops while one of the four 500 kV lines specified in the Interconnection SIS is out of service and BFN is operating at EPU conditions. Note that the SVC also addresses the transient stability issue as well as adding reactive compensation. BFN can operate at EPU conditions before the main generator excitation system is modified and SVC is installed. In the interim, TVA will issue a detailed temporary operating guide that provides mitigation for transient stability issues during outages at any of the four identified 500 kV lines. Therefore, the SVC installation and excitation system modification schedule will not affect the EPU schedule.

ENCLOSURE 1

RERP-GE-RAI 4

Will TVA be conducting its own environmental review, pursuant to National Environmental Policy Act (NEPA) for the proposed transmission line construction and other transmission system upgrades? If so, describe TVA's projected timeline for the NEPA review and whether TVA anticipates issuing an environmental assessment (EA), environmental impact statement (EIS) or supplement to a previous EA or EIS.

TVA Response:

TVA performed an Interconnection System Impact Study (SIS) for the extended power uprate (EPU) of all three Browns Ferry Nuclear Plant (BFN) units. Revision ~~1~~ 3 of the Interconnection SIS identified replacing six 500 kilovolt (kV) breaker failure relays, installation of a minimum of 764 megavolt-ampere reactive (MVAR) ~~capacitor banks~~reactive compensation in five locations throughout the TVA transmission system, and modifying the excitation system of all three BFN main generators. The additional reactive compensation will consist of one static VAR compensator (SVC) and four capacitor banks. Therefore the new 500 kV transmission line will no longer be required to support BFN EPU and the environmental impact of a new SVC and modified excitation system will be addressed in lieu of the transmission line. As a federal agency subject to the requirements of the National Environmental Policy Act (NEPA), TVA evaluates the effects on the environment of these proposed upgrades. TVA's evaluation of the environmental effects of proposed upgrades is discussed in the response to RERP-GE-RAI-2. TVA does not anticipate issuing an environmental assessment (EA), or environmental impact statement (EIS), or supplement to existing EAs or EISs. ~~-~~Categorical Exclusion Checklists (CECs) ~~are being~~have been performed for the breaker failure relay replacements, main generator excitation system modification, the SVC installation, and each of the ~~upgrade~~ four capacitor banks projects. RERP-GE-RAI-4 Table 1 below lists these proposed transmission system upgrades and main generator modification~~upgrades~~, the anticipated level of NEPA review, and the projected date for closure of these ~~CECs~~environmental review documents.

RERB-GE-RAI-4 Table 1

Upgrade	Anticipated Environmental Review Documentation	Estimated Closure Date
500 kV BKR Failure Relay Replacements		
West Point TL (BKR 5208)	CEC	Closed 08/27/2015
West Point TL (BKR 5204)	CEC	Closed 08/27/2015
Maury (BKR 5258)	CEC	~~01/27~~Closed 01/24/2017
Maury (BKR 5254)	CEC	~~01/27~~Closed 01/24/2017
Union (BKR 5278)	CEC	~~01/27~~Closed 01/24/2017
Union (BKR 5274)	CEC	~~01/27~~Closed 01/24/2017
~~Capacitor Banks~~Reactive Compensation		
~~Wilson 500 kV~~Limestone SVC	CEC	~~06/22/2017~~04/27/2017

ENCLOSURE 1

Clayton Village 161 kV	CEC	~~08/31~~Closed 01/24/~~2016~~2017
Holly Springs 161 kV	CEC	~~11/18/2016~~Closed 01/24/2017
Corinth 161 kV	CEC	~~11/18/2016~~Closed 01/24/2017
East Point 500 kV (161 kV line)	CEC	~~04/04~~Closed 01/24/2017
Modify Excitation System		
BFN Main Generator Excitation System	CEC	Closed 01/19/2017~~Closed 05/11/2016~~

ENCLOSURE 2

BFN EPU LAR, Attachment 42, Supplemental Environmental Report, Revision 2

ATTACHMENT 42

SUPPLEMENTAL ENVIRONMENTAL REPORT

Revision ~~1~~2

Pages changed by Revision ~~1~~ 2 are as follows:

~~Table of Contents, Section 5.0 Page Numbers,~~
List of Acronyms, Abbreviations, and Symbols,
Page 42-1, Section 1.0, Executive Summary,
~~Page 42-2, Section 2.0, Introduction,~~
Page 42-5, Related Power Uprate Submittals and NEPA Documentation,
Page 42-11, Section 4.0, Overview of Operational and Equipment Changes,
Page 42-15, Section 6.0, Cost Benefit Analysis,
Page 42-16, Section 7.1.1.1, Land Use, Wetlands, and Natural Areas,
Page 42-29, Section 7.1.2, Transmission Facilities
Page 42-52, Table 7.2-3, Summary of BFN Hydrothermal Impacts for Warm, Summer Meteorology
~~Pages 42-46 and 42-52, Section 7.2.3, Impact on Discharge, changed by response to RERP-SW-RAI-1, Attachment 1.~~

Table of Contents

1.0 EXECUTIVE SUMMARY 1
2.0 INTRODUCTION 2
2.1 Browns Ferry Nuclear Plant History and Background 2
2.2 Related Power Uprate Submittals and NEPA Documentation 3
2.2.1 References 6
3.0 PURPOSE OF AND NEED FOR ACTION 9
3.1 The Proposed Action 9
3.2 Need for TVA Action 9
3.3 Alternatives to the Proposed Action 9
4.0 OVERVIEW OF OPERATIONAL AND EQUIPMENT CHANGES 11
5.0 SOCIOECONOMIC AND ENVIRONMENTAL JUSTICE CONSIDERATIONS12
5.1 Socioeconomics 12
5.1.1 Payments in Lieu of Taxes 12
5.1.2 Project Employment 12
5.1.3 Impacts on the Area 13
5.2 Environmental Justice 14
5.3 Conclusion 14
5.4 References 14
6.0 COST-BENEFIT ANALYSIS 15
7.0 NONRADIOLOGICAL ENVIRONMENTAL IMPACTS 16
7.1 Terrestrial Effects 16
7.1.1 BFN Site and Surroundings 16
7.1.2 Transmission Facilities 29
7.1.3 Electric Shock and Electromagnetic Field 30
7.1.4 Non-Radiological Waste Streams 31
7.1.5 Noise 33
7.1.6 Terrestrial Biota 37
7.1.7 Air Impacts 39
7.1.8 References 40
7.2 Hydrology and Aquatic Ecology Effects 42

7.2.1 Wheeler Reservoir 42
7.2.2 Impact on Withdrawal 43
7.2.3 Impact on Discharge 43
7.2.4 Fish 54
7.2.5 Benthic Organisms 62
7.2.6 Entrainment and Impingement of Fish 72
7.2.7 Threatened and Endangered Species – Aquatic 75
7.2.8 References 78

8.0 RADIOLOGICAL ENVIRONMENTAL IMPACTS 82

8.1 Radiological Waste Streams 82

8.1.1 Solid Low Level Radioactive Waste 83
8.1.2 Liquid Waste 85
8.1.3 Gaseous Waste 87
8.1.4 Spent Fuel 89

8.2 Radiation Levels and Offsite Doses 89

8.2.1 Occupational Radiation Dose (Onsite Dose) 89
8.2.2 Radiological Impacts Normal Operation (Offsite Dose) 90

8.3 Radiological Consequences of Accidents 94

8.3.1 Radiological Impacts—Accident Related 94

8.4 References 96

9.0 ENVIRONMENTAL EFFECTS OF URANIUM FUEL CYCLE ACTIVITIES AND FUEL AND RADIOACTIVE WASTE TRANSPORT 97

9.1 References 99

10.0 EFFECTS OF DECOMMISSIONING 100

10.1 References 101

List of Figures

Figure 7.1-1: Recorded Architectural Resources Within 6 Miles of BFN, Coded by NRHP Status 18
Figure 7.1-2: Residential Subdivisions Within 2-Mile Radius of BFN 36
Figure 7.2-1: Classification of Summer Hydrothermal Conditions for the Tennessee River Valley....53

List of Tables

Table 2.2-1: BFN NEPA Documentation[1] 7
Table 7.1-1: Annual Hazardous Waste Generation 32
Table 7.1-2: Federally Listed and State-Listed as Protected Terrestrial Animals Reported From or With Potential to Occur in Limestone County, Alabama 38
Table 7.2-1: BFN Cooling Tower Characteristics, October 2014 48
Table 7.2-2: Basic Assumptions for BFN Hydrothermal Modeling 50
Table 7.2-3: Summary of BFN Hydrothermal Impacts for Warm, Summer Meteorology 52
Table 7.2-4: Summary of Autumn RFAI Scores 57
Table 7.2-5: Species Collected Upstream (TRM 295.9) of BFN Discharge—Autumn 2013 58
Table 7.2-6: Species Collected Downstream (TRM 292.5) of BFN Discharge—Autumn 2013 60
Table 7.2-7: Summary of RBI Scores 65
Table 7.2-8: Mean Density of Benthic Taxa Upstream and Downstream of BFN, Autumn 2013 66
Table 7.2-9: Mussel Species Collected by Alabama Game and Fish Division Near BFN and Upstream From BFN to Guntersville Dam, 1995–2000 69
Table 7.2-10: Mussels Collected in Ponar Dredge Samples 71
Table 7.2-11: Aquatic Listed Species Known to Occur Within Tributaries to Wheeler Reservoir, in a 10-Mile Radius of BFN, and From Tennessee River Miles 274.9 to 310.7 77
Table 8.1-1: BFN Average Annual Low-Level Radioactive Waste Shipped Off Site, 2009-2013 84
Table 8.1-2: Liquid Effluent Releases From BFN, 2009–2013 86
Table 8.1-3: Gaseous Effluent Releases From BFN, 2009–2013 88
Table 8.2-1: Average Offsite Dose Commitments From Liquid Effluents 93
Table 8.2-2: Average Offsite Dose Commitments From Gaseous Effluents 93
Table 8.3-1: Summary of Radiological Consequences of Postulated Accidents 95

List of Acronyms, Abbreviations, and Symbols

Acronym	Definition
^{o}F	degrees Fahrenheit
ADEM	Alabama Department of Environmental Management
AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
ATL	alternate thermal limits
APE	area of potential effects
AST	alternative source term
BFN	Browns Ferry Nuclear Plant
BIP	Balanced Indigenous Populations
BLEU	blended low enriched uranium
BWR	boiling water reactor
CCW	condenser circulating water
cfs	cubic feet per second
CLTP	current licensed thermal power
CPPU	constant pressure power uprate
CT	cooling tower
CWA	Clean Water Act
dBA	decibels A-weighted scale
DBA	design basis accident
DO	dissolved oxygen
DOE	U.S. Department of Energy
EA	environmental assessment
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
EPU	extended power uprate
ER	environmental report
ERM	Elk River Mile
FES	final environmental statement

FICON	Federal Interagency Committee on Noise
FONSI	finding of no significant impact
FSEIS	final supplemental environmental impact statement
FY	fiscal year
GEIS	generic environmental impact statement
gpm	gallons per minute
GWh	gigawatt-hour
GWPP	groundwater protection program
HEU	highly enriched uranium
hp	horsepower
IRP	Integrated Resource Plan
ISFSI	independent spent fuel storage installation
kV	kilovolt
L_{dn}	day/night sound level
L_{eq}	equivalent sound level
LEU	low enriched uranium
LLRW	low-level radioactive waste
LRA	license renewal application
MGD	million gallons per day
MW	megawatt
MWd/MTU	megawatt-days per metric ton of uranium
MWt	megawatts thermal
MVAR	mega volt-ampere reactive
NEI	Nuclear Energy Institute
NESC	National Electrical Safety Code
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NPG	Nuclear Power Group (TVA)
NRC	U.S. Nuclear Regulatory Commission

NRHP	National Register of Historic Places
ODCM	Offsite Dose Calculation Manual
OLTP	original licensed thermal power
PFOS	perfluorooctane sulfonate
PUSAR	Power Uprate Safety Analysis Report
QA	quality assurance
RBI	Reservoir Benthic Index
RCRA	Resource Conservation and Recovery Act
REMP	Radiological Environmental Monitoring Program
RFAI	Reservoir Fish Assemblage Index
ROD	record of decision
RWCU	reactor water cleanup system
SVC	Static VAR Compensator
SEIS	supplemental environmental impact statement
SHPO	State Historic Preservation Officer
TLTP	target licensed thermal power
TRM	Tennessee River Mile
TVA	Tennessee Valley Authority
TWh	terawatt-hours
UFSAR	Updated Final Safety Analysis Report
USACE	U.S. Army Corps of Engineers
WMA	wildlife management area

1.0 EXECUTIVE SUMMARY

This supplemental environmental report (ER) contains the Tennessee Valley Authority's (TVA's) assessment of the environmental impacts of a proposed output power increase for Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3. Each unit was originally licensed to operate at 3,293 megawatts thermal (MWt). The proposed increase is from the current operating limit of 105 percent of the original licensed thermal power (OLTP), or 3,458 MWt, to 120 percent OLTP, or 3,952 MWt, for each unit. The increase to 105 percent OLTP was termed a "stretch" uprate, and the increase to 120 percent OLTP is termed an extended power uprate (EPU). The intent of this supplemental ER is to provide information needed by the U.S. Nuclear Regulatory Commission (NRC) to evaluate the environmental impact of the power uprate in accordance with 10 CFR Part 51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions.

EPU for BFN Units 1, 2, and 3 does not require extensive changes to plant systems that directly or indirectly interface with the environment. With the exception of ~~capacitor bank~~reactive compensation installations at five substation locations ~~distant~~ offsite from BFN, all other modifications will be in or on existing BFN structures; none will involve disturbing additional land or constructing new facilities outside the existing plant areas. There will be no increase in condenser circulation (cooling) water, and BFN will maintain compliance with its National Pollutant Discharge Elimination System (NPDES) permit through use of the cooling towers or, if needed, by derating. The rate of low-level radioactive waste (LLRW) generation would increase slightly compared to the current rate, but would still be bounded by the BFN environmental licensing basis; this is also true for gaseous radiological emissions. Offsite radiation doses will remain small and within applicable regulatory limits. The number of dry storage casks of spent fuel would also increase.

As a federal agency subject to the requirements of the National Environmental Policy Act (NEPA), TVA evaluates the effects on the environment of all proposed actions. The environmental impacts of operating BFN Units 1, 2, and 3 at 120 percent OLTP are bounded by the impacts described in this supplemental ER, the revised response to NRC request for additional information (RAI) RERP-~~RAI-GE-2~~GE-RAI 2, and previous BFN environmental reviews and are appropriately constrained by applicable regulatory limits. TVA also concludes that human health and the environment would not be significantly affected.

2.0 INTRODUCTION

TVA operates BFN Units 1, 2, and 3 in Limestone County, Alabama, consistent with its broad responsibilities for the natural and social well-being of the Tennessee Valley Region as charged under the Tennessee Valley Authority Act of 1933. TVA is committed to operating BFN in a manner that will protect the environment and preserve natural resources while producing safe, reliable, and economical electric power. In keeping with this charge, TVA is requesting a license amendment to allow BFN Units 1, 2, and 3 to operate at up to 120 percent OLTP, deemed an EPU. As discussed in Section 2.2, the units have already been uprated by 5 percent, thus, the remaining power increase being requested is approximately a 15-percent increase for each BFN unit.

In June 2004, TVA submitted two license amendment requests for increasing the output power level of the three BFN units to 120 percent OLTP. One submittal addressed EPU of Units 2 and 3, and the other submittal addressed EPU of Unit 1. On September 22, 2006, TVA submitted a supplement to the application for EPU of BFN Unit 1 that requested interim operation at 105 percent OLTP. On March 6, 2007, NRC issued Amendment No. 269 to Renewed Facility Operating License No. DPR-33 for BFN Unit 1, allowing an operating power increase of Unit 1 from 3,293 to 3,458 MWt. TVA subsequently withdrew the 2004 EPU license amendment requests and corresponding ERs on September 18, 2014.

This revised supplemental ER, which addresses the environmental impacts of EPU for all three units, replaces the ER for Unit 1 and the ER for Units 2 and 3 that were submitted in June 2004. As a supplemental ER, this document supplements the NEPA documentation currently in place for previous licensing actions, as discussed in Section 2.2 and summarized in Table 2.2-1, and is intended as input for NRC's NEPA review of the requested EPU at BFN Units 1, 2, and 3.

2.1 Browns Ferry Nuclear Plant History and Background

BFN is located on an 840-acre tract located on the north shore of Wheeler Reservoir at Tennessee River Mile (TRM) 294 in Limestone County, Alabama, approximately 10 miles northwest of Decatur, Alabama, and 10 miles southwest of Athens, Alabama. TVA began major construction on BFN in 1967.

As a federal agency subject to the requirements of NEPA, enacted in 1969, TVA evaluated the effects on the environment of construction and operation of BFN in a three-volume document entitled *Final Environmental Statement, Browns Ferry Nuclear Plant, Units 1, 2, and 3* (FES), and dated September 1, 1972. The U.S. Atomic Energy Commission (AEC) participated in the preparation of the FES as a cooperating agency. The AEC concluded on August 28, 1972, that the FES was adequate to support the proposed license to operate the plant. The FES was sent to the Council on Environmental Quality and made available to the public on September 1, 1972.

BFN has three General Electric boiling water reactors (BWRs) and associated turbine generators that can produce more than three billion watts of power. Each of BFN's three nuclear reactors is connected to its own dedicated generator. Unit 1 began commercial operation in August 1974, Unit 2 in 1975, and Unit 3 in 1977. A fire shut down BFN Unit 1 in 1975 for over a year. All three units were taken off line in 1985 when TVA idled its nuclear fleet. After an extended shutdown to review the TVA nuclear power program and to correct significant weaknesses, TVA returned Unit 2 to service in May 1991, Unit 3 in November 1995 and, following extensive repairs and refurbishment, Unit 1 came back on line in May 2007. In 1998, BFN completed an Integrated Plant Improvement Project for Units 2 and 3 which, among other improvements, resulted in an NRC-approved 5-percent uprate of OLTP for each unit. The cooling towers serving Units 1, 2, and 3 have also undergone replacement in the past years with the last two of the original six cooling towers being currently planned for replacement in fiscal year (FY) 18 and FY19. To increase total plant cooling capacity, a new and larger cooling tower was constructed in May 2012.

TVA submitted a license renewal application (LRA) to the NRC in December 2003 for renewal of the facility operating licenses for each BFN unit. The NRC issued *Supplement 21 Regarding Browns Ferry Nuclear Plant Units 1, 2, and 3* to the Generic EIS for License Renewal of Nuclear Plants (NUREG-1437) in June 2005. NRC issued the renewed operating licenses for Units 1, 2, and 3 in May 2006, allowing continued operation of the three BFN units until 2033, 2034, and 2036, respectively.

2.2 Related Power Uprate Submittals and NEPA Documentation

As mentioned above, the BFN FES was prepared by TVA with the AEC as a cooperating agency to assess the effects on the environment of construction and operation of BFN and was issued in 1972.

To support a 5-percent uprate of OLTP for Units 2 and 3, termed a "stretch uprate", TVA prepared an environmental assessment (EA) dated August 1997, and a finding of no significant impact (FONSI) was issued by TVA on August 28, 1997. In response to TVA's application of October 1, 1997, for the 5-percent uprate on Units 2 and 3, the NRC issued an EA and FONSI of its own on August 26, 1998, and an amendment to the BFN operating licenses for Units 2 and 3 was approved by the NRC for the 5-percent uprate on September 8, 1998. Later, on March 6, 2007, the NRC approved an amendment to the BFN Unit 1 operating license allowing the same 5-percent "stretch" operating power increase (3,293 MWt to 3,458 MWt) as for Units 2 and 3.

Following review of licensing topical reports NEDC-32424P-A, "Generic Guidelines for General Electric Boiling Water Reactor Extended Power Uprate," dated February 1999, and NEDC-32523P-A, "Generic Evaluations of General Electric Boiling Water Reactor Extended Power Uprate," dated February 1999, the NRC concluded that the reports provided an acceptable methodology to uprate the power output of BWRs, such as the BFN units, up to 120 percent OLTP. Subsequent to these NRC's reviews, TVA initially pursued EPUs for Units 2 and 3.

TVA completed the *Browns Ferry Nuclear Plant Extended Power Uprate for Units 2 and 3 Environmental Assessment* in March 2001. This assessment described the potential environmental effects of increasing thermal output power from BFN Units 2 and 3 from 105 percent to 120 percent OLTP. A FONSI was issued for the proposed project contingent upon certain mitigation measures for rendering increased thermal loads to surface waters insignificant. At that time, thermal impact mitigation measures included construction of a new 16-cell cooling tower and the use of existing cooling towers. Following completion of this EA, on April 18, 2001, the TVA Board approved the EPU project for BFN Units 2 and 3.

After the Units 2 and 3 EPU FONSI was issued, additional technical analyses completed in late 2001 predicted that without the new cooling tower the plant would need to derate for no more than 183 hours in a 10-year period to stay in compliance with thermal limits. Subsequent refinements of the modeling effort in the summer of 2003, using 16 years of data, predicted that operation of the BFN Units 2 and 3 at 120 percent OLTP without the proposed new cooling tower was projected to need no more than 128 hours of derating in a 16-year period. Further economic analysis indicated that due to transmission system improvements, the cost of replacement power for 128 hours over a 16-year period would not be enough to justify construction of a new cooling tower as a part of the EPU project for Units 2 and 3. Based upon these modeling refinements, on August 7, 2003, TVA issued a new EA and FONSI for the Units 2 and 3 EPU project. This EA and FONSI concluded that implementation of EPU using the existing five cooling towers would not have a significant impact on the quality of the environment, contingent upon derating as necessary to remain compliant with NPDES permit discharge temperature limits and continuation of aquatic monitoring programs for 3 years after EPU.

In June 2004, TVA submitted two license amendment requests to the NRC for increasing the output power level of the three BFN units to 120 percent OLTP. One submittal addressed EPU of Units 2 and 3, and the other submittal addressed EPU of Unit 1 separately because, unlike the other two units, it had not undergone the 5-percent “stretch” uprate and was therefore seeking approval to go directly to 120 percent OLTP. On September 22, 2006, TVA submitted a supplement to the application for EPU of BFN Unit 1 that requested interim operation at 105 percent OLTP until certain steam dryer analyses could be completed. On March 6, 2007, NRC issued Amendment Number 269 to Renewed Facility Operating License No. DPR-33 for BFN Unit 1, allowing an operating power increase to 3,458 MWt. Subsequently, TVA withdrew the 2004 EPU license amendment requests on September 18, 2014.

To support a separate licensing action, application for renewal of BFN Units 1, 2, and 3 operation licenses, TVA completed work in March 2002 on *Final Supplemental Environmental Impact Statement for Operating License Renewal of the Browns Ferry Nuclear Plant in Athens, Alabama* (FSEIS), which also included an assessment of the impact of recovering and restarting Unit 1. Renewal of the operating licenses of all three units would allow operation to continue for an additional 20 years past the original 40-year operating license terms, which expired or will expire in 2013, 2014, and 2016 for Units 1, 2, and 3, respectively. A Record of Decision (ROD) was approved by the TVA Board in May 2002 and published in the June 18, 2002 *Federal Register*. The FSEIS and ROD acknowledge that restart of Unit 1 and operation of all three

units at EPU up to 120 percent of the originally licensed power level would require additional cooling tower capacity beyond what was available at that time (2002). Therefore, the preferred alternative, as stated in the FSEIS and confirmed in the ROD, included the addition of a new 20-cell mechanical draft cooling tower to replace cooling tower 4 which was destroyed by fire in 1986.

As discussed in Section 2.1, TVA submitted an LRA to the NRC in December 2003 for renewal of the operating licenses for each BFN unit. The LRA contained an extensive ER, which updated analyses in some subject matter areas presented in the FSEIS, including thermal discharge (i.e., main condenser cooling water effluent temperatures and mixing characteristics); however, the basic conclusions of the FSEIS remained unaltered. A notice of receipt and availability of the application was published in the *Federal Register* on March 10, 2004 (69 FR 11462). The NRC issued *Supplement 21 Regarding Browns Ferry Nuclear Plant Units 1, 2, and 3,* to the Generic EIS for License Renewal of Nuclear Plants (NUREG-1437) in June 2005. The renewed operating licenses for Units 1, 2, and 3 were issued in May 2006, allowing continued operation of the three BFN units until 2033, 2034, and 2036, respectively.

During the summer of 2010, derates to below 50 percent power were required at BFN for several days in July and about half of August to meet the NPDES permit maximum allowable cooling water discharge temperature. To provide more efficient cooling and additional capacity needed for current operations and future uprates, TVA pursued replacement of four original cooling towers (CTs 1, 2, 5, and 6) with larger towers and the construction of an additional, much larger mechanical draft cooling tower (CT 7). In October 2010, TVA issued an EA and a FONSI for the *Browns Ferry Nuclear Plant Cooling Towers Addition and Replacements*. In addition, to support replacement of CT 3 with a more modern tower, TVA completed a supplemental EA and a FONSI in December 2012.

Currently, all but two of the six original cooling towers have been replaced and upgraded. CTs 1 and 2 are currently planned for replacement in FY18 and FY19. With the addition of CT 7, the current fleet of seven cooling towers is sufficient to maintain NPDES permit compliance. Details of current cooling tower characteristics are described in Table 7.2-1, BFN Cooling Tower Characteristics, October 2014.

TVA performed an Interconnection System Impact Study (SIS) to evaluate the impact of the additional power from the proposed BFN EPU on the TVA transmission system. ~~The~~ Revision 3 of the Interconnection SIS identified transmission system and BFN main generator excitation system ~~upgrades~~ modifications needed to support the planned BFN unit uprates. The environmental reviews of the transmission system and BFN main generator excitation system ~~upgrades~~ modifications are described in the revised response to NRC RERP-GE-RAI 2~~RAI-GE-2~~.

2.2.1 References

69 FR 11462. Tennessee Valley Authority, Browns Ferry Nuclear Plant, Units 1, 2, and 3; Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process. *Federal Register* 69:11462 (March 10, 2004).

ADEM (Alabama Department of Environmental Management). 2002. “Final listing decision for Wheeler Reservoir on the Tennessee River waterbody identification number AL/Wheeler_Res01 pH temperature/thermal modification.”

Table 2.2-1: BFN NEPA Documentation[1]

NEPA Document	Decision
Operation of BFN	
Final Environmental Statement, Browns Ferry Nuclear Plant, Units 1, 2, and 3, August 1972 Prepared by TVA to evaluate the effects on the environment of construction and operation of BFN. The U.S. Atomic Energy Commission participated in the preparation of the FES as a cooperating agency.	ROD issued August 28, 1972
Final Supplemental Environmental Impact Statement for Operating License Renewal of the Browns Ferry Nuclear Plant in Athens, Alabama, March 2002 Prepared by TVA to seek extension of NRC licenses for BFN Units 1 through 3 at 120 percent OLTP for an additional 20 years beyond the original 40-year operating license terms. Mitigation measures for increased thermal loads to surface waters included use of existing cooling towers, construction of a new cooling tower, and derating the plant as necessary.	ROD issued May 16, 2002
License Renewal Application for Browns Ferry Nuclear Plant Units 1, 2, and 3, December 2003 Prepared by TVA to apply for renewal of BFN's operating licenses for an additional 20 years.	December 2003
Supplement 21 Regarding Browns Ferry Nuclear Plant Units 1, 2, and 3 to the Generic EIS for License Renewal of Nuclear Plants (NUREG-1437), June 2005 Prepared by NRC to evaluate the continued operation of BFN Units 1, 2, and 3 during a 20-year renewed license term at OLTP or at EPU of 120 percent.	June 2005
Power Uprates	
Browns Ferry Nuclear Plant Units 2 and 3 Power Uprate Project EA, August 1997. TVA prepared the EA to pursue action to request license amendment from NRC to increase BFN Units 2 and 3 maximum power level to 105 percent OLTP.	FONSI issued August 28, 1997
NRC-issued EA and FONSI NRC prepared this EA to support an amendment to the BFN operating licenses for Units 2 and 3 for a 5-percent uprate on September 8, 1998.	August 26, 1998

NEPA Document	Decision
Browns Ferry Nuclear Plant Extended Power Uprate for Units 2 and 3 Environmental Assessment, March 2001 This assessment described the potential environmental effects of increasing thermal output power from BFN Units 2 and 3 from 105 percent to 120 percent OLTP. A FONSI was issued for the proposed project contingent upon certain mitigation measures for rendering increased thermal loads to surface waters insignificant. At that time, thermal impact mitigation measures included construction of a new 16-cell cooling tower and the use of existing cooling towers.	FONSI issued March 15, 2001
Browns Ferry Nuclear Plant Extended Power Uprate for Units 2 and 3 EA, August 2003 Based on new technical and economic analyses, TVA prepared this new EA and FONSI. It concluded that implementation of EPU using the existing five cooling towers would not have a significant impact on the quality of the environment, contingent upon derating as necessary to remain compliant with NPDES permit discharge temperature limits and continuation of aquatic monitoring programs for three years after EPU.	FONSI issued August 7, 2003
Cooling Tower Replacement and Upgrades	
Final Environmental Assessment Browns Ferry Nuclear Plant Cooling Towers Addition and Replacements, October 2010 To provide more efficient cooling and additional capacity needed for current operations and future uprates, TVA prepared this EA for replacement of CTs 1, 2, 5, and 6 and a new CT 7.	FONSI issued October 28, 2010
Browns Ferry Nuclear Plant Cooling Tower 3 Replacement Supplemental EA, December 2012 In July 2012, CT 3 partially collapsed. To support its replacement with a more modern tower that included larger fan motors and a larger cold water basin, TVA prepared this supplemental EA.	FONSI issued December 6, 2012

1. Listing of BFN NEPA documentation pertinent to power uprates.

3.0 PURPOSE OF AND NEED FOR ACTION

3.1 The Proposed Action

In response to the increasing (continuing) demands for bulk power, TVA is requesting a license amendment for EPUs to increase the reactor thermal power for BFN Units 1, 2, and 3 such that each unit can be operated at 120 percent OLTP (3,293 MWt) or 3,952 MWt. Use of existing facilities to the greatest extent possible has the three-fold benefit of assuring future power supplies, avoiding the large capital outlays associated with new construction, and avoiding the environmental impacts from siting and constructing a new power generating facility.

Under the current schedule, EPU would be implemented at Unit 1 during the scheduled refueling outage in fall 2018 (Refueling Outage—Unit 1 Cycle 12), at Unit 2 in spring 2019 (Refueling Outage—Unit 2 Cycle 20), and at Unit 3 during spring 2018 (Refueling Outage—Unit 3 Cycle 18). Upon approval of the EPU by the NRC, each unit would begin operating at the uprated power level following the outages identified above.

3.2 Need for TVA Action

Determination of a need for power begins with long-term forecasts of the growth in demand for electricity, both in terms of peak demand and energy sales to the end-user. TVA estimates that energy consumption will increase at a compound annual growth rate of 1.2 percent from 2015 to 2020, with moderate growth continuing beyond 2020. The total firm capacity of existing resources decreases over time primarily due to retirement of coal-fired units and the expiration of existing power purchase agreements.

Watts Bar Unit 2 is anticipated to be operational by the end of 2015 and will add approximately 1,150 MW of nearly zero carbon emission generating capacity to the system. However, by spring 2016, five coal units totaling more than 1,000 MW will be idled or retired. Since 2011, TVA has retired, or plans to retire by 2019, more than 6,500 MW (net dependable capacity) of coal-fired generation.

TVA estimates that, with current resources and those planned to be available, when compared to the demand forecast, additional capacity and energy of 2,400 MW and almost 10,000 GWh will be needed in 2020. The BFN EPUs would offer lower-cost, nearly zero carbon emission base-load power without the high capital cost typical of most nuclear power additions.

3.3 Alternatives to the Proposed Action

TVA considered various alternatives to the proposed action. If the proposed action is not undertaken, TVA would need to supply system energy and capacity needs from other resources.

In the "No Action" alternative, where the BFN EPU project is not approved, TVA would need to purchase market capacity and/or employ new gas generation without the uprates in order to

satisfy firm requirements. Both of these actions raise system fixed and capital costs relative to the proposed action. Energy requirements would need to be met with coal and gas generating resources and spot energy purchases resulting in higher system operational costs.

4.0 OVERVIEW OF OPERATIONAL AND EQUIPMENT CHANGES

Increasing the electrical output of a BWR power plant is accomplished primarily by generating higher steam flow in the reactor and supplying it to the turbine generator. The activities needed to produce thermal power increases are a combination of those that directly produce more power and those that will accommodate the effects of the power increase. The additional reactor energy requirements for extended power are accomplished by increasing the reload fuel batch size, changing the fuel loading pattern, and changing the planned deployment of fuel enrichment and burnable poison. This is operationally accomplished by enhancements to core management throughout the fuel cycle. These enhancements address both control rod pattern and core flow management. Collectively, the core design and operational enhancements that achieve the increase in core thermal power result in a more uniform power distribution. Therefore, operating at EPU conditions will not challenge fuel design limits.

As part of the EPU project, plant systems have been analyzed to determine modifications required to support changes in system operation. The majority of these modifications are to address the increase to reactor steam and feedwater flow. A complete list of planned modifications is provided in Attachment 47. A representative list, but not all inclusive of the modifications to plant equipment necessary for EPU implementation, is as follows:

- Modifications to the high-pressure turbine
- Replacement of reactor feedwater pumps
- Installation of higher capacity condensate booster pumps and motors
- Modifications to the condensate demineralizer system
- Modifications to the feedwater heaters
- Replacement of the reactor pressure vessel steam dryers
- Upgrades of miscellaneous instrumentation, setpoint changes, and software modifications
- Modifications to the main generator excitation systems

All onsite modifications will be within the existing structures, buildings, and fenced equipment yards that currently house the major unit components. The project will make use of existing parking lots, road access, laydown areas, offices, workshops, warehouses, and restrooms located in previously disturbed surface areas at BFN. Transmission Planning has conducted and revised an ~~-~~Interconnection SIS and identified transmission system upgrades that are required for EPU. These upgrades include installation of a minimum of 764 megavolt-ampere reactive (MVAR) ~~capacitor banks~~reactive compensation at five substation locations ~~distant~~ offsite from BFN and upgrading six 500 kilovolt (kV) breaker failure relays, and modifying the main generator excitation systems.

All deliveries of materials to support the work identified above will be by truck. Equipment will be unloaded on site with equipment typical to material receipt and construction activities and will be temporarily stored in existing storage buildings and laydown areas. Existing land uses will not be altered.

5.0 SOCIOECONOMIC AND ENVIRONMENTAL JUSTICE CONSIDERATIONS

5.1 Socioeconomics

BFN is located in Limestone County, Alabama, which is part of the Huntsville Metropolitan Area. The population of Limestone County in 2010 was 82,782. The primary labor market area for the plant consists of three metropolitan areas: Huntsville (Limestone and Madison counties), Decatur (Lawrence and Morgan counties), and Florence (Colbert and Lauderdale counties). The 2010 population of these three metropolitan areas combined was 718,559. (USCB 2010) Based on 2013 data, the labor force in Limestone County was 40,640; the primary labor market area had a labor force of 351,412. The unemployment rate in 2013 was 5.5 percent in Limestone County, while the average in the primary labor market area was 5.8 percent. Both Limestone County and the labor market area had lower unemployment rates than did the state (7.2 percent) and the nation (7.4 percent). (BLS 2013)

5.1.1 Payments in Lieu of Taxes

TVA does not pay property taxes; however, in accordance with federal law, Section 13 of the TVA Act, 16 U.S.C. §8311, it makes payments in lieu of taxes to states and counties in which its power operations are carried on and in which it has acquired properties previously subject to state and local taxation. Under Section 13, TVA pays 5 percent of its gross power revenues to such states and counties. Only a very small share of the payments is paid directly by TVA to counties; most is paid to the states, which use their own formulas for redistribution of some or all of the payments to local governments. TVA's payments in lieu of taxes are apportioned among the state and counties according to the state's allocation formula but, in general, half of the payment is apportioned based on power sales and half is apportioned based on the "book" value of TVA power property. Therefore, for a capital improvement project such as EPU, the in-lieu-of-tax payments are affected in two ways: (1) as power sales increase, the total amount of the in-lieu-of-tax payment to be distributed increases, and (2) the increased "book" value of BFN causes a greater proportion of the total payment to be allocated to Limestone County. The state's general fund, as well as all counties in Alabama that receive TVA in-lieu-of-tax distributions from the State of Alabama, benefit under this method of distribution. In 2014, TVA's payments in lieu of taxes to Alabama were approximately $104 million. Limestone County's share was approximately $8.3 million, largely because of the TVA fixed assets (BFN) in the county.

5.1.2 Project Employment

Under the current EPU schedule, implementation would occur at Unit 1 during the scheduled refueling outage in fall 2018 (Refueling Outage—Unit 1 Cycle 12), at Unit 2 in spring 2019 (Refueling Outage—Unit 2 Cycle 20), and at Unit 3 during spring 2018 (Refueling Outage—Unit 3 Cycle 18). Typically, the increased staffing for an outage is 800–1,200 supplemental workers for an average of 1,000. Supplemental staffing ramps up 2 to 3 weeks prior to the outage start

with maximum staffing reached at about Day 3 of the outage and continuing until Day 21 to 28 when ramping down usually begins, whereby normal staffing is reached 1 week after the end of the outage. TVA's current business plan outage duration is 35 days or less. BFN typically targets 25- to 30-day durations.

The EPU work will be coordinated with other outage activities and completed by workers who have other outage duties as well. An estimated 10 percent or less of the average supplemental workforce of 1,000 will be dedicated to the EPU portion of the outage work. The maximum employment level for all outage work would represent about 2.5 percent of the current labor force of Limestone County and about 0.3 percent of the labor force in the primary labor market area.

5.1.3 Impacts on the Area

In addition to the areas included in the primary labor market area, the Birmingham, Alabama, and Nashville, Tennessee, areas are sources of workers for the proposed activity. Workers from these areas generally would commute rather than relocate for the relatively short duration of the proposed activity. TVA experience at BFN suggests that it is likely that less than half of all the workers hired for outage activities would move into the primary labor market area. The remaining workers generally would already reside within the primary labor market area or locations, such as the Birmingham or Nashville areas, close enough to commute on a temporary basis. Based on this, it is anticipated that the maximum impact from workers moving into the area would be about 400 to 450 workers, not all resulting from this proposed action. Because of the very short-term nature of the work, about five weeks, and the short duration of the maximum employment level, very few workers who do move in are expected to bring families with them. It is not likely that the increased population in the area due to all outage activities would exceed about 450 persons. However, it is possible that the demand for the required skills would make recruiting difficult, resulting in a somewhat larger number of workers moving temporarily into the local area.

Due to the short duration of the project, the total impact on annual earnings and income in Limestone County and in the labor market area would be very small and insignificant. Impacts on community services such as police, fire, and medical would also be very small and insignificant because of the small size of the impact on population, dispersal of the workers who move within the labor market area, and the short duration of the maximum workforce.

After it is implemented, the EPU project is not expected to affect the size of the BFN permanent workforce and would not have a material effect on the labor force required for future plant outages; however, there would be some continuing positive benefits to the local economy. Capitalization of some costs associated with the EPU would increase the "book" value of BFN and thereby result in a small increase in the in-lieu-of-tax payments received by Limestone County. EPU would also have a positive impact on the long-term viability of BFN as described in Chapter 6.0 (Cost-Benefit Analysis) of this report.

5.2 Environmental Justice

The population of Limestone County is 21.3 percent minority (non-white), well below both the state of Alabama (33.0 percent) and the nation (36.3 percent) (USCB 2010). The labor market area has a higher minority population share (26.5 percent), still well below the state and national levels. The "below the poverty threshold rate" in Limestone County is 13.3 percent, lower than both the state average of 18.1 percent and the national average of 14.9 percent. The poverty rate in the labor market area is 14.1 percent, higher than Limestone County, but still lower than the state and the nation. (USCB 2012) Almost all of the activity associated with the proposed action would occur inside the plant, further removing it from the population in the surrounding area. Also, no significant negative impacts to the environment are expected if the proposed action occurs. Therefore, no disproportionate negative impacts to disadvantaged populations are expected.

5.3 Conclusion

The favorable cost effectiveness of the EPU project compared with that for any other means of new generation, and the associated reduction in incremental operating costs, make the project economically attractive; this, in turn, allows it to contribute to keeping BFN a competitive electric power producer for years to come. Maintaining BFN as a reliable equal opportunity employer, in-lieu-of-tax provider, and source of reliable and clean electric power contributes a measure of stability and prosperity to the local social structure.

5.4 References

BLS (U.S. Bureau of Labor Statistics). 2013. U.S. Bureau of Labor Statistics 2013 Annual Data.

USCB (U.S. Census Bureau). 2010. Census of Population, 2010 and American Fact Finder.

USCB. 2012. American Fact Finder 2012 Alabama Poverty Data, 2012 USA Poverty Data, U.S. Bureau of the Census, American Community Survey.

6.0 COST-BENEFIT ANALYSIS

TVA performed analysis to study the cost effectiveness of implementing EPUs at the BFN site. The proposed EPUs provide additional supply of approximately 155 MW per unit (465 MW total) capacity and approximately 4 terawatt-hours (TWh) of reliable energy to the TVA system. The EPU project is expected to be economically beneficial by $450 million through the end of the current operating licenses at Browns Ferry.

Based on TVA's load forecast, capacity plans have shown TVA would need to purchase market capacity and/or employ new generation without the uprates in order to satisfy firm requirements. Detailed model simulations were completed to estimate the capacity and energy (mostly fuel) cost impacts. The capacity savings from the EPU project are largely driven by deferring or reducing the need for new capacity. The low variable cost of the additional nuclear generation delivers significant fuel savings by offsetting more expensive coal generation, gas generation, and the need for market purchases. This also includes reduced carbon emissions. TVA projects the total cost of the project to be $479 million which includes transmission system upgrades.

An Interconnection SIS was also conducted to determine all adverse system impacts on TVA's transmission system caused by the EPUs at BFN. Revision 3 of the interconnection SIS identified ~~S~~several projects ~~are~~ required to mitigate the identified adverse system impacts and the estimated cost of these projects is $~~45~~75.5 million. The cost and timeframe for these required projects is significantly reduced from the prior study because TVA plans to install a static VAR compensator and to modify the excitation system for all three units at BFN instead of building a new 500 kV transmission line. While the transmission system upgrade expense lowers the economic benefit, it is still highly positive.

7.0 NONRADIOLOGICAL ENVIRONMENTAL IMPACTS

7.1 Terrestrial Effects

7.1.1 BFN Site and Surroundings

7.1.1.1 Land Use, Wetlands, and Natural Areas

The changes associated with EPU are within the existing structures, buildings, and fenced equipment yards housing the major unit components at the 840-acre BFN site. The project will make use of existing parking lots, road access, laydown areas, offices, workshops, warehouses, and restrooms located in previously disturbed surface areas at BFN. No other changes to BFN properties or immediately surrounding environs are expected. The only potential land use changes are associated with upgrades to the power transmission system ~~distant~~ offsite from BFN.

Site surveys conducted in 2003 (TVA 2003) indicated approximately 12 acres of wetlands present on the BFN site meet the U.S. Army Corps of Engineers (USACE) wetland parameters for federal jurisdictional wetlands which may be regulated under the Clean Water Act (CWA). However, no wetlands are present within areas proposed for construction activities associated with the proposed EPU. Therefore, the project would have no impacts or effects upon wetlands.

The TVA Natural Heritage database indicated on May 12, 2015, that two natural areas occur within a 6-mile vicinity of the project area. The Mallard-Fox Creek Wildlife Management Area (WMA) and the Swan Creek WMA. The Mallard-Fox Creek WMA is located across the Tennessee River from the BFN site. Swan Creek WMA is located approximately 5.2 miles upstream from the BFN site. The proposed EPU of BFN Units 1, 2, and 3 would not affect either WMA because, with the exception of installation of the SVC at Limestone substation and four capacitor banks at ~~five~~ locations ~~distant~~ offsite from BFN, construction work would occur within the boundaries of the BFN site. No offsite impacts from operation are expected at that location.

7.1.1.2 Cultural Resources and Visual Aesthetics

TVA complies with Section 106 of the National Historic Preservation Act (NHPA) for every TVA undertaking that has the potential to affect properties included or eligible for inclusion in the National Register of Historic Places (NRHP). TVA's practice includes identifying historic properties, evaluating project effects, and resolving any adverse effects to historic properties, in consultation with the appropriate parties including State Historic Preservation Officer(s) (SHPO) and tribal governments, pursuant to the procedures stipulated by 36 CFR 800.3-800.13. In addition, for any actions requiring compliance with NEPA, TVA considers the action's possible effects on historic structures, Native American religious or cultural properties, and archaeological sites.

In 2001, TVA conducted a Phase I archaeological survey during the preparation of the BFN Operating License Renewal Supplemental Environmental Impact Statement (SEIS) on three

areas within the BFN site that were proposed for use as disposal areas for soil that could be removed for some of the potential cooling tower expansion alternatives being considered in the SEIS (Gage 2001). Two historic properties were identified. One was an Early to Middle Woodland (600 B.C. to 1000 A.D.) occupation considered eligible for listing on the NRHP; the other was the Cox Cemetery, which was relocated during construction of BFN. Neither of these resources is located within the area of potential effects (APE) for the current EPU undertaking. The APE consists of the areas where ground-disturbing actions could occur as part of the undertaking. The current APE's potential to contain intact archaeological sites is low; native soils and sediments throughout most of the APE were destroyed during plant construction. However, photographs of plant construction taken in November 1968 and March 1969 (TVA 1968, 1969) indicate that the wooded hill along the southern border of the APE was not disturbed and could contain archaeological sites. Although facilities were added in that area at a later date, there remain approximately 4 acres of wooded area within the 840-acre BFN site that contain intact soils and sediments. No modern archaeological surveys have taken place in those areas and the presence or absence of archaeological sites there would have to be determined should TVA, in the future, propose an undertaking that would affect the wooded area and be subject to NEPA or NHPA Section 106.

BFN is considered by TVA to be eligible for listing in the NRHP under Criterion A (association with events that have made a significant contribution to the broad patterns of our history), based on an in-house assessment. Contributing resources include the powerhouse, water intake and skimmer, cooling towers, and the Aquatic Research Center. TVA found that the cooling tower replacements and addition of CT 7 would not appreciably alter the existing silhouette of BFN and would therefore have no visual effect. The Alabama SHPO agreed with this finding (Section 7.1.1.3).

Due to the time elapsed between that finding and the current ER, TVA researched current historic property records for above ground resources at the Alabama Historical Commission, in order to verify whether the APE contained any recently identified properties. Figure 7.1-1 shows all previously identified above-ground properties within a 6-mile radius of BFN. No architectural resources included or eligible for inclusion in the NRHP have been recorded within 3 miles of BFN. The nearest such resource is the Burt Cemetery, located approximately 3.5 miles southeast of the plant on the opposite side of the Tennessee River.

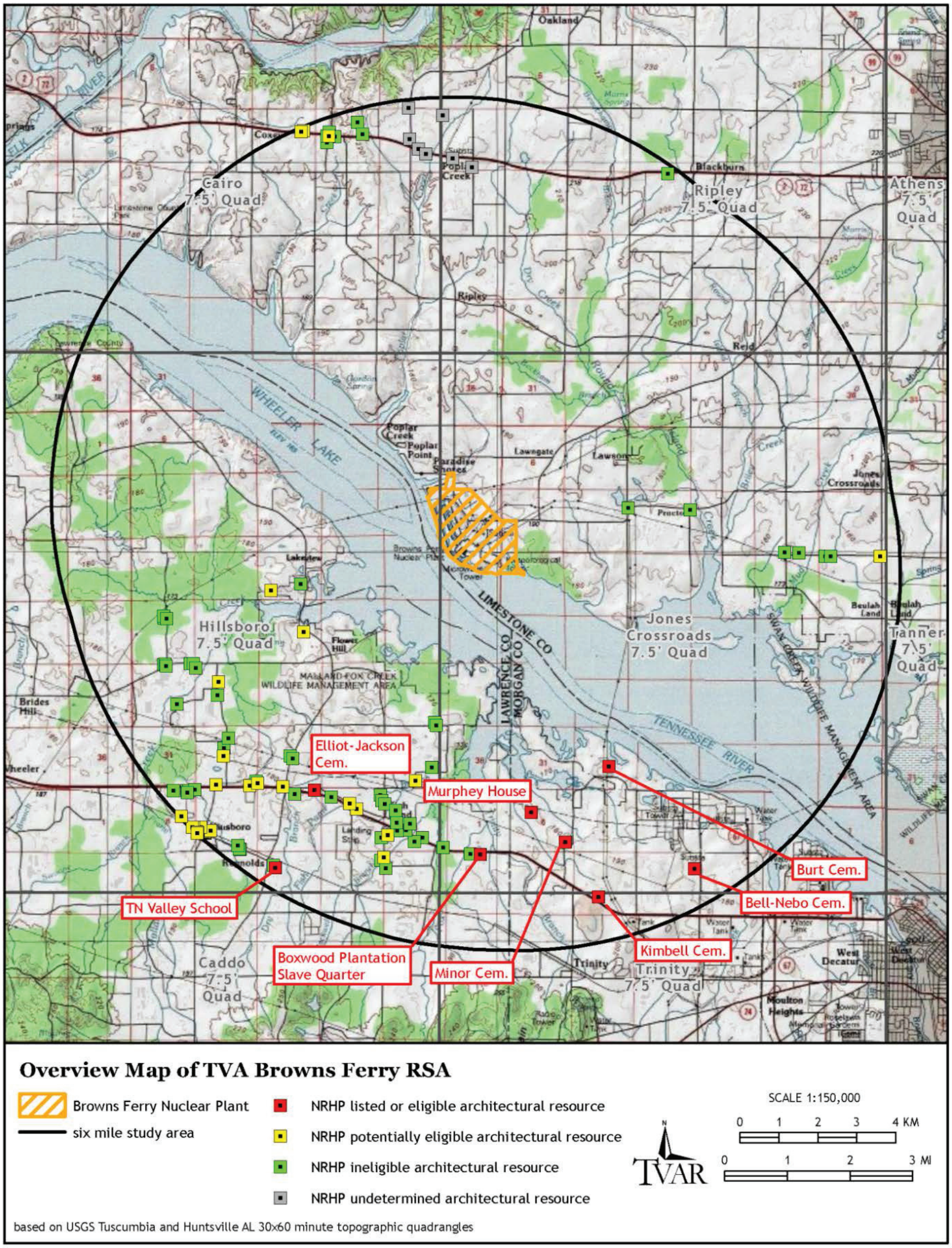


Figure 7.1-1: Recorded Architectural Resources Within 6 Miles of BFN, Coded by NRHP Status

7.1.1.3 Written Communications

To support a NEPA review of previously proposed construction activities by TVA for replacement of CTs 1, 2, 5, and 6 and construction of an additional cooling tower, CT 7, TVA consulted with the Alabama SHPO and federally recognized Indian tribes. TVA determined that no below-ground archaeological resources would be affected by the undertaking and the Alabama SHPO agreed. No tribes objected to the undertaking. The SHPO and tribal correspondence is included below.

Tennessee Valley Authority, 400 West Summit Hill Drive, Knoxville, Tennessee 37902-1499

September 24, 2010

Ms. Stacye Hathorn
Alabama Historical Commission
468 South Perry Street
Montgomery, Alabama 36130-0900

Dear Ms. Hathorn:

BROWNS FERRY NUCLEAR (BFN) POWER PLANT COOLING TOWER ADDITIONS, LIMESTONE COUNTY, ALABAMA

The Tennessee Valley Authority (TVA) proposes to replace four of six existing cooling towers (Towers 1, 2, 5, and 6) with larger units and construct one additional 25–30 cell linear mechanical draft cooling tower site at BFN (Figures 1 and 2). The four existing cooling towers would be demolished and rebuilt within the existing footprint. In 2001, TVA consulted with your office regarding the Environmental Impact Statement (EIS) for the relicensing of Units 1, 2, and 3 and additional cooling towers for BFN (AHC 2001-1439). Your office concurred with TVA that there would be no effect provided that 1LI535 could be avoided. The EIS did not include the currently proposed new cooling tower (Tower 7).

Tower 7 would be located along the east side of Shaw Road at the location of an existing perimeter ditch and includes the installation of a new pumping station, a cold water discharge canal, lift pumps and piping, and two new transformers (Figure 2). A portion of the ditch would be relocated directly northeast of proposed Tower 7 to maintain a perimeter ditch north of the new cooling tower. In addition, the cold water discharge canal is proposed between the north end of the spoil pile and the existing western perimeter ditch, and approximately a five-acre construction staging area is necessary.

TVA considers the archaeological area of potential effect (APE) to be the footprint where ground disturbance would take place (1LI535 is outside of the APE). TVA finds the proposed undertaking would not appreciably add to the existing silhouette of BFN and there would be no visual effect.

The archaeological APE has been extensively disturbed with the construction of BFN, such that no intact archaeological deposits would be present. It is TVA's finding that no cultural resources potentially eligible for the National Register of Historic Places (NRHP) would be affected by the proposed undertaking and no further investigations are recommended. Pursuant to 36 CFR Part 800, we are seeking your concurrence with TVA's findings and recommendations.

Pursuant to 36 CFR Part 800.3(f)(2), TVA is consulting with federally recognized Indian tribes regarding properties within the proposed project's APE that may be of religious and cultural significance and eligible for the NRHP.

Ms. Stacye Hathorn
Page 2
September 24, 2010

If you have any questions or comments, please call me or Richard Yarnell at telephone (865) 632-3463 or by e-mail at wryarnell@tva.gov.

Sincerely,

Eric Howard

A. Eric Howard
Federal Preservation Officer
Manager (Acting), Cultural Compliance
WT 11D-K

MH:RY:IKS
Enclosures
cc: Cynthia M. Anderson, LP 5D-C
Brenda E. Brickhouse, LP 5U-C
Ruth M. Horton, WT 11D-K
Susan J. Kelly, LP 5U-C
Khurshid K. Mehta, WT 6A-K
EDMS, WT 11D-K

Tennessee Valley Authority, 400 West Summit Hill Drive, Knoxville, Tennessee 37902-1499

September 24, 2010

To those listed:

BROWNS FERRY NUCLEAR (BFN) POWER PLANT COOLING TOWER ADDITIONS, LIMESTONE COUNTY, ALABAMA

The Tennessee Valley Authority (TVA) proposes to replace four of six existing cooling towers (Towers 1, 2, 5, and 6) with larger units and construct one additional 25–30 cell linear mechanical draft cooling tower site at BFN (Figures 1 and 2). The four existing cooling towers would be demolished and rebuilt within the existing footprint.

The new cooling tower (Tower 7) would be located along the east side of Shaw Road at the location of an existing perimeter ditch and includes the installation of a new pumping station, a cold water discharge canal, lift pumps and piping; and two new transformers (Figure 2). A portion of the ditch would be relocated directly northeast of proposed Tower 7 to maintain a perimeter ditch north of the new cooling tower. In addition, the cold water discharge canal is proposed between the north end of the spoil pile and the existing western perimeter ditch, and an approximate five-acre construction staging area is necessary.

TVA considers the archaeological area of potential effect (APE) to be the footprint where ground disturbance would take place. The majority of the BFN reservation has been previously disturbed by construction of the power plant and associated infrastructure. The majority of the land not disturbed by construction of BFN was surveyed in 2001 as part of the BFN relicensing and expansion Environmental Impact Statement. The survey identified one historic property, Site 1LI535, an Early to Middle Woodland period occupation that is considered potentially eligible for the National Register of Historic Places (NRHP) and is outside of the APE. The APE for the proposed undertaking has been extensively disturbed with the construction of BFN. It is TVA's findings that no cultural resources would be affected by the proposed undertaking.

TVA is consulting with the following federally recognized Indian tribes regarding properties within the proposed project's APE that may be of religious and cultural significance to them and eligible for the NRHP: Cherokee Nation, Eastern Band of Cherokee Indians, United Keetoowah Band of Cherokee Indians in Oklahoma, The Chickasaw Nation, Muscogee (Creek) Nation of Oklahoma, Alabama-Coushatta Tribe of Texas, Alabama-Quassarte Tribal Town, Kialegee Tribal Town, Poarch Band of Creek Indians, Thlopthlocco Tribal Town, Seminole Nation of Oklahoma, Seminole Tribe of Florida, Absentee Shawnee Tribe of Oklahoma, Eastern Shawnee Tribe of Oklahoma, and the Shawnee Tribe.

By this letter, TVA is providing notification of these findings and is seeking your comments regarding this undertaking and any properties that may be of religious and cultural significance and may be eligible for the NRHP pursuant to 36CFR § 800.2 (c)(2)(ii), 800.3 (f)(2), and 800.4 (a)(4)(b).

Those listed
Page 2
September 24, 2010

If you have any questions, please contact me by telephone at (865) 632-6461 or by e-mail at pbezzell@tva.gov. Please respond within 30 days of receipt of this letter, if you have any comments on the proposed undertaking.

Sincerely,

Pat Bernard Ezzell

Pat Bernard Ezzell
Tribal Liaison and Corporate Historian
Federal Determinations
WT 11D-K

MH:RY:PBE:IKS
Enclosures
cc: Cynthia M. Anderson, LP 5D-C
Brenda E. Brickhouse, LP 5U-C
Ruth M. Horton, WT 11D-K
Susan J. Kelly, LP 5U-C
Khurshid K. Mehta, WT 6A-K
EDMS, WT 11D-K

THOSE LISTED:

Dr. Richard Allen
Policy Analyst
Cherokee Nation
Post Office Box 948
Tahlequah, Oklahoma 74465

Governor Bill Anoatubby
The Chickasaw Nation
Post Office Box 1548
Ada, Oklahoma 72821-1548

Ms. Augustine Asbury
Cultural Preservation Coordinator
Alabama Quassarte Tribal Town
Post Office Box 187
Wetumka, Oklahoma 74883

Mr. Bryant Celestine
Tribal Historic Preservation Officer
Alabama-Coushatta Tribe of Texas
571 State Park Rd. 56
Livingston, Texas 77351

Mr. Charles Coleman
NAGPRA Representative
Thlopthlocco Tribal Town
Route 1, Box 190-A
Weleetka, Oklahoma 74880

Ms. Natalie Deere
Tribal Historic Preservation Officer
Seminole Nation of Oklahoma
Post Office Box 1498
Wewoka, Oklahoma 74884

Ms. Robin DuShane
Cultural Preservation Director
Eastern Shawnee Tribe of Oklahoma
127 West Oneida
Seneca, Missouri 64865

Mr. Henry Harjo
Environmental Director
Kialegee Tribal Town
Post Office Box 332
Wetumka, Oklahoma 74883

Mr. Tyler Howe
Historic Preservation Specialist
Eastern Band of the Cherokee Indians
Post Office Box 455
Cherokee, North Carolina 28719

cc: Mr. Russ Townsend
Tribal Historic Preservation Officer
Eastern Band of the Cherokee Indians
Post Office Box 455
Cherokee, North Carolina 28719

Mr. Ted Isham
Manager
Cultural Preservation
Muscogee (Creek) Nation
Post Office Box 580
Okmulgee, Oklahoma 74447

Ms. Karen Kaniatobe
Tribal Historic Preservation Officer
Absentee Shawnee Tribe of Oklahoma
2025 S. Gordon Cooper
Shawnee, Oklahoma 74801

Ms. Lisa C. LaRue
Director, Language, History and Culture &
Acting Tribal Historic Preservation Officer
United Keetoowah Band
of Cherokee Indians in Oklahoma
Post Office Box 746
Tahlequah, Oklahoma 74464

Mr. Kirk Perry
Administrator
Division of Policy and Standards
The Chickasaw Nation
Post Office Box 1548
Ada, Oklahoma 72821-1548

Ms. Jennifer Pietarila
Archaeological Data Analyst
Seminole Tribe of Florida
Ah-Tah-Thi-Ki Museum
HC-61 Box 21-A
Clewiston, Florida 33440

cc: Ms. Anne Mullins
Project Coordinator
Seminole Tribe of Florida
Ah-Tah-Thi-Ki Museum
HC-61, Box 21-A
Clewiston, Florida 33440

cc: Mr. Willard Steele
Tribal Historic Preservation Officer
Seminole Tribe of Florida
Ah-Tah-Thi-Ki Museum
HC-61, Box 21-A
Clewiston, Florida 33440

the Chickasaw Nation

Bill Anoatubby, Governor
Jefferson Keel, Lt. Governor

Headquarters

October 4, 2010

Ms. Patricia B. Ezzell
Tribal Liaison and Corporate Historian
Federal Determinations
WT 11D-K
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902-1499

Dear Ms. Ezzell:

Thank you for your letter of notification regarding your proposal to replace four of six existing cooling towers with larger units and construct one additional 25-30 cell linear mechanical draft cooling tower site at Browns Ferry Nuclear Power Plant in Limestone County, Alabama. We accept your finding that no cultural resources will be affected by this proposed undertaking.

This area is located within the aboriginal lands of the Chickasaw Nation and is an important area to us. We are unaware of any specific historic properties or traditional cultural, religious and/or sacred sites at this time. However, in the event of inadvertent discoveries, we expect all construction activities to cease and we be notified according to all applicable state and federal laws.

If you have any questions, please contact Ms. Gingy Nail, historic preservation officer at (580) 559-0817, gingy.nail@chickasaw.net or Ms. Julie Ray, historic preservation and repatriation manager at (580) 559-0825, julie.ray@chickasaw.net.

Sincerely,

Jefferson Keel

Jefferson Keel, Lt. Governor
The Chickasaw Nation

jar

Arlington at Mississippi · Post Office Box 1548 · Ada, OK 74821-1548 · 580-436-2603 · www.chickasaw.net

UNITED WE THRIVE

SEMINOLE TRIBE OF FLORIDA
TRIBAL HISTORIC PRESERVATION OFFICE

TRIBAL HISTORIC PRESERVATION OFFICE
SEMINOLE TRIBE OF FLORIDA
AH-TAH-THI-KI MUSEUM
34725 WEST BOUNDARY ROAD
CLEWISTON, FL 33440
PHONE: (863) 983-6549
FAX (863) 902-1117

TRIBAL OFFICERS
CHAIRMAN
MITCHELL CYPRESS
VICE CHAIRMAN
RICHARD BOWERS JR.
SECRETARY
PRISCILLA D. SAYEN
TREASURER
MICHAEL D. TIGER

Pat Bernard Ezzell
Tennessee Valley Authority
400 W. Summit Hill Drive
Knoxville, TN 37902

THPO#: 006967

October 20, 2010

Subject: Browns Ferry Nuclear Power Plant Cooling Tower Additions, Limestone County, Alabama

Dear Ms. Ezzell,

The Seminole Tribe of Florida's Tribal Historic Preservation Office (STOF-THPO) has received the Tennessee Valley Authority's correspondence concerning the aforementioned project. The STOF-THPO has no objection to your findings at this time. However, the STOF-THPO would like to be informed if cultural resources that are potentially ancestral or historically relevant to the Seminole Tribe of Florida are inadvertently discovered during the construction process. We thank you for the opportunity to review the information that has been sent to date regarding this project. Please reference ***THPO-006967*** for any related issues.

We look forward to working with you in the future.

Sincerely,

Willard Steele
Tribal Historic Preservation Oficer
Seminole Tribe of Florida

Direct routine inquiries to:

Anne Mullins
Compliance Review Supervisor
annemullins@semtribe.com

JLP:am

STATE OF ALABAMA
ALABAMA HISTORICAL COMMISSION
468 SOUTH PERRY STREET
MONTGOMERY, ALABAMA 36130-0900

FRANK W. WHITE
EXECUTIVE DIRECTOR

TEL: 334-242-3184
FAX: 334-240-3477

October 25, 2010

Eric Howard
TVA
400 West Summit Hill Drive
Knoxville, Tennessee 37902-1499

Re: AHC 10-1306
Cooling Tower Additions
Browns Ferry Nuclear Plant
Cooling Tower Additions
Limestone County, Alabama

Dear ~~Mr. Howard:~~ Eric:

Upon review of the information forwarded by your office, we have determined the proposed action should have no effect on significant cultural resources provided archaeological site 1Li535 is avoid, as stated in your letter.

We appreciate your efforts on this project. Should you have any questions, please contact Greg Rhinehart at (334) 230-2662. Please have the AHC tracking number referenced above available and include it with any correspondence.

Truly yours,

Elizabeth

Elizabeth Ann Brown
Deputy State Historic Preservation Officer

EAB/LAW/GCR/gcr

THE STATE HISTORIC PRESERVATION OFFICE
www.preserveala.org

7.1.2 Transmission Facilities

TVA owns, operates, and maintains the electrical transmission grid to which BFN is connected. The proposed uprate would contribute more power to the TVA transmission grid. An Interconnection SIS was performed to evaluate the impact of the additional power from BFN on the TVA transmission system. The revised Interconnection SIS (revision 3) identified transmission system upgrades and BFN main generator excitation system ~~upgrades~~ modifications needed to support the planned BFN unit uprates.

~~The~~ Revision 3 of the Interconnection SIS identified six 500 kV breakers in the BFN switchyard which have inadequate critical clearing time for a stuck 500 kV breaker coincident with a single line to ground fault event. The breaker failure relays in these six 500 kV breakers require upgrading. Because the 500 kV breakers are located in the BFN Control Building, replacement of the relays will not require additional land disturbance. The environmental review of the breaker failure relay upgrades is described in the revised response to NRC RERP-GE-RAI 2~~RAI-GE-2~~.

Revision 3 of the~~The~~ Interconnection SIS also identified an issue with the BFN main generators when one of four specific 500 kV transmission lines is out of service coincident with a three-phase fault. To mitigate this issue an SVC will be installed at the Limestone substation and the excitation system of each of the BFN main generators will need to be ~~upgraded~~modified. Because the BFN main generator exciters are located in an existing BFN structure, the ~~upgrade~~ modification will not require additional land disturbance. The environmental review of the SVC installation and the BFN main generator excitation system ~~upgrade~~ modification is described in the revised response to NRC RERP-GE-RAI 2~~RAI-GE-2~~.

Revision 3 of the~~The~~ Interconnection SIS determined that the BFN reactive power capability after uprate would require a minimum of an additional 764 MVAR to satisfy TVA's interconnection requirements. The additional reactive compensation will consist of one static VAR compensator (SVC) and four capacitor banks. ~~This reactive power will be added by the installation of 764 MVAR capacitor banks in five locations throughout the TVA transmission system.~~ The SVC will be installed at the Limestone substation and capacitor bank installations occur on sites ~~distant~~ offsite from BFN. Two of the capacitor bank installation sites will remain within existing substation boundaries. The ~~three~~ two remaining sites will require expansion of the existing substation footprint and additional grading and clearing. The SVC installation will require expansion of the existing substation footprint. The environmental review of the SVC and capacitor bank installations is described in the revised response to NRC RERP-GE-RAI 2~~RAI-GE-2~~.

7.1.3 Electric Shock and Electromagnetic Field

Design criteria that limit hazards from steady-state currents are based on the National Electrical Safety Code (NESC), which requires that transmission lines are designed to limit the short-circuit current to ground produced from the largest anticipated vehicle to less than 5 milliamperes. TVA has designed transmission lines to exceed the requirements given in the NESC at the time the lines were constructed. As a general rule, TVA's transmission lines are upgraded consistent with current codes when work such as re-conductoring or re-sagging is performed on the lines, or the land use has changed under or around the line to cause a clearance problem.

TVA performs transmission line inspections to identify defects that could cause an interruption or an unsafe condition for employees or the public. Inspections are also used to plan maintenance activities and to protect TVA's easement rights. Typically, aerial patrol (i.e., usually helicopter fly-by) inspections are conducted every 6 months, and foot patrol (i.e., walking inspection of the entire transmission line and a visual inspection of the conductors, structures, and right-of-way) inspections are conducted every 4 years. If the land use under or adjacent to the line has changed causing a clearance problem, steps are taken to correct it such as removing the encroachment or adjusting line height.

A study documented in the 2003 BFN LRA ER concluded that the vertical clearances of all transmission lines built to connect BFN to TVA's transmission system met or exceeded the vertical clearance requirements of the 2002 Edition of the NESC. In January 2015, TVA analyzed the modifications that have occurred to each BFN transmission line since the 2003 license renewal study, and concluded that no modifications have been made since the 2003 study that would result in noncompliance with the vertical clearance and electric field requirements of the current NESC (2012 edition). It was concluded in 2003, and it remains a valid conclusion in 2015, that all BFN transmission lines have sufficient clearance to limit the steady-state current due to electrostatic effects to 5 milliamperes, should the largest anticipated truck, vehicle, or equipment under the line be short-circuited to ground.

TVA Transmission and Power Supply is cognizant of current findings of research into the health effects of electromagnetic fields (EMF) via literature and publications. EPU at BFN will increase line currents accordingly, which will result in higher magnetic fields. However, in 1999 the National Institute of Environmental Health Science concluded that the scientific evidence suggesting that EMF exposure poses any health risk is weak. The United States does not have national guidelines for exposure to power frequency EMF.

7.1.4 Non-Radiological Waste Streams

BFN generates four categories of non-radiological solid waste. These categories are:

1. General plant solid waste consisting of paper, cardboard, wood, metals, and garbage,
2. Recycled solid waste such as office paper, cardboard, wood pallets, scrap metal, aluminum cans, plastic bottles, and batteries,
3. Construction and demolition debris associated with site activities,
4. Universal Waste and Hazardous Waste as defined under the Resource Conservation and Recovery Act (RCRA).

7.1.4.1 Solid Waste

BFN generates municipal solid waste commonly known as "trash" or "garbage" which consists of food waste, plastic film, paper waste, and food product packaging waste. General plant trash is collected as part of routine plant operation activities and is managed through TVA Long-term Valley Wide Contract 4394 with Republic Service. Waste material is collected in dumpsters and transported to a state-licensed regional landfill permitted to accept waste materials. BFN uses Morris Farms Landfill in Lawrence County, Alabama, which is owned and operated by BFI Waste Systems of America. Generation rates for BFN are approximately 1.6 tons per day.

7.1.4.2 Recycled Solid Waste

BFN has an active recycling program that segregates and recycles scrap metal, cardboard, office paper, wood pallets, aluminum cans, plastic bottles, and batteries. The segregated materials are accepted for recycling by TVA-approved waste treatment and disposal facilities through contract with C&D Recycling.

7.1.4.3 Construction/Demolition Solid Waste

BFN has a permitted construction/demolition (C and D) landfill that is operated under ADEM Permit No. 42-02 and is designed to accept C and D waste such as unwanted material produced directly or incidentally by C and D at BFN. This includes material such as non-asbestos insulation, nails, wood, electrical wiring, rebar, bricks, concrete, excavated dirt, tree stumps, and rubble. The BFN C and D landfill is approximately 7.7 acres in size. The BFN Solid Waste Disposal Facility Permit allows a maximum average daily volume of 5 tons per day of C and D waste disposal. BFN can either use its own on-site C and D landfill or contract with local solid waste haulers to dispose of C and D solid waste in permitted local landfills. BFN currently has in place the necessary contracts for proper disposal of C and D wastes. The BFN C and D landfill permit from ADEM expires in September 2015. TVA requested renewal of the BFN five-year C and D landfill permit in March 2015.

7.1.4.4 Hazardous Waste

BFN generates a variety of wastes that are classified as hazardous under RCRA. The majority of the hazardous wastes generated at BFN are from spent solvents used in cleaning and degreasing activities and paint-related wastes from coating activities. In addition to these two

major waste streams, BFN generates universal waste such as spent batteries, fluorescent light bulbs, and used oil for recycling.

TVA Nuclear Power Group (NPG) has design change procedures in place to evaluate modifications for potential changes in, or additions to, hazardous waste generation. Some of the plant modifications required to implement the EPU could result in the generation of small amounts of hazardous waste. Neither the types nor amounts of waste generated are expected to be different from those routinely handled at BFN. No new waste streams have been identified due to the uprate activities. The volumes of waste inclusive of the waste attributable to EPU are anticipated to be within the ranges defined by Title 40 of the Code of Federal Regulations for a Small Quantity Hazardous Waste Generator and would not impact site hazardous waste reduction goals. RCRA regulations define a Large Quantity Generator as generating more than 2,200 pounds (i.e., 1,000 kilograms) per month of hazardous waste. Hazardous wastes generated at BFN are managed through the TVA Direct Shipment Program with Waste Management's permitted landfill at Emelle, Alabama. Hazardous waste generation rates for BFN for the past 5 years are presented in Table 7.1-1.

Table 7.1-1: Annual Hazardous Waste Generation

Year	Hazardous Waste Generated at BFN (Pounds)	RCRA Generator Status
2010	1,917	Small Quantity Generator
2011	3,179	Small Quantity Generator
2012	3,601	Small Quantity Generator
2013	4,343	Small Quantity Generator
2014	2,335	Small Quantity Generator

BFN has not generated more than 2,200 pounds in any 1 month in the last 5 years; therefore, BFN is not a Large Quantity Generator.

7.1.4.5 Groundwater

TVA's NPG participates in an active program of groundwater monitoring consistent with the Nuclear Energy Institute's (NEI) guidance given in NEI 07-07, Industry Groundwater Protection Initiative—Final Guidance Document. TVA's NPG meets the requirements of the initiative through implementation of the Groundwater Protection Program (GWPP). The implementation of the GWPP demonstrates a commitment to the control of licensed material through prevention, early detection, and mitigation/remediation of impacts associated with groundwater contamination. TVA's GWPP also includes provisions to monitor, inspect, and improve underground piping and tank integrity to prevent future unintended releases of radiological materials to groundwater. TVA's NPG communicates events involving radiological contaminated spills and leaks to the NRC in accordance with 10 CFR 50.72 (b)(2)(xi) and to other outside agencies as required by the GWPP. The BFN EPU will not impact implementation of this voluntary initiative. No changes to the GWPP are required as a result of EPU implementation.

7.1.5 Noise

The only noise source of any significance from BFN which can periodically be heard off site is from the cooling towers, which operate most frequently during the summer months. After EPU is implemented, the increased discharge temperatures would require some additional cooling tower operation, which would slightly lengthen the duration of noise for residents nearest the cooling towers. There are no federal, State of Alabama, or local municipal noise standards, regulations or ordinances that apply to the action alternatives evaluated in this supplemental ER.

Areas that are potentially affected by environmental noise from typical industrial operations are usually within a 1-mile radius of the noise source(s). However, under special conditions that are favorable to outdoor sound propagation, affected areas can be as much as 2 miles distant. The results of past noise surveys and projections of noise levels indicate that the increase in noise level at the nearest residence to BFN, during cooling tower operation, is minor, and not noticeably altered. Current BFN Communications personnel are not aware of any complaints from area residents regarding noise from BFN operations; their tenure is at least 4 years. Also, a search of news clips by BFN Media Relations personnel for the past 5 years did not find anything about noise complaints. Cooling tower operations at BFN began in 1976 and are not new to the surrounding residents. Figure 7.1-2 shows the residential subdivisions within a 2-mile radius of BFN.

There are waterfront homes upstream and adjacent to BFN property (Pointe Westmoreland and Lookingbill subdivisions), but these residences are more than a mile from the closest cooling towers (CT 1 and CT 6) and there is a small hill and the main plant in between them and the cooling towers. Because of the physical configuration and the lack of favorable conditions for sound propagation in this direction, this residential area is not considered sensitive to environmental noise.

The Lakeview Community is across the river and approximately 8,500 feet from the center of the cooling tower area. It is primarily year-round homes with a few recreational residences. Even though Lakeview is well over a mile from BFN, it could be sensitive to environmental noise because the open pathway across water is favorable to sound propagation. However, BFN cooling tower noise has not been audible in the past at the Lakeview Community.

The older waterfront community of Paradise Shores is situated downstream of BFN and adjacent to the cooling tower area. Paradise Shores is currently a mix of year-round and recreational homes, forming a medium-to high-density suburban area that could be sensitive to environmental noise. There are about 100 residences within 1 mile of the closest cooling towers, and some are as close as 1,500 feet.

Because no physical changes for EPU are being made external to existing buildings, no construction noise is expected which could be heard off site.

The U.S. Environmental Protection Agency's (EPA's) protective noise guideline (EPA 1974) recommends an average annual equivalent day/night sound level (L_{dn}) of 55 decibels A-

weighted scale (dBA) to protect the health and well-being of the public with an adequate margin of safety. TVA uses the EPA guideline of 55 dBA L_{dn} as a design goal, when feasible, if the nearest receptor is residential. For industrial and commercial areas, TVA uses the equivalent sound level (L_{eq}) of 60 dBA at the property line. In addition, TVA uses the Federal Interagency Committee on Noise (FICON) recommendation that a 3-decibel increase in L_{dn} indicates possible impact and the need for further analysis when the background is 60 dBA or less (FICON 1992). There are no federal, State of Alabama, or local municipal noise standards, regulations, or ordinances that apply to the action alternatives evaluated in this supplemental ER.

An environmental sound pressure level assessment was performed at BFN on August 8, 2012, while six of the seven cooling towers were in operation. From this 24-hour ambient noise sample, the L_{dn} was calculated at 61.9 dBA. A second 24-hour ambient noise sample was collected on September 6, 2012, while none of the cooling towers were operating; the calculated L_{dn} for this sample was 59.7 dBA. Both noise sample sets were collected at the location of the nearest residence to BFN, which is in the Paradise Shores community, located approximately 1,500 feet from the BFN property boundary. The measured 2012 background or ambient baseline noise levels without operation of the cooling towers exceeded the 55 dBA guideline for residential areas, but the FICON guideline of an allowable 3-decibel increase in L_{dn} at residences and exterior plant boundaries was met during cooling towers operation.

Since the August/September 2012 sound level measurements, CTs 3, 5, and 6 have been replaced. CT 4 had been replaced earlier in 2007, and CT 7 was constructed in 2011. Currently, work on all but two BFN cooling towers (CTs 1 and 2) of the seven BFN cooling towers is complete, and replacement of CTs 1 and 2 is scheduled for completion in FY 2018 and FY 2019. Additional sound monitoring is planned to be conducted following replacement of CTs 1 and 2. Sound level measurements will also be taken at the subdivisions within a 2-mile radius of BFN.

TVA will continue to meet FICON guidelines by working with the selected cooling tower vendor to ensure noise attenuating features are incorporated as required, such as low-noise fans, lower speed fans, and sound attenuators. Operational noise levels will be verified by a qualified acoustical engineer to ensure that noise levels comply with applicable guidelines and are consistent with previous commitments. In the event that the resulting noise levels are found to exceed the FICON guidelines, TVA would develop and implement additional acoustical mitigation such as modifications to fans and motors, or the installation of barriers. On site, TVA will continue to comply with Occupational Safety and Health Administration regulations to protect worker health.

The area around the cooling towers has been an industrialized area for more than 40 years, and wildlife species commonly observed in the area include those species that are less sensitive to human disturbance and common in the region. The noise produced during cooling tower operation is a combination of low-frequency steady humming produced by the cooling tower fans and sounds associated with the water cascading through the cooling tower fill. Under normal operation, there are no high-pitched sounds or intermittent loud noises that would serve

to disrupt local wildlife. Onsite observations indicate that the wildlife in the area has adapted to the industrial noise of the site, and there is no indication that operation of the cooling towers disturbs the wildlife in the area. There are no state-protected or federally listed terrestrial animal species within 3 miles of the BFN site, which is well beyond the audible range of noises associated with cooling tower operation.

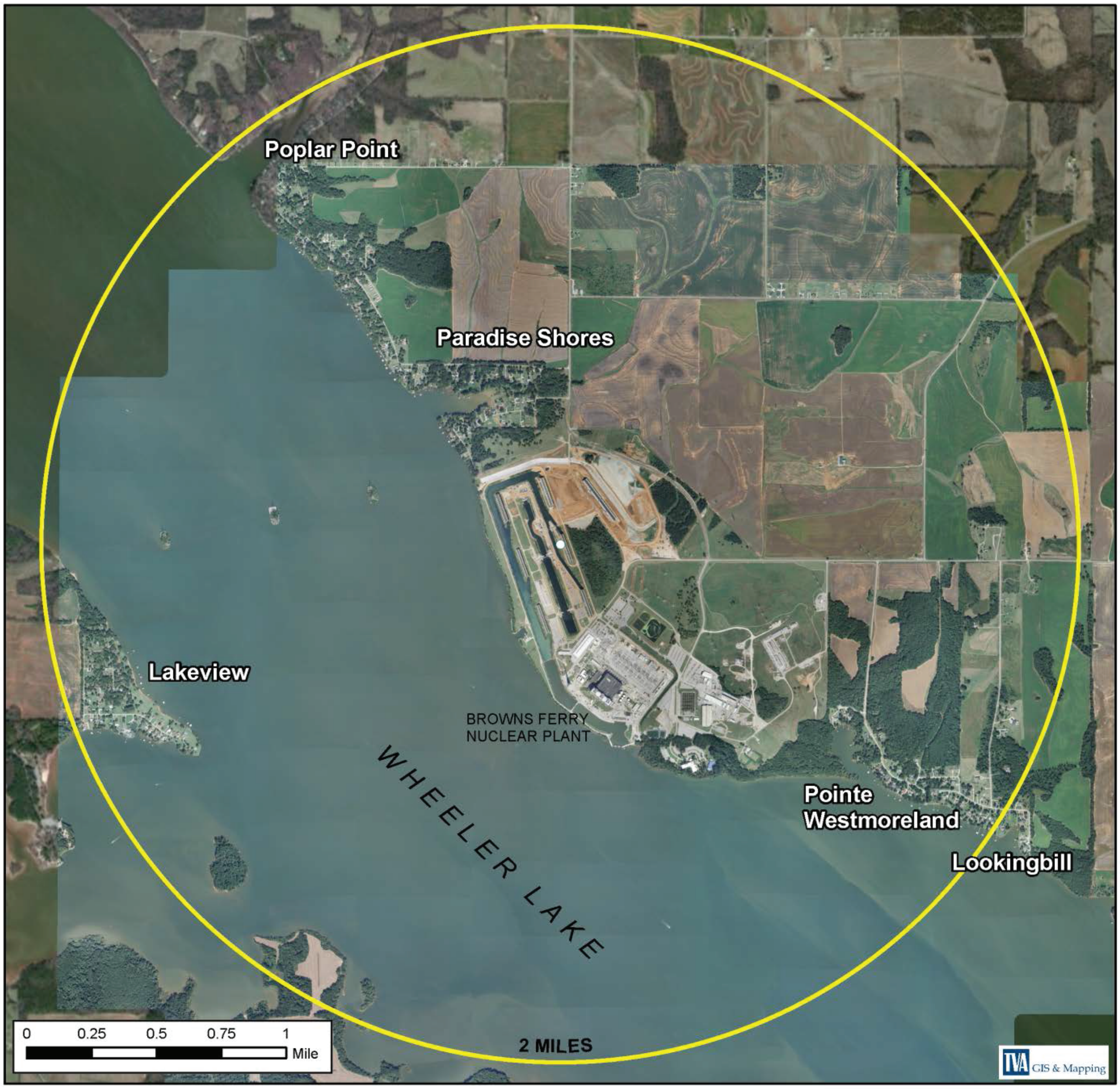


Figure 7.1-2: Residential Subdivisions Within 2-Mile Radius of BFN

.

7.1.6 Terrestrial Biota

7.1.6.1 Terrestrial Biota—Animals

The BFN site is a heavily disturbed area and provides limited wildlife habitat. Due to the lack of features that provide high-quality wildlife habitats, such as streams, springs, caves, rock bluffs, and moist forested habitats, the overall diversity of wildlife at BFN is not uncommon from a local, state, or regional perspective. Terrestrial wildlife species found among upland habitats on the BFN site are generally common and have widespread distributions. No uncommon wildlife communities, important terrestrial habitats such as caves, or wading bird colonies occur within 6 miles of BFN. Proposed actions would not impact unique or important terrestrial habitats or populations of migratory birds.

The TVA Natural Heritage database indicated on September 23, 2014, the presence of one federally listed species and no state-listed species within 6 miles of the BFN EPU project footprint. One federally listed species with partial status (hellbender) and one federally listed endangered species (gray bat) have been recorded within Limestone County, Alabama. The federally listed endangered Indiana bat and federally listed threatened northern long-eared bat also have the potential to exist across the known range for these species (Pruitt and TeWinkel 2007; USFWS 2014a; USFWS 2015). Although these bat species have not yet been reported from Limestone County, Alabama, they are thought to have the potential to occur across the northern portion of Alabama (Pruitt and TeWinkel 2007; USFWS 2014a; USFWS 2015). Table 7.1-2 provides a summary of federally listed and state-listed as protected terrestrial animals reported, or with the potential to occur, in Limestone County, Alabama. Thus, impacts to these species will also be evaluated.

Hellbenders are generally found in clear, rocky creeks and rivers where water temperatures are typically less than 20°C. They are associated with large shelter rocks and submerged logs (Hammerson 2005). This species has been reported approximately 15.4 miles away from the project footprint and is known to occur in the Tennessee River. Proposed actions would not increase temperature or flow rates of discharged water beyond permitted NPDES limits. Suitable habitat for this species is also plentiful along the Tennessee River and its tributaries. Hellbenders would not be impacted by the proposed EPU.

Bald eagles are protected under the Bald and Golden Eagle Protection Act (USFWS 2013). This species is associated with larger mature trees capable of supporting its massive nests. These are usually found near larger waterways where the eagles forage on fish (USFWS 2007). The TVA Natural Heritage database indicated that the nearest bald eagle nest is approximately 5.4 miles away from BFN. Proposed modifications actions would occur in or on existing BFN structures and no tree removal would occur in association with this project. Proposed actions are not expected to adversely impact the fish community of Wheeler Reservoir either (see Sections 7.2.4 and 7.2.6). Nesting and foraging habitat for the bald eagle would not be impacted by the proposed actions, thus bald eagles would not be impacted by the proposed actions.

Table 7.1-2: Federally Listed and State-Listed as Protected Terrestrial Animals Reported From or With Potential to Occur in Limestone County, Alabama

Common Name	Scientific Name	Status	
		Federal	State (Rank)
Amphibians			
Hellbender	*Cryptobranchus alleganiensis*	PS	PROT(S2)
Birds			
Bald eagle	*Haliaeetus leucocephalus*	DM	NMGT(S3)
Mammals			
Gray bat	*Myotis grisescens*	LE	END(S2)
Northern long-eared bat	*Myotis septentrionalis*	LT	NMGT(S4)
Indiana bat	*Myotis sodalis*	LE	END(S1)

Source: TVA Natural Heritage database.

Federal Status Abbreviations: DM = Delisted; Recovered but Monitored; LE = Listed Endangered; LT = Listed Threatened; PS = Partial Status.

State Status Abbreviations: END = Endangered; NMGT = In need of management; PE = Proposed Endangered; PROT = Protected;

State Rank Information:

S1 = Critically Imperiled
S2 = Imperiled
S3 = Vulnerable
S4 = Apparently Secure

Gray bats roost in caves year-round and migrate between summer and winter roosts during spring and fall (Brady et al. 1982; Tuttle 1976). Bats disperse over bodies of water at dusk where they forage for insects emerging from the surface of the water (Harvey 1992). The TVA Natural Heritage database on September 23, 2014, indicated two gray bat caves have been recorded, approximately 9.5 and 13.7 miles away from the project footprint. There are no caves that occur on or immediately adjacent to BFN property. Gray bats foraging habitat exists over Wheeler Reservoir; however, proposed actions would not impact foraging bats. Gray bats would not be impacted by the proposed project.

Indiana bats inhabit caves during winter and migrate to roost under exfoliating bark and within cavities of trees (typically greater than or equal to 5 inches in diameter) during summer (USFWS 2014b; Pruitt and TeWinkel 2007; Kurta et al. 2002). Foraging occurs along riparian zones, above the tops of forests, and along forested edges and tree lines (Pruitt and TeWinkel 2007). Some habitat requirements overlap between the Indiana and northern long-eared bat, which roosts in caves or cave-like structures in winter, and utilizes cave-like structures as well as live in dead trees with exfoliating bark and crevices in the summer (USFWS 2014a). There are no known records of the northern long-eared bat within Limestone County, Alabama or within 10 miles of the project footprint. The nearest known Indiana bat record is from a hibernaculum approximately 9.5 miles from BFN in Lauderdale County, Alabama. Both species are thought to occur throughout northern Alabama, thus both have the potential to occur in the area (Pruitt and TeWinkel 2007; USFWS 2014a; USFWS 2015). However, no suitable habitat for either bat

species would be impacted by the proposed actions. There is no tree clearing occurring in association with this project nor are any caves known on or within 6 miles of BFN property. Proposed actions would not impact bats foraging over Wheeler Reservoir. Proposed actions would not impact the Indiana bat. The northern long-eared bat has recently been federally listed as threatened, and interim measures for their conservation were issued by the USFWS (USFWS 2015). In the interim, federal action agencies are required to make determinations with respect to whether proposed actions would result in jeopardy to the species based on guidance provided by the USFWS on January 6th, 2014 (USFWS 2014a; USFWS 2015). Based on the nature and scope of the project, the proposed actions are not likely to jeopardize the continued existence of the northern long-eared bat.

7.1.6.2 Terrestrial Biota—Plants

Threatened and Endangered Species and Terrestrial Ecology (Plants)

The TVA Natural Heritage Database indicated that no federally listed or state-listed plant species have been previously reported from within a 6-mile radius of the project area. No federally listed plant species or designated critical habitat for plant species occur in Limestone County, Alabama.

The proposed EPU of BFN Units 1, 2, and 3 would not affect federally listed or state-protected plant species, because all work would occur in areas that have been heavily impacted by previous construction, operation, and maintenance of the facility. These areas are incapable of supporting rare species or habitats and do support a large component of nonnative, invasive species indicative of disturbed sites.

7.1.7 Air Impacts

The remaining BFN EPU construction and equipment installation would occur during the refueling outages between now and EPU implementation. During those outages, additional air emissions will be from the increased workforce driving to and from the site. As described in Section 5.1, the increased staffing for an outage is 800 to 1,200 supplemental workers. Staffing ramps up 2 to 3 weeks prior to the outage start. Staffing begins to ramp down 21 to 28 days from the start of the outage. TVA's current business plan outage duration is 35 days or less. For the EPU outages, TVA estimates that 10 percent or less of the supplemental work force will be dedicated to the EPU portion of the outage. The short-term impacts on air emissions would be commensurate with the increased supplemental staffing. The major equipment and materials to support the EPU outages will mostly be supplied and stored on site well before the start of the outage period. Most of the smaller EPU supplies will be delivered on trucks that routinely supply similar tools and materials to support plant operations. Therefore, temporary increases in air emissions prior to and during EPU outages are expected to be minor.

The emergency diesel generators are operated under a Synthetic Minor Source Air Operating Permit. The BFN EPU will not increase the frequency or duration of the emergency diesel generator surveillance test and the future operation of the diesel generators will be in accordance with the requirements of the air permit. Therefore, no increase in emissions from this source is anticipated.

7.1.8 References

Brady, J., T. H. Kunz, M. D. Tuttle, and D. Wilson. 1982. Gray Bat Recovery Plan. Denver, Colorado: U.S. Fish and Wildlife Service, Denver, Colorado.

Gage, M. D. 2001. A Cultural Resources Reconnaissance Survey of Three Locations for the Proposed Expansion of Browns Ferry Nuclear Power Plant in Limestone County, Alabama. Prepared for Tennessee Valley Authority, Division of Land and Forest Resources, Norris, Tennessee. Moundville, Alabama: The University of Alabama, Office of Archaeological Services.

Hammerson, G. 2005. "Hellbender: Element Ecology, and Life History." NatureServe: An Online Encyclopedia of Life. Retrieved from <http://explorer.natureserve.org/servlet/NatureServe?searchName=cryptobranchus+alleganiensis>.

Harvey, M. J. 1992. *Bats of the Eastern United States*. Little Rock, Arkansas: Arkansas Game and Fish Commission.

Kurta, A., S. W. Murray, and D. H. Miller. 2002. Roost Selection and Movements Across the Summer Landscape. In *The Indiana Bat: Biology and Management of an Endangered Species*, edited by A. Kurta and J. Kennedy. Austin, Texas: Bat Conservation International.

Pruitt, L. and L. TeWinkel. 2007. Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision. Fort Snelling, Minnesota: U.S. Fish and Wildlife Service.

Tuttle, M. D. 1976. Population Ecology of the Gray Bat (*Myotis grisescens*): Philopatry, Timing, and Patterns of Movement, Weight Loss During Migration, and Seasonal Adaptive Strategies. Occasional Papers of the Museum of Natural History, University of Kansas.

TVA (Tennessee Valley Authority). 1968. Photograph: File number KX-8579, taken in November 1968 of BFN construction in progress. Knoxville, Tennessee: TVA Historic Photograph Collection.

TVA. 1969. Oblique aerial photograph: File number KX-8694, taken March 11, 1969 of BFN construction in progress. Knoxville, Tennessee: TVA Historic Photograph Collection.

TVA. 2003. *Applicant's Environmental Report—Operating License Renewal Stage, Browns Ferry Nuclear Plants Units 1, 2, and 3*. Appendix E. License 50-259, 50-260, and 50-296. December 2003.

USFWS (U.S. Fish and Wildlife Service). 2007. "National Bald Eagle Management Guidelines." Retrieved from <http://www.fws.gov/northeast/ecologicalservices/pdf/NationalBaldEagleManagementGuidelines.pdf>.

USFWS. 2013. "Bald and Golden Eagle Protection Act." Retrieved from <http://www.fws.gov/northeast/ecologicalservices/eagleact.html>.

USFWS. 2014a. "Northern Long-eared Bat Interim Conference and Planning." Retrieved from <http://www.fws.gov/midwest/endangered/mammals/nlba/pdf/NLEBinterimGuidance6Jan2014.pdf>.

USFWS. 2014b. "2014 Range-Wide Indiana Bat Summer Survey Guidelines." Retrieved from <http://www.fws.gov/athens/pdf/2014IBatSummerSurveyGuidelines13Jan2014.pdf>.

USFWS. 2015. "Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Northern Long-Eared Bat With 4(d) Rule; Final Rule and Interim Rule." *Federal Register*, Vol. 80, No. 63, pp 17974-18033. April 2, 2015.

7.2 Hydrology and Aquatic Ecology Effects

7.2.1 Wheeler Reservoir

BFN is located on the north shore of Wheeler Reservoir at TRM 294. Wheeler Reservoir extends from TRM 274.9 to TRM 349. For orientation, TRM 0.0 is downstream where the Tennessee River joins the Ohio River in Paducah, Kentucky. Wheeler Dam is downstream of BFN at TRM 274.9, and Guntersville Dam lies upstream at TRM 349.0.

Wheeler Reservoir was created in 1936 and has an area of 67,070 acres and a volume of 1,050,000 acre-feet at the normal summer pool elevation of 556 feet mean sea level. Most of Wheeler Reservoir is classified by ADEM for use as public water supply, swimming and other whole-body water-contact sports, and fish and wildlife. Although the area of the reservoir immediately upstream and downstream of BFN is not currently classified for public water supply, it potentially could be if a municipal water intake was sited there in the future. Water quality is generally good in Wheeler Reservoir, but nutrient loads are a concern. The reservoir is on the 2014 Alabama 303(d) list as partially supporting its designated uses due to excess nutrients attributed to agricultural sources (ADEM 2014).

Fish consumption advisories have also been issued for certain areas of the reservoir. The State of Alabama recommends (1) limiting consumption of largemouth bass from TRM 296.0 to TRM 303.0 and all species of fish from Baker's Creek embayment because of perfluorooctane sulfonate (PFOS) contamination, and (2) limiting consumption of largemouth bass from Limestone Creek and Round Island Creek embayments because of elevated concentrations of mercury. PFOS is a manmade compound used in a variety of industrial and commercial products. PFOS is no longer manufactured in the United States and its use is being phased out. (EPA 2014a) Mercury occurs naturally in rock and soils but can also originate from other sources, including atmospheric emissions from human activities (fossil fuel combustion, waste incinerations, steel mills) or from natural processes (forest fires, volcanoes) (USGS 2014).

Water temperature patterns in Wheeler Reservoir are constantly changing in response to varying meteorological and flow conditions. Natural water temperatures in the reservoir vary from around 35 degrees Fahrenheit (^{o}F) in January to around 88 to 90^{o}F in July and August. Temperature patterns upstream of BFN are typically well mixed or develop only weak thermal stratification.

There are nine potable water intakes on Wheeler Reservoir withdrawing a total of approximately 216 million gallons per day (MGD) for municipal and industrial use. Wastewater discharges include 13 municipal plants discharging approximately 54 MGD. Eight (non-TVA) industrial entities discharge approximately 146 MGD. The largest withdrawal and discharge by far is cooling water from BFN. In 2010, BFN withdrew approximately 2,750 MGD and returned approximately 2,741 MGD. Consumptive and off-stream water uses do not conflict significantly due to the large volume of reservoir water available, the river flow rate that has 24-hour average minimum flows ranging from 7,000 cubic feet per second (cfs) to 10,000 cfs, and the return of almost all of the water withdrawn.

7.2.2 Impact on Withdrawal

BFN uses a once-through condenser circulating water (CCW) system to dissipate waste heat from the plant steam turbines. The water is withdrawn from the Tennessee River by an intake structure located at about TRM 294.3. For open mode operation, the CCW system is designed to provide a flow of 630,000 gpm for Unit 1 and 675,000 gpm for Unit 2 and Unit 3. For all three units, this suggests a total CCW design flow of 1,980,000 gpm or 4,412 cfs. Due to system upgrades, such as refitting the condensers with larger diameter and lower resistance tubes, the total per-unit condenser circulating water system flow, in general, is now higher than the design values. In addition to flow through the CCW pumps, the plant total intake also includes withdrawals for the emergency equipment cooling water system, the residual heat removal service water system, the fire protection system, and the intake screen wash system. Velocity measurements collected in front of the plant intake in November 2014 suggest a total intake flow on the day of the measurements of about 2,118,300 gpm or 4,720 cfs. No changes are expected for the plant intake systems as a result of the power uprate. That is, the uprate project will not impact the current volume of water withdrawn from Wheeler Reservoir by the plant.

7.2.3 Impact on Discharge

Most of the water withdrawn at the plant intake is returned to the river. Water losses by evaporation and drift (water droplets entrained in airstream passing through tower) will occur for the CCW system when cooling towers are in service. For the other systems, the only loss of water would be comparatively negligible, unquantifiable amounts due to evaporation whenever the water is exposed to air.

The water returned to the river from the plant is accomplished using submerged diffusers situated on the bottom of the river at about TRM 294.0. The diffusers are designed to mix the plant thermal effluent with the water in the river by discharging the effluent through thousands of small outlet ports in the diffuser pipes. In terms of hydrothermal impacts on the Tennessee River, operation of the circulating water system is regulated by the State of Alabama under NPDES Permit No. AL0022080 (ADEM 2012). The permit specifies that the river ambient temperature shall be measured by an upstream monitor located at about TRM 297.8, and that impacts relative to the ambient temperature shall be measured by three downstream monitors located at about TRM 293.5. The upstream monitor is about 3.8 miles upstream of the diffusers, whereas the downstream monitors are located near the end of a mixing zone, which extends 2,400 feet (0.45 miles) downstream of the diffusers. The NPDES permit specifies that at the downstream end of the mixing zone, the operation of the plant shall not cause:

- The measured 1-hour average temperature to exceed 93°F.
- The measured daily average temperature to exceed 90°F.
- The measured daily average temperature rise (relative to ambient) to exceed 10 F°.

Furthermore, if the natural heating of Tennessee River causes the daily average upstream ambient river temperature to exceed 90°F, the daily average downstream temperature may equal, but not exceed, the upstream value. However, in connection with such an event, if the daily average upstream ambient river temperature begins to cool at a rate of 0.5 F° per day or

more, the downstream temperature is allowed to exceed the upstream value for that day. In the NPDES permit, the latter occurrence is identified as a cooling anomaly condition.

When plant operating conditions create a river temperature threatening one of the NPDES limits given above, the plant is shifted from open mode operation to helper mode operation, wherein the condenser circulating water is treated (cooled) by cooling towers before it is routed to the river. The amount of water treated by the cooling towers depends on the amount of cooling needed for the plant to remain in compliance with the NPDES limits. The three units can be placed in helper mode individually or collectively (i.e., one, two or all three units). If helper mode operation is not sufficient in keeping the river temperature from threatening an NPDES limit, TVA reduces the thermal power of one or more of the units to maintain regulatory compliance.

Hydrothermal impacts are assessed on the changes in water temperature and other water quality parameters of the Tennessee River as a result of the power uprate. Previous studies of the thermal impacts due to the proposed power uprate are given by TVA (2003) and TVA (2004). The evaluations summarized herein incorporate observations from recent years containing warm and dry meteorology, and recent and planned future changes in the plant cooling system. The plant has seven cooling towers, and the same is expected throughout the life of the power uprate. The current characteristics of the plant cooling towers are summarized in Table 7.2-1. Compared to previous studies, recent changes in the cooling system include the rebuilding of four of the original six cooling towers, and the addition of the new seventh cooling tower. Planned future changes in the cooling system include rebuilding of the two remaining original cooling towers (CTs 1 and 2).

To predict the impact of this additional heat, hydrothermal model simulations were updated from those performed previously (TVA 2003; TVA 2004). The computer simulations were limited to the evaluation of river temperature in the immediate vicinity of the plant as represented by the NPDES mixing zone. It is in this region that the impact of the additional heat is the greatest, and it is in this region that regulatory requirements for river temperature have the greatest influence on the operation of the plant. In previous studies, simulations also were performed to examine impacts reservoir wide and not only for river temperature, but also for algal biomass and dissolved oxygen. In these studies, even in years that were warmer and dryer than normal, the predicted impacts on these parameters were minor, and not noticeably altered. Because the plant cooling tower capacity is now greater than that assumed in the previous studies, reservoir-wide impacts are expected to be bounded by previous studies and therefore reservoir-wide modeling was not repeated in the current evaluations.

It is important to note that in previous studies, the number of cooling towers was insufficient to treat all of the condenser circulating water flowing through the plant when all of the units were operating at the full flow capacity of the individual CCW systems. In contrast, the current number of cooling towers (as summarized in Table 7.2-1) have enough capacity to treat all of the condenser circulating water flowing through the plant.

The dissipation of waste heat from the plant is of greatest concern in the summer, when the largest potential exists for aquatic wildlife to become stressed by high water temperature. TVA

classifies summer hydrothermal conditions for the Tennessee Valley based on the average June-July-August air temperature and average June-July-August river flow at Chattanooga (TRM 464). For the available period of record, from 1948 through 2014 (67 years), Figure 7.2-1 summarizes these conditions in a cross plot showing for each year the deviation in average air temperature from the long-term mean at Chattanooga (x-axis), and the deviation in average natural river flow from the long-term mean at Chickamauga Dam (y-axis). The natural river flow is a theoretical discharge based on (1) observed rainfall/runoff upstream of Chickamauga Dam, and (2) no flow regulation by any control structures in the Tennessee River and its tributaries (e.g., dams). The natural flow at Chickamauga Dam (TRM 471) provides a measure of the extent of wet or dry conditions in the eastern part of the Tennessee Valley. The long-term mean air temperature and mean natural river flow are based on the summertime values for the entire 67-year period of record. The cross plot divides summer conditions into one of four quadrants: warm and wet, warm and dry, cool and dry, and cool and wet. For BFN, only summers in the warm and dry quadrant yield conditions that seriously challenge the NPDES limits for river temperature. For the period of record, about 43 percent of years fall in the warm and dry quadrant. However, in the past 10 years (highlighted in Figure 7.2-1), seven have fallen in the warm and dry quadrant.

To mimic a possible future dominated by warm and dry summer meteorology, the simulations presented herein evaluate the plant operation based on river flows and meteorology as observed for the 6-year period from 2007 through 2012 (highlighted in red in Figure 7.2-1). All but one of these years include a warm and dry summer. Summer 2009 was warm and barely wet (average natural flow only 0.5 percent above mean). This 6-year period includes the warmest summer of record, 2010, and extreme drought conditions that occurred in 2007 and 2008.

A detailed description of the hydrothermal model is given by TVA (2005). For the results presented herein, Table 7.2-2 provides a summary of basic model assumptions. In general, the model marches forward in time, computing the NPDES temperatures based on the ambient conditions of the river, the operating conditions of the plant, and meteorology. The model also computes the turbine backpressure for each unit, which also contains an operating limit. Depending on the computed temperatures verses the NPDES limits (or the computed backpressure verses the backpressure limit), the model decides whether or not helper mode operation is needed, and whether or not a derate is needed. In this process, it is important to note that the model examines operating conditions only one hour into the future. Furthermore, to maintain compliance, the model only considers changes in the operating conditions of the plant, not that of the river. In actuality, the TVA process for managing the river and thermal plants examines forecast conditions for up to a week or more into the future, allowing changes to be made perhaps days in advance to avert, defer, or reduce the need for helper mode operation and/or a derate. The process also allows changes in the operation of the river as well as changes in the operation of the plant. The dynamics of the actual process for managing the river and BFN are far too indefinite and complex to be captured in the model. For this reason, model results are considered to represent only a rough order of magnitude estimate of the potential bounding impacts of the power uprate.

For the simulations summarized herein, the results at 105 percent OLTP assume the configuration of cooling towers is the same as that summarized in Table 7.2-1. Results at 120 percent OLTP assume that CTs 1 and 2 are replaced with new cooling towers with design characteristics the same as those for CT 5.

Presented in Table 7.2-3 are the results comparing plant operation at 120 percent OLTP with plant operation at 105 percent OLTP. The table includes four sections: the first summarizes impacts on water temperature, the second summarizes impacts on helper mode operation (i.e., cooling tower operation), the third and fourth summarize impacts on plant electrical generation (i.e., derates and net generation). Notable observations include the following:

- For years with warm summers, the temperature of water exiting the diffusers at 120 percent OLTP, on the average, will be about 2.6 F° warmer than the temperature of water at 105 percent OLTP. For the maximum hourly value, as well as the maximum 24-hour average value, the model results imply a change in the temperature of water exiting the diffusers of 4.7 F° warmer and 3.4 F° warmer, respectively.
- For years with warm summers, the temperature of the river at the compliance depth at the downstream end of the mixing zone at 120 percent OLTP, on the average, will be about 0.6 F° warmer than the temperature at 105 percent OLTP. For the maximum hourly value, as well as the maximum 24-hour average value, the model results imply very subtle changes in the temperature of the river at the compliance depth at the downstream end of the mixing zone (only 0.1 F° cooler). This primarily is due to additional helper mode operation.
- For years with warm summers, the number of days of helper mode operation, on the average, is expected to increase by about 22 days at 120 percent OLTP as compared to 105 percent OLTP. At 120 percent OLTP, the most extreme years are expected to include about 121 days of helper mode operation.
- For years with warm summers the number of summers containing derates is expected to remain at 1 in 6 at EPU conditions. For warm summers containing derates, the maximum number of hours of derate per year is expected to increase by about 28 at 120 percent OLTP with a maximum overall increase in annual hydrothermal derate energy loss of about 20,785 MWh. In derate events, the average amount of derate power loss is expected to increase by about 54 MW at 120 percent OLTP.
- The average annual net generation with the uprate from 105 percent OLTP to 120 percent OLTP is expected to increase by about $4.9\text{x}10^6$ MWh.

At both 105 percent and 120 percent OLTP, the derate predictions summarized in Table 7.2-3 occurred only for 2010, the warmest summer of record (see Figure 7.2-1). Other notable observations from the hydrothermal simulations include the following:

- In helper mode operation, the model results indicate a water loss due to cooling tower evaporation of about 2.7 percent of the cooling tower flow on average. Berger (1995) suggests that manufacturers strive to limit cooling tower drift to about 0.2 percent of the flow. Thus, during helper mode operation, the combined loss due to evaporation and drift is expected to be roughly 3 percent of the cooling tower flow. If all seven cooling towers

are in service, and for the power uprate (i.e., CT 1 and 2 replaced with new cooling towers the same as CT 5), the design flows in Table 7.2-1 suggest the water loss by cooling tower evaporation and drift to be magnitude 60,300 gpm or 134 cfs.

- The hydrothermal derates of Table 7.2-3 include events wherein the downstream temperature challenged the 1-hour average NPDES temperature limit of 93°F. To protect this limit in the hydrothermal model, cooling tower operation and derates were triggered when hourly temperatures reached 92°F. However, if the model predictions emerge as accurate, these events will come as one hour temperature spikes with little or no warning to the plant. In these events, and in contrast to the model, current plant operating procedures do not support such a rapid response for implementing cooling tower operation and derates. In fact, operating limitations of some plant equipment make it impossible to respond to these types of events within one hour. To prepare for such, plant operating procedures will need to be updated to initiate cooling tower operation and derates more conservatively; for example, by specifying a lower value of the measured 1-hour average downstream temperature to trigger changes in helper mode operation and derates. The use of a hydrothermal forecast model (such as the one utilized herein) also may help to identify conditions conducive for potential threats to the 93°F limit.
- At 120 percent OLTP, model predictions for helper mode operation include events to protect the NPDES limit for the maximum instream temperature rise of 10 F°. These events will occur in the cooler months of the year, primarily in the late winter and early spring when river flows are curtailed to allow filling of tributary reservoirs in the eastern part of the Tennessee River watershed. Although such events have occurred for existing plant conditions (e.g., March 2014), the frequency and duration of these events will increase at 120 percent OLTP. That is, cooling tower equipment will need to be prepared for operation during periods outside of the normal period of high readiness in the summer.

The existing protocol between TVA River Operations and BFN Operations ensures that during normal conditions the cooling towers are operated and/or the units are de-rated to comply with the NPDES permit.

In addition to the diffuser discharge, effluent discharges also occur from other plant systems such as yard drainage, station sumps, and sewage treatment. These are not expected to change due to the power uprate, and as such are expected to remain within the bounding conditions established in the NPDES permit for these discharges. Overall, in terms of plant discharges to the river, the power uprate will have minimal impact either individually or cumulatively on the environment.

Table 7.2-1: BFN Cooling Tower Characteristics, October 2014

Tower [1, 2]	Startup	Reference			No. Cells or Fans	Fan hp	No. Pumps	Pump hp	Flow per Pump Max (gpm)	Tower Flow			Capability (%)
		Wet Bulb Temp (°F)	Hot Water Temp (°F)	Cold Water Temp (°F)						Design (gpm)	Min (gpm)[3]	Max (gpm)	
1	1976	78.0[4]	126.7[4]	95.0[4]	16	200	2	3100	145,950	275,000	220,000	291,900[5]	94.0[5]
2	1976	80.0[5]	129.7[5]	98.0[5]	16	200	2	3100	139,800	275,000	220,000	279,600[5]	113.0[5]
3	2013	82.0[6]	118.5[6]	91.6[6]	16	250	2	3100	137,500	265,000[7, 8]	212,000	275,000[7, 8]	102.5[6]
4	2007	80.0[9]	119.2[9]	91.0[9]	16	250	2	3100	140,150	275,000	220,000	280,300[9]	102.0[9]
5	2013	82.0[10]	118.5[10]	90.0[10]	19	250	2	3100	137,500	265,000[8, 11]	212,000	275,000[8,11]	103.9[10]
6	2014	82.0[12]	118.5[12]	91.6[12]	16	250	2	3100	137,500	265,000[8, 13]	212,000	275,000[8, 13]	100.0[12]
7	2012	82.0[14]	118.5[14]	90.0[14]	28	250	4	2700	111,475	410,000[14]	328,000	445,900[14]	103.1[14]

Notes:

1. CT 1 and CT 2 = Ecodyne, Inc. (original towers). CT 3, CT 5, CT 6, and CT 7 = Composite Cooling Solutions, Inc. Tower 4 = Marley, Inc.
2. Cooling towers 1 and 2 are currently planned to be replaced in FY18 and FY19.
3. For BFN forecasting models, assume pumps can be throttled to 80 percent of design flow to balance CCW flow.
4. Reference wet bulb, hot water, and cold water temperatures derived from performance curves of original towers. Design wet bulb, hot water, and cold water temperatures of original towers are 55.0°F, 115.7°F, and 84.0°F, respectively.
5. Thermal Performance Tests, CTI Report No. CA08-13, Rev. 1, 01/21/2009, SPX Cooling Technologies, Inc.
6. Cooling Tower Performance Test At TVA Browns Ferry Nuclear Plant On Cooling Tower #3, BFN-CT3-2013-TEST, Fulkerson and Associates, Inc., September 12, 2013. Entered into TVA EDMS 04/24/2014: Document ID = BFN-CT3-2013-TEST (B41140424001).
7. MDN0000272013000155, Calculation of Flow Rate to New Cooling Tower No. 3.
8. New towers designed for 275,000 gpm, but use of existing/original pumps results in lower flow because new towers are taller than original towers. Notes 9, 10, and 11 are hydraulic analyses supporting the replacement of the cooling towers. The calculated design flows at NORMAL water level in the warm water channel are 265,461 gpm (CT 3), 264,383 gpm (CT 5), and 266,091 gpm (CT 6). The calculated flows at MAXIMUM water level are 274,994 gpm (CT 3), 273,850 gpm (CT 5), and 275,586 gpm (CT 6). The design and maximum flows provided herein, 265,000 gpm and 275,000 gpm, respectively, are assigned as the average of the NORMAL and MAXIMUM calculated flows, respectively (rounded to the nearest 1000 gpm). In tests conducted in the summer 2013, CT 3 and CT 5 provided only 246,725 gpm and 246,329 gpm, respectively. Lift pump flow is a function of the water level in the warm water channel--flows higher than these measured values are expected when the water level in the warm water channel is higher (i.e., lower head to the top of the towers).
9. Thermal Acceptance Tests, T07-08, July 2007, Cooling Tower Test Associated, Inc.
10. Cooling Tower Performance Test At TVA Browns Ferry Nuclear Plant On Cooling Tower #5, BFN-CT5-2013-TEST, Fulkerson and Associates, Inc., October 31, 2013. Entered into TVA EDMS on 04/24/2014. Document ID = BFN-CT5-2013-TEST (B41140424002).

11. MDN0000272013000162, Calculation of Flow Rate to New Cooling Tower No. 5.
12. Results from cooling tower performance tests unknown as of 11/2014--assume 100 percent capability based on performance of other new towers.
13. MDN0000272013000197, Calculation of Flow Rate to New Cooling Tower No. 6.
14. Thermal Performance Tests, Mesa Specification No. 1057004-MS11-002, Calc No. MDN0027201000. Also, Cooling Tower Performance Test At TVA Browns Ferry Nuclear Plant, BFN-CT7-2012-TEST, B41140424003, Fulkerson and Associates, Inc., September 20, 2012.

Table 7.2-2: Basic Assumptions for BFN Hydrothermal Modeling

Unit Operation
All three units operate at full power unless a derate is required. For 120% OLTP, the maximum generation is 1,332 MWe (pf = 1.0) per unit.
Unit power level is not reduced until all towers are brought into service, subject to the 80% minimum tower water loading (see below).
Unit power level is reduced (derated) when operation at full load causes one or more of the following triggers to be attained: 1-hour downstream temperature = 92.5 (NPDES limit 93°F), 24-hour average downstream temperature = 89.5 (NPDES limit 90°F), 24-hour average temperature rise (ΔT or delta T) = 9.5 (NPDES limit 10 F°), or 1-hour unit backpressure = 5.5 in Hg (i.e., assume limit is 5.5 in Hg).
Power reductions are reduced sequentially among the operating units (i.e., one unit at a time).
Power is reduced in electric generation amounts equivalent to increments of 50 MWe.
If power is reduced on a unit, it must remain at the lowest value for at least 8 hours before initiating recovery.
If the equivalent generation on a unit drops below 440 MWe it is shut down.
Condenser Circulating Water (CCW) Operation
Open-mode CCW flows are 276,300; 531,237; 688,776 gpm for 1, 2, and 3 pumps, respectively.
The static head on the CCW pumps is increased by 2.63 feet if the unit is operating in helper-mode.
Helper-mode CCW flows are 276,300; 519,342; 670,105 gpm for 1, 2, and 3 pumps, respectively.
Always operate with 3 CCW pumps.
CCW pumps are throttled when specifically needed to balance the plant flow.
The condenser cleanliness is 85% for all units.
Cooling Tower Operation
All cooling towers are assumed to be in reliable operating condition.
At 105% OLTP all towers are assumed to be those currently existing (2014).
At 120% OLTP CTs 1 and 2 are assumed to be replaced by 19 cell towers equivalent to the current (2014) CT 5.
Cooling towers are brought into service in order of decreasing rating (best first to worst last).
Cooling tower rating is a combination of maximum flow, the design point, and the capability. In this, the tower with the largest flow capacity is not necessarily brought into service first.
Cooling towers are brought into service one lift pump at a time until all of the CCW flow is handled or all towers are in service.
The last lift pump added can be throttled to 80% flow.
Only the last lift pump on a tower may be throttled in order to not exceed the maximum flow for that cooling tower.
All but the last tower added will be operated at their individual maximum water loading.
If cooling towers are brought into service they must remain in service for at least 8 hours.
Helper mode operation is initiated or increased if plant operation causes at least one of the following triggers to be attained: 1-hour downstream temperature of any single unit = 92.0°F (NPDES limit 93°F), 24-hour average downstream temperature = 88°F (NPDES limit 90°F), or 24-hour average temperature rise (ΔT or delta T) = 8 F° (NPDES limit 10 F°).
Meteorology for cooling tower operation per historical data recorded at the BFN met station for the period of record 2007 through 2012.

Table 7.2-2: Basic Assumptions for BFN Hydrothermal Modeling

Equipment Service Loads
The service load for the CCW pumps is 1.35 MWe/pump.
The service load is the same for a CCW pump whether it is throttled or not.
The service load for the cooling tower lift pumps is as given in Table 7.2-1.
The service load is the same for a cooling tower lift pump whether it is throttled or not.
The service load for the cooling tower fans is as given in Table 7.2-1.
Plant Water Routing
If a unit is operating in open mode, the water flows from the condenser directly to the diffuser.
All of the water from all units operating in helper mode is fully mixed at the entrance to the cooling tower warm water channel.
The mixed water from all units operating in helper mode is lifted to the cooling towers.
All of the water leaving the cooling towers is mixed and then split evenly among the diffusers of units <u>not operating</u> in open mode. That is, water from the cooling towers is not mixed with water discharged from any unit operating in open mode.
Any water from units operating in helper mode and not flowing through the cooling towers is bypassed to the diffusers.
Bypass water is mixed with cooling tower discharge.
Ambient River Conditions
River flows past BFN computed based on historical operation of Wheeler Dam and Guntersville Dam per TVA Hourly Water Records for the period of record 2007 through 2012.
Ambient river temperature per historical data recorded at BFN Water Station No. 4 for the period of record 2007 through 2012.
Diffuser Mixing
Equivalent diffuser slot width 1.5 feet.
Ambient entrainment coefficients are 1.00 for one-unit operation and 0.25 for two-unit and three-unit operation.
Diffuser re-entrainment coefficient is 0.25.

Table 7.2-3: Summary of BFN Hydrothermal Impacts for Warm, Summer Meteorology

Parameter [1]		0% OLTP [2]	105% OLTP	120% OLTP	Change 105%→120% OLTP
Water Temperature (°F)					
Ambient River Temperature at Compliance Depth	Average	66.5	66.5	66.5	0
	Hourly Max	94.3	94.3	94.3	0
	Hourly Min	37.6	37.6	37.6	0
	24-hr Avg Max	91.5	91.5	91.5	0
	24-hr Avg Min	38.4	38.4	38.4	0
Diffuser Discharge Temperature, Flow-Weighted	Average	NA [4]	86.9	89.5	+2.6 F°
	Hourly Max	NA	112.5	117.2	+4.7 F°
	Hourly Min	NA	60.3	58.0	-2.3 F°
	24-hr Avg Max	NA	107.1	110.5	+~~3.5~~3.4 F°
	24-hr Avg Min	NA	60.8	64.3	+3.5 F°
Temperature at Downstream End of Mixing Zone at Compliance Depth	Average	66.5 [3]	70.8	71.4	+0.6 F°
	Hourly Max	94.3 [3]	92.1	92.0	-0.1 F°
	Hourly Min	37.6 [3]	39.8	40.3	+0.5 F°
	24-hr Avg Max	91.5 [3]	89.4	89.3	-0.1 F°
	24-hr Avg Min	38.4 [3]	40.4	41.2	+0.8 F°
Helper Mode Operation					
Max No. days of cooling tower operation per year		NA	82	121	+39
Avg No. days of cooling tower operation per year		NA	66	88	+22
Hydrothermal Derate Operation					
Percent of Summers with Derates		NA	1 in 6	1 in 6	unchanged
Max No. Hours of Derate for Summers with Derate		NA	185	207	+~~28~~22
Max Derate MWH for Summers with Derate		NA	81065	101850	+20785
Avg Derate MWe for Summers with Derate		NA	438	492	54
Changes in Net Generation (10^6 MWH)					
Maximum Annual Net Generation		NA	29.6	34.5	+4.9
Minimum Annual Net Generation		NA	29.2	34.1	+4.9
Average Annual Net Generation		NA	29.4	34.3	+4.9

Notes:
1. Based on simulations with historical hydrology and meteorology for years 2007-2012.
2. 0% OLTP = no withdrawal from or discharge to the river from BFN.
3. Value assumed to be the same as ambient (i.e., neglects any heat exchange between the reservoir and the atmosphere/riverbed in the reach between the ambient measurement at TRM 297.8 and the downstream end of mixing zone at TRM 293.5).

NA=not applicable.

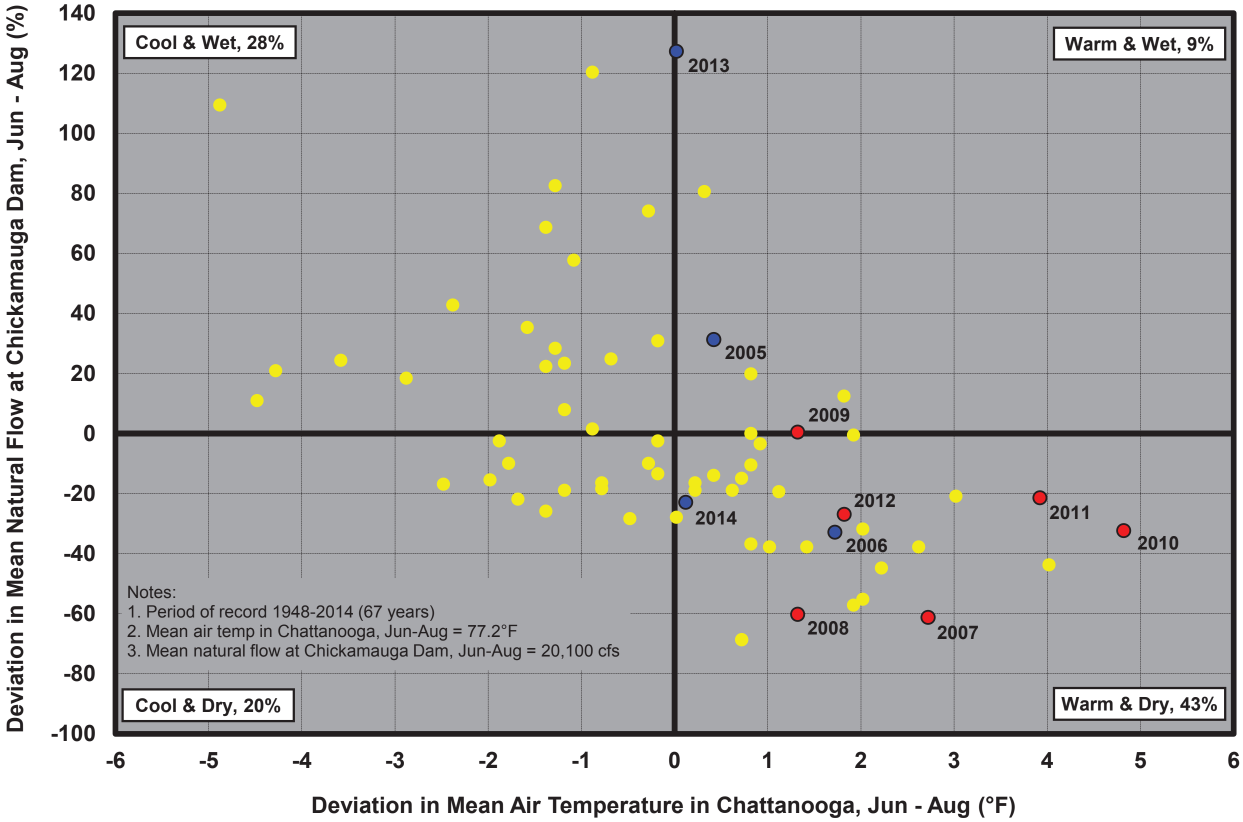


Figure 7.2-1: Classification of Summer Hydrothermal Conditions for the Tennessee River Valley

7.2.4 Fish

Baseline Wheeler Reservoir fish community data include 10 years of reservoir fish standing stock surveys (1949-1954 and 1969-1972), gill and trap net surveys (1968-1972), and ichthyoplankton (larval fish) investigations (1971-1973) (TVA 1978a). Aquatic monitoring continued until 1980 as required by BFN Technical Specifications issued by the NRC (Baxter and Buchanan 1998). In 1981, the NRC eliminated the aquatic monitoring requirement from the BFN Technical Specifications. TVA conducted a three-phase biological monitoring program to evaluate the effects of the BFN thermal discharge on total standing stocks and selected fish species in Wheeler Reservoir during the period 1985 through 1997 (Lowery and Poppe 1992; Buchanan 1990; Baxter and Buchanan 1998). The results were reported to ADEM in 1998 and were provided as part of the NPDES permit renewal application submitted in September 1999 (Baxter and Buchanan 1998; TVA 1999). This study concluded that the operation of BFN under the current permit limitations had not had a significant impact on the aquatic community of Wheeler Reservoir or on the specific species studied.

Section 316(a) of the Clean Water Act (CWA) authorizes alternate thermal limits (ATL) for the control of the thermal component of a point source discharge so long as the limits will assure the protection of Balanced Indigenous Populations (BIP) of aquatic life. The Reservoir Fish Assemblage Index (RFAI) is a measure of quality of the resident fish community in the Wheeler Reservoir in the vicinity of BFN. RFAI sampling in the Wheeler Reservoir was initiated as part of the TVA Vital Signs Monitoring Program. TVA proposed in its 1999 NPDES permit application, use of its RFAI and Reservoir Benthic Index (RBI) methodologies to demonstrate BIP.

From 2000 to 2011, and during 2013, TVA conducted extensive annual sampling of the fish community in the vicinity of BFN and used these methodologies to demonstrate maintenance of BIP in relation to BFN's thermal variance (TVA 2014). Sampling was conducted at two locations each autumn. The upstream station was centered on TRM 295.9 and served as a control station that was completely unaffected by the BFN discharge. The downstream station (TRM 292.5) was centered just downstream of the discharge and represented the potentially thermally affected area. Fish communities are used to evaluate ecological conditions because of their importance in the aquatic food web and because fish life cycles are long enough to integrate conditions over time. The RFAI methodology incorporates fish species richness and composition, trophic composition, and fish abundance and health. It has been thoroughly tested on TVA's reservoirs and other reservoirs and it has been published in peer-reviewed literature (Jennings et al. 1995; Hickman and McDonough 1996; McDonough and Hickman 1999).

TVA's Reservoir Monitoring Program (began in 1993 in Wheeler Reservoir) includes three additional RFAI sampling sites in the reservoir. TVA reservoirs are typically divided into three zones for monitoring: inflow, transition, and forebay. The inflow zone is generally in the upper reaches of the reservoir and is riverine in nature; the transition zone or mid-reservoir is the area where water velocity decreases due to increased cross-sectional area, and the forebay is the lacustrine area near the dam. The Wheeler Reservoir inflow zone sample site is located at TRM 347, the transition zone sample site is located at TRM 295.9 (also serves as BFN upstream

control site), and the forebay zone sample site is located at TRM 277. An additional site is located on the Elk River embayment of Wheeler Reservoir at Elk River Mile (ERM) 6. Data from these sites are used to provide additional information about the health of the fish communities throughout Wheeler Reservoir; however, fish communities at these sites are not subject to thermal effects from BFN and are not used in determination of BIPs, as defined by the CWA in relation to the plant.

The RFAI uses 12 fish community metrics from four general categories: species richness and composition; trophic composition; abundance; and fish health. Together, these 12 metrics provide a balanced evaluation of fish community integrity and address all four attributes of a BIP as defined by the CWA. Scoring categories are based on “expected” fish community characteristics in the absence of human-induced impacts other than impoundment of the reservoir. These categories were developed from historical fish assemblage data representative of transition zones from lower main stem Tennessee River reservoirs (Hickman and McDonough 1996). Attained values for each of the 12 metrics were compared to the scoring criteria and assigned scores to represent relative degrees of degradation: least degraded (5); intermediately degraded (3); and most degraded (1).

TVA uses RFAI results to determine maintenance of BIP using two approaches. One is “absolute” in that it compares the RFAI scores and individual metrics to predetermined values. The other is “relative” in that it compares RFAI scores attained downstream to the upstream control site. The “absolute” approach is based on Jennings et al. (1995) who suggested that favorable comparisons of the RFAI score attained from the potential impact zone to a predetermined criterion can be used to identify the presence of normal community structure and function, and hence existence of BIP. For multi-metric indices, TVA uses two criteria to ensure a conservative screening of BIP. First, if an RFAI score reaches 70 percent of the highest attainable score of 60 (adjusted upward to include sample variability as described below), and second, if fewer than half of RFAI metrics receive a low (1) or moderate (3) score, then community structure and function are considered normal, indicating that BIP had been maintained and no further evaluation would be needed.

RFAI scores range from 12 to 60. Ecological health ratings (12-21 “Very Poor”, 22-31 “Poor”, 32-40 “Fair”, 41-50 “Good”, or 51-60 “Excellent”) are then applied to scores. The average variation for RFAI scores in TVA reservoirs is 6 (± 3). Therefore, any location that attains a RFAI score of 45 (75 percent of the highest score) or higher would be considered to have BIP. It must be stressed that scores below this threshold do not necessarily reflect an adversely impacted fish community. The threshold is used to serve as a conservative screening level meaning that any fish community that meets these criteria is not adversely impacted. RFAI scores below this level require a more in-depth look to determine if BIP exists. An inspection of individual RFAI metric results and species of fish used in each metric are an initial step to help identify if operation of BFN is a contributing factor. This approach is appropriate because a validated multi-metric index is being used and scoring criteria applicable to the zone of study are available.

A comparison of RFAI scores from the area downstream of BFN to those from the upstream (control) area is one basis for determining if operation of the plant has had any impacts on the resident fish community. The definition of “similar” is integral to accepting the validity of these interpretations. The Quality Assurance (QA) component of TVA’s Reservoir Monitoring Program deals with how well the RFAI scores can be repeated and is accomplished by collecting a second set of samples at 15 percent-20 percent of the areas each year. Comparison of paired-sample QA data collected over 7 years shows that the difference in RFAI index scores ranges from 0 to 18 points. The mean difference between these 54 paired scores is 4.6 points with 95 percent confidence limits of 3.4 and 5.8. The 75th percentile of the sample differences is 6, and the 90th percentile is 12. Based on these results, a difference of six points or less in the overall RFAI scores is the value selected for defining “similar” scores between upstream and downstream fish communities. That is, if the downstream RFAI score is within six points of the upstream score and if there are no major differences in overall fish community composition, then the two locations are considered similar. It is important to bear in mind that differences greater than six points can be expected simply due to method variation (25 percent of the QA paired sample sets exceeded that value). An examination of the 12 metrics (with emphases on fish species used for each metric) is conducted to analyze any difference in scores and the potential for the difference to be thermally related.

As previously discussed, RFAI scores have an intrinsic variability of ± 3 points. This variability comes from several sources, including annual variations in air temperature and stream flow; variations in pollutant loadings from nonpoint sources; changes in habitat, such as extent and density of aquatic vegetation; natural population cycles and movements of the species being measured (TWRA 2014). Another source of variability arises from the fact that nearly any practical measurement, lethal or non-lethal, of a biological community is a sample rather than a measurement of the entire population (TVA 2014).

A summary of RFAI scores for the sampling sites upstream and downstream of BFN and those from the three other Wheeler Reservoir are shown in Table 7.2-4. Over the 13 sample years (2000 to 2011, 2013), RFAI scores only differed by greater than six points during one year (2005). Long-term averages for these sites are identical (score of 41 “Good”), indicating that no substantial differences in ecological structure or balance between the two communities have persisted and that a BIP has been maintained. Additionally, all other Wheeler Reservoir monitoring sites have averaged a “Good” ecological health rating (Table 7.2-4). Most recent (autumn 2013) fish species collected and corresponding electrofishing and gill net catch per unit effort downstream (TRM 292.5) and upstream (TRM 295.9) of BFN discharge are shown in Tables 7.2-5 and 7.2-6 The EPU is not expected to have significant impacts on the fish communities of Wheeler reservoir in the vicinity of the BFN thermal discharge. TVA concludes that a BIP would continue to be maintained upstream and downstream of the plant through continued compliance with thermal discharge temperature limitations as specified in the NPDES permit.

Table 7.2-4: Summary of Autumn RFAI Scores

Site	Location	1993	1994	1995	1997	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2013	1993-2013 Avg.
Inflow	TRM 348.0	46	48	42	48	36	-	36	40	38	42	44	42	32	38	40	40	46	40	42
Transition BFN Upstream	TRM 295.9	45	43	34	40	30	41	37	43	39	43	46	41	39	42	39	43	40	46	41
Transition BFN Downstream	TRM 292.5	-	-	-	-	-	43	40	41	43	43	36	42	42	45	36	38	38	40	41
Forebay	TRM 277.0	52	44	48	45	42	-	41	45	44	43	45	44	49	46	47	40	46	43	45
Elk River Embayment	ERM 6.0	41	47	36	49	36	-	49	-	44	49	47	-	39	-	42	-	43	39	44

RFAI Scores: 12-21 (“Very Poor”), 22-31 (“Poor”), 32-40 (“Fair”), 41-50 (“Good”), or 51-60 (“Excellent”)

Table 7.2-5: Species Collected Upstream (TRM 295.9) of BFN Discharge—Autumn 2013

Common Name	Scientific Name	Trophic Level	Native Species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hr	Total Fish EF	GN Catch Per Net Night	Total Fish GN	Total Fish Combined	Percent Composition
Longnose gar	*Lepisosteus osseus*	TC	X	TOL	.	X	.	0.07	0.25	1	0.50	5	6	0.8
Gizzard shad	*Dorosoma cepedianum*	OM	X	TOL	.	X	X	11.73	44.67	176	0.50	5	181	25.4
Common carp*	*Cyprinus carpio*	OM	.	TOL	.	X	.	0.40	1.52	6	.	.	6	0.8
Golden shiner	*Notemigonus crysoleucas*	OM	X	TOL	.	X	X	0.40	1.52	6	.	.	6	0.8
Spotfin shiner	*Cyprinella spiloptera*	IN	X	TOL	.	.	.	1.27	4.82	19	.	.	19	2.7
Redbreast sunfish*	*Lepomis auritus*	IN	.	TOL	.	.	X	0.07	0.25	1	.	.	1	0.1
Green sunfish	*Lepomis cyanellus*	IN	X	TOL	.	.	X	0.80	3.05	12	.	.	12	1.7
Bluegill	*Lepomis macrochirus*	IN	X	TOL	.	.	X	4.73	18.02	71	.	.	71	9.9
Largemouth bass	*Micropterus salmoides*	TC	X	TOL	.	.	X	2.33	8.88	35	0.40	4	39	5.5
White crappie	*Pomoxis annularis*	TC	X	TOL	.	.	X	0.07	0.25	1	.	.	1	0.1
Skipjack herring	*Alosa chrysochloris*	TC	X	INT	.	X	.	.	.	.	0.60	6	6	0.8
Northern hog sucker	*Hypentelium nigricans*	BI	X	INT	.	.	.	0.07	0.25	1	.	.	1	0.1
Spotted sucker	*Minytrema melanops*	BI	X	INT	X	X	.	1.13	4.31	17	0.10	1	18	2.5
Black redhorse	*Moxostoma duquesnei*	BI	X	INT	.	X	.	0.07	0.25	1	.	.	1	0.1
Longear sunfish	*Lepomis megalotis*	IN	X	INT	.	.	X	1.13	4.31	17	.	.	17	2.4
Smallmouth bass	*Micropterus dolomieu*	TC	X	INT	.	.	X	0.60	2.28	9	.	.	9	1.3
Spotted gar	*Lepisosteus oculatus*	TC	X	.	.	X	.	0.33	1.27	5	0.10	1	6	0.8
Threadfin shad	*Dorosoma petenense*	PK	X	.	.	X	X	1.53	5.84	23	.	.	23	3.2
Emerald shiner	*Notropis atherinoides*	IN	X	.	X	.	.	0.07	0.25	1	.	.	1	0.1
Bullhead minnow	*Pimephales vigilax*	IN	X	.	.	.	X	0.47	1.78	7	.	.	7	1.0
Smallmouth buffalo	*Ictiobus bubalus*	OM	X	.	.	X	.	1.87	7.11	28	0.50	5	33	4.6
Black buffalo	*Ictiobus niger*	OM	X	.	.	X	.	0.07	0.25	1	0.20	2	3	0.4

Common Name	Scientific Name	Trophic Level	Native Species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hr	Total Fish EF	GN Catch Per Net Night	Total Fish GN	Total Fish Combined	Percent Composition
Blue catfish	*Ictalurus furcatus*	OM	X	.	.	X	X	.	.	.	0.40	4	4	0.6
Channel catfish	*Ictalurus punctatus*	OM	X	.	.	X	X	2.73	10.41	41	0.60	6	47	6.6
Flathead catfish	*Pylodictis olivaris*	TC	X	.	.	X	X	0.07	0.25	1	0.10	1	2	0.3
White bass	*Morone chrysops*	TC	X	.	.	.	X	1.07	4.06	16	0.20	2	18	2.5
Yellow bass	*Morone mississippiensis*	TC	X	.	.	X	X	0.67	2.54	10	.	.	10	1.4
Warmouth	*Lepomis gulosus*	IN	X	.	.	.	X	0.07	0.25	1	.	.	1	0.1
Orangespotted sunfish	*Lepomis humilis*	IN	X	.	.	.	X	0.20	0.76	3	.	.	3	0.4
Redear sunfish	*Lepomis microlophus*	IN	X	.	.	.	X	1.73	6.60	26	0.40	4	30	4.2
Hybrid sunfish	Hybrid *Lepomis* sp.	IN	X	.	.	.	.	0.20	0.76	3	.	.	3	0.4
Spotted bass	*Micropterus punctulatus*	TC	X	.	.	.	X	0.07	0.25	1	.	.	1	0.1
Black crappie	*Pomoxis nigromaculatus*	TC	X	.	.	.	X	0.07	0.25	1	.	.	1	0.1
Logperch	*Percina caprodes*	BI	X	.	X	.	.	2.33	8.88	35	.	.	35	4.9
Sauger	*Sander canadensis*	TC	X	.	.	.	X	.	.	.	0.40	4	4	0.6
Freshwater drum	*Aplodinotus grunniens*	BI	X	.	.	X	.	1.27	4.82	19	0.20	2	21	2.9
Mississippi silverside*	*Menidia audens*	IN	.	.	.	X	X	4.47	17.01	67	.	.	67	9.4
Total			**34**		**3**	**17**	**23**	**44.16**	**167.97**	**662**	**5.20**	**52**	**714**	**100.0**
Number Samples								**15**			**10**			
Species Collected								**34**			**15**			

Trophic level: benthic invertivore (BI), herbivore (HB), insectivore (IN), omnivore (OM), planktivore (PK), parasitic (PS), specialized insectivore (SP), top carnivore (TC);
Tolerance: tolerant species (TOL), intolerant species (INT); Comm.-Commercially, Rec.-Recreationally.

*Denotes aquatic nuisance species next to common name. All species are considered representative important species. No species collected are federally listed.

Table 7.2-6: Species Collected Downstream (TRM 292.5) of BFN Discharge—Autumn 2013

Common Name	Scientific Name	Trophic Level	Native Species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hr	Total Fish EF	GN Catch Per Net Night	Total Fish GN	Total Fish Combined	Percent Composition
Gizzard shad	*Dorosoma cepedianum*	OM	X	TOL	.	X	X	10.40	40.10	156	1.30	13	169	17.4
Common carp*	*Cyprinus carpio*	OM	.	TOL	.	X	.	0.13	0.51	2	0.10	1	3	0.3
Spotfin shiner	*Cyprinella spiloptera*	IN	X	TOL	.	.	.	7.13	27.51	107	.	.	107	11.0
Redbreast sunfish*	*Lepomis auritus*	IN	.	TOL	.	.	X	0.07	0.26	1	.	.	1	0.1
Green sunfish	*Lepomis cyanellus*	IN	X	TOL	.	.	X	2.87	11.05	43	.	.	43	4.4
Bluegill	*Lepomis macrochirus*	IN	X	TOL	.	.	X	2.00	7.71	30	0.20	2	32	3.3
Largemouth bass	*Micropterus salmoides*	TC	X	TOL	.	.	X	1.27	4.88	19	0.10	1	20	2.1
Skipjack herring	*Alosa chrysochloris*	TC	X	INT	.	X	.	.	.	.	1.20	12	12	1.2
Spotted sucker	*Minytrema melanops*	BI	X	INT	X	X	.	0.20	0.77	3	.	.	3	0.3
Black redhorse	*Moxostoma duquesnei*	BI	X	INT	.	X	.	0.07	0.26	1	.	.	1	0.1
Longear sunfish	*Lepomis megalotis*	IN	X	INT	.	.	X	4.00	15.42	60	.	.	60	6.2
Smallmouth bass	*Micropterus dolomieu*	TC	X	INT	.	.	X	1.53	5.91	23	.	.	23	2.4
Spotted gar	*Lepisosteus oculatus*	TC	X	.	.	X	.	.	.	.	0.20	2	2	0.2
Threadfin shad	*Dorosoma petenense*	PK	X	.	.	X	X	0.80	3.08	12	.	.	12	1.2
Emerald shiner	*Notropis atherinoides*	IN	X	.	X	.	.	0.20	0.77	3	.	.	3	0.3
Bullhead minnow	*Pimephales vigilax*	IN	X	.	.	.	.	0.33	1.29	5	.	.	5	0.5
Smallmouth buffalo	*Ictiobus bubalus*	OM	X	.	.	X	.	1.80	6.94	27	0.20	2	29	3.0
Black buffalo	*Ictiobus niger*	OM	X	.	.	X	.	.	.	.	0.10	1	1	0.1
Blue catfish	*Ictalurus furcatus*	OM	X	.	.	X	X	.	.	.	0.20	2	2	0.2
Channel catfish	*Ictalurus punctatus*	OM	X	.	.	X	X	1.40	5.40	21	0.10	1	22	2.3
Flathead catfish	*Pylodictis olivaris*	TC	X	.	.	X	X	.	.	.	0.40	4	4	0.4
Yellow bass	*Morone mississippiensis*	TC	X	.	.	X	X	0.13	0.51	2	0.20	2	4	0.4

Common Name	Scientific Name	Trophic Level	Native Species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hr	Total Fish EF	GN Catch Per Net Night	Total Fish GN	Total Fish Combined	Percent Composition
Warmouth	*Lepomis gulosus*	IN	X	.	.	.	X	0.13	0.51	2	.	.	2	0.2
Redear sunfish	*Lepomis microlophus*	IN	X	.	.	.	X	0.27	1.03	4	.	.	4	0.4
Hybrid sunfish	Hybrid *Lepomis* sp.	IN	X	.	.	.	.	0.13	0.51	2	.	.	2	0.2
Black crappie	*Pomoxis nigromaculatus*	TC	X	.	.	.	X	.	.	.	0.10	1	1	0.1
Stripetail darter	*Etheostoma kennicotti*	SP	X	.	.	.	.	0.07	0.26	1	.	.	1	0.1
Logperch	*Percina caprodes*	BI	X	.	X	.	.	1.87	7.20	28	.	.	28	2.9
Sauger	*Sander canadensis*	TC	X	.	.	.	X	.	.	.	0.30	3	3	0.3
Freshwater drum	*Aplodinotus grunniens*	BI	X	.	.	X	.	2.93	11.31	44	0.40	4	48	5.0
Mississippi silverside*	*Menidia audens*	IN	.	.	.	X	X	21.47	82.78	322	.	.	322	33.2
Total			**28**		**3**	**15**	**17**	**61.20**	**235.97**	**918**	**5.10**	**51**	**969**	**100**
Number Samples								**15**			**10**			
Species Collected								**24**			**15**			

Trophic level: benthic invertivore (BI), herbivore (HB), insectivore (IN), omnivore (OM), planktivore (PK), parasitic (PS), specialized insectivore (SP), top carnivore (TC);
Tolerance: tolerant species (TOL), intolerant species (INT); Comm.-Commercially, Rec.-Recreationally.

*Denotes aquatic nuisance species next to common name. All species are considered representative important species. No species collected are federally listed.

7.2.5 Benthic Organisms

As briefly mentioned in Section 7.2.4, benthic macroinvertebrate populations are assessed using the RBI methodology to provide additional information on the health of aquatic communities upstream and downstream of the BFN thermal discharge. Because benthic macroinvertebrates are relatively immobile, negative impacts to aquatic ecosystems can be detected earlier in benthic macroinvertebrate communities than in fish communities (TVA 2014).

During autumn 2013, benthic macroinvertebrate data were collected in the transition zone of Wheeler Reservoir along three transects established across the width of the reservoir. The upstream transect (TRM 295.9) was used as a control site to compare to benthic community composition potentially affected by the BFN thermal effluent. One downstream transect (TRM 293.2) was within the thermal plume and one transect (TRM 290.4) was located just below the downstream extent of the plume (TVA 2014). These two sites were established during 2011 to better determine the effect, if any, of the thermal discharge on benthic communities (TVA 2012a). Previously (2000 to 2010), the downstream site consisted of one transect located at TRM 291.7. A Ponar sampler (area per sample 0.06 m^2) was used to collect benthic samples at 10 points equally spaced along each transect. Sediments from each sample were washed on a 533μ screen, and organisms were picked from the screen and any remaining substrate.

Benthic samples are evaluated using seven metrics that represent characteristics of the benthic community (for a more detailed description of metrics and scoring criteria, refer to TVA 2014). Results for each metric were assigned a rating of 1, 3, or 5, based upon comparison to reference conditions developed for TVA's Reservoir Benthic Monitoring transition zone sample sites (Table 7.2-7). For each sample site, the ratings for the seven metrics were then summed to produce an RBI score. Potential RBI scores ranged from 7 to 35. Ecological health ratings derived from the range of potential values (7-12 "Very Poor", 13-18 "Poor", 19-23 "Fair", 24-29 "Good", or 30-35 "Excellent") were then applied to scores.

A similar or higher benthic index score at the downstream sites compared to the upstream site was used as the basis for determining absence of impact on the benthic macroinvertebrate community related to BFN's thermal discharge. The QA component of TVA's Reservoir Benthic Monitoring Program compared benthic index scores from 49 paired sample sets collected over seven years. Differences between these paired sets ranged from 0 to 14 points; the 75th percentile was four, the 90th percentile was six. The mean difference between these 49 paired scores was 3.1 points with 95 percent confidence limits of 2.2 and 4.1. Based on these results, a difference of four points or less was the value selected for defining "similar" scores between upstream and downstream benthic communities. That is, if benthic scores at the downstream sites are within four points of the upstream score, the communities are considered similar. However, differences greater than four points can be expected simply due to method variation (25 percent of the QA paired sample sets exceeded that value). Any difference in scores of greater than four points between communities is examined on a metric-by-metric basis to determine what caused the difference and the potential for the difference to be thermally related.

Similar to RFAI, TVA's Wheeler Reservoir Monitoring Program includes three additional RBI sampling sites, located at the same river miles as the RFAI stations. Data from these sites are used to provide additional information about the health of benthic macroinvertebrate communities throughout Wheeler Reservoir; however, aquatic communities at these sites are not subject to thermal effects from BFN and are not used in determination of BIP in relation to the plant (TVA 2014).

A summary of RBI scores for the sampling sites upstream and downstream of BFN and those from the three other Wheeler Reservoir monitoring stations are shown in Table 7.2-7. Over the 13 sample years (2000 to 2011, 2013), RBI scores only differed by greater than four points during one year (2009). Most recent assessments of the RBI (2013) at the reference station and at the two stations within the BFN thermal plume received “Excellent” ratings (Table 7.2-7). Long-term averages for these sites are within the “Good” to “Excellent” range, indicating that no substantial differences in ecological structure or balance between the two communities have persisted and that a BIP has been maintained. The Wheeler Reservoir inflow site has averaged “Good”, while the forebay and Elk River embayment have averaged “Poor”. Land use in the lower Elk River basin is predominantly agricultural, and high levels of sediment and nutrient input are most likely suppressing the benthic community. The Elk River discharges into the forebay, which may be a contributor to the low ecological health rating observed in the forebay. Mean density per square meter of benthic taxa collected upstream and downstream of BFN during autumn 2013 are shown in Table 7.2-8. Monitoring results for autumn 2013 support the conclusion that a BIP of benthic macroinvertebrates was maintained downstream of BFN, and the benthic community at the most downstream sampling site was considered similar to the upstream benthic community (2014).

Freshwater mussels are not directly assessed as part of TVA's Reservoir Monitoring Program; however, they are excellent indicators of water quality due to their sessile nature and inability to avoid perturbations impacting water quality. Various post-impoundment mussel surveys in Wheeler Reservoir have documented the occurrence of mussel species (Garner and McGregor 2001). Scruggs (1960) and Isom (1969) documented, as described in Ahlstedt and McDonough (1992), 24 species from various locations surveyed from TRM 275 to TRM 348. During these surveys, it was noted that commercial overharvest and siltation were major factors affecting abundance, recruitment, and survival of many species. Gooch et al. (1979) documented 32 mussel species, 7 of which were not collected during earlier surveys, from TRM 334.3 to TRM 348.4 and in Spring Creek embayment (TRM 283.8). During 1991, 18 live mussel species and 6 species represented by relict shell were documented in Wheeler Reservoir and the mussel fauna consisted of riverine and thin-shelled invader species that have adapted to lake-like conditions and soft bottomed substrates which are now predominate. Half of the species reported from Wheeler Reservoir post impoundment are uncommon or rare and may survive as old, non-reproducing individuals (Ahlstedt and McDonough 1992).

From 1995 to 2000, the Alabama Game and Fish Division (now Alabama Division of Wildlife and Freshwater Fisheries) identified 29 species from upstream of BFN to Guntersville Dam (TRM 294.5 to TRM 349) and 11 species downstream (Garner 2015) (see Table 7.2-9). These freshwater mussel species were collected in Wheeler Reservoir during 5 years of qualitative,

non-standardized dives, using an unknown amount of effort, and during various years. There was a substantial difference in bottom time spent at multiple locations in searches for mussels upstream of BFN (63.1 hours) versus at one location, TRM 292, downstream of BFN (16.3 hours). Significant impacts on the benthic communities of Wheeler reservoir in the vicinity of the BFN thermal discharge are not expected due to EPU since BIPs are continually maintained upstream and downstream of the plant. See Section 7.2.7 for additional discussion.

Table 7.2-10 is a list of mussels collected in Ponar dredge samples while sampling reservoir benthic macroinvertebrates near BFN. These were not collected during a mussel-specific survey, but they are the most recent collections available from Wheeler Reservoir near BFN. These records are stored in TVA's reservoir benthic taxa database.

Table 7.2-7: Summary of RBI Scores

Site	Location	1994	1995	1997	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2013	LTA
Inflow	TRM 347	31	21	25	23	---	21	25	31	31	31	33	33	---	31	---	27	31	**28**
BFN Upstream (Transition)	TRM 295.9	33	25	31	31	31	29	31	31	33	31	31	33	25	29	25	27	35	**30**
BFN Downstream (Transition)	TRM 291.7	---	---	---	---	27	31	27	35	33	31	31	29	29	23	23	---	---	**29**
BFN Downstream (Transition)	TRM 293.2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	23	35	**N/A**
BFN Downstream (Transition)	TRM 290.4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	21	31	**N/A**
Forebay	TRM 277	19	15	23	17	---	17	15	15	19	15	13	13	15	13	---	13	17	**13**
Embayment	ERM 6	15	13	15	15	---	15	---	15	---	17	---	13	---	13	---	13	13	**13**

Reservoir Benthic Index Scores: 7-12 (“Very Poor”), 13-18 (“Poor”), 19-23 (“Fair”), 24-29 (“Good”), 30-35 (“Excellent”)
LTA = Long-term average

Table 7.2-8: Mean Density of Benthic Taxa Upstream and Downstream of BFN, Autumn 2013

Taxa	BFN Downstream TRM 290.4	BFN Downstream TRM 293.2	BFN Upstream TRM 295.9
ANNELIDA			
Hirudinea			
Rhynchobdellida			
Glossiphoniidae			
Actinobdella sp.	---	2	---
Actinobdella inequiannulata	2	---	---
Helobdella elongata	---	---	2
Helobdella stagnalis	7	8	8
Oligochaeta			
Haplotaxida			
Naididae	---	---	2
Tubificinae	30	78	20
Branchiura sowerbyi	3	7	5
Limnodrilus hoffmeisteri	5	7	18
ARTHROPODA			
Crustacea			
Malacostraca			
Amphipoda			
Corophiidae			
Apocorophium lacustre	167	38	282
Gammaridae			
Gammarus sp.	---	2	5
Hexapoda			
Insecta			
Coleoptera			
Elmidae			
Dubiraphia sp.	---	2	---
Diptera			
Ceratopogonidae	2	---	---
Chironomidae			
Orthocladiinae			
Chironominae	---	---	2
Axarus sp.	5	32	45
Chironomus sp.	43	28	70
Cryptochironomus sp.	---	7	5
Dicrotendipes neomodestus	---	---	7

Taxa	BFN Downstream TRM 290.4	BFN Downstream TRM 293.2	BFN Upstream TRM 295.9
Glyptotendipes sp.	---	---	3
Harnischia sp.	---	---	2
Microchironomus sp.	---	2	---
Polypedilum halterale gp.	---	3	2
Stempellina sp.	---	2	---
Xenochironomus xenolabis	---	---	5
Epoicocladius flavens	2	---	---
Thienemanniella lobapodema	---	2	---
Tanypodinae			
Ablabesmyia annulata	33	13	32
Ablabesmyia mallochi	---	---	2
Coelotanypus sp.	97	263	145
Paramerina sp.	---	30	---
Procladius sp.	---	2	7
Ephemeroptera			
Ephemeridae			
Hexagenia sp. <10mm	262	230	163
Hexagenia sp. >10mm	262	213	100
Trichoptera			
Leptoceridae	---	2	---
Oecetis sp.	2	37	28
Polycentropodidae			
Cyrnellus fraternus	18	---	32
MOLLUSCA			
Gastropoda			
Architaenioglossa			
Viviparidae			
Campeloma decisum	---	2	2
Lioplax sulculosa	---	3	3
Viviparus sp.	5	3	12
Neotaenioglossa			
Hydrobiidae			
Amnicola limosa	5	113	53
Somatogyrus sp.	---	3	2
Pleuroceridae			
Pleurocera canaliculata	---	---	3
Bivalvia			
Veneroida			
Corbiculidae			

Taxa	BFN Downstream TRM 290.4	BFN Downstream TRM 293.2	BFN Upstream TRM 295.9
Corbicula fluminea <10mm	263	312	278
Corbicula fluminea >10mm	---	3	40
Sphaeriidae			
Eupera cubensis	5	---	---
Musculium transversum	158	233	85
Pisidium compressum	2	---	---
Unionidae			
Truncilla donaciformis	---	---	3
Utterbackia imbecillis	---	---	2
NEMATODA	---	22	3
PLATYHELMINTHES			
Turbellaria			
Tricladida			
Planariidae			
Dugesia tigrina	3	2	5
Number of samples	**10**	**10**	**10**
Mean-Density per square meter²	**1,380**	**1,703**	**1,482**
Taxa Richness	**21**	**29**	**34**
Sum of area sampled (square meter²)	**0.6**	**0.6**	**0.6**

Note: All taxa listed contributed to individual RBI metrics and total scores.

Table 7.2-9: Mussel Species Collected by Alabama Game and Fish Division Near BFN and Upstream From BFN to Guntersville Dam, 1995–2000

Common Name	Scientific Name
TRM 292 (Total dive bottom time 16.3 hours)	
Washboard	*Megalonaias nervosa*
Pink Heelsplitter	*Potamilus alatus*
Threehorn Wartyback	*Obliquaria reflexa*
Mapleleaf	*Quadrula quadrula*
Threeridge	*Amblema plicata*
Flat Floater	*Anodonta suborbiculata*
Ebonyshell	*Fusconaia ebena*
Fragile Papershell	*Leptodea fragilis*
Giant Floater	*Pyganodon grandis*
Pistolgrip*	*Quadrula verrucosa*
White Heelsplitter	*Lasmigona complanata*
Upstream of BFN (TRM 294.5) to Guntersville Dam (TRM 349) (Total dive bottom time 63.1 hours)	
Washboard	*Megalonaias nervosa*
Pink Heelsplitter	*Potamilus alatus*
Pimpleback	*Quadrula pustulosa*
Threehorn Wartyback	*Obliquaria reflexa*
Threeridge	*Amblema plicata*
Elephantear	*Elliptio crassidens*
White Heelsplitter	*Lasmigona complanata*
Pistolgrip*	*Quadrula verrucosa*
Purple Wartyback	*Cyclonaias tuberculata*
Mapleleaf	*Quadrula quadrula*
Butterfly*	*Ellipsaria lineolata*
Giant Floater*	*Pyganodon grandis*
Pink Papershell*	*Potamilus ohiensis*
Flat Floater*	*Anodonta suborbiculata*
Spectaclecase	*Cumberlandia monodonta*
Spike	*Elliptio dilatata*
Ebonyshell	*Fusconaia ebena*
Yellow Sandshell	*Lampsilis teres*
Pink Mucket	*Lampsilis abrupta*
Fragile Papershell	*Leptodea fragilis*
Monkeyface	*Quadrula metanevra*
Black Sandshell	*Ligumia recta*
Sheepnose*	*Plethobasus cyphyus*
Ohio Pigtoe	*Pleurobema cordatum*
Pyramid Pigtoe	*Pleurobema rubrum*
Kidneyshell*	*Ptychobranchus fasciolaris*

Common Name	Scientific Name
Purple Lilliput	*Toxolasma lividus*
Fawnsfoot	*Truncilla donaciformis*
Paper Pondshell	*Utterbackia imbecillis*

* Collected as dead shells

Table 7.2-10: Mussels Collected in Ponar Dredge Samples

River Mile	Taxa	Count	Date
TRM 290.4	*Megalonaias nervosa*	1	10/3/2011
TRM 291.7	*Utterbackia imbecillis*	1	9/26/2006
TRM 293.2	*Truncilla donaciformi*	1	10/3/2011
TRM 295.9	*Obliquaria reflexa*	1	10/20/2004
TRM 295.9	*Obliqueria reflexa*	2	10/4/2011
TRM 295.9	*Truncilla donaciformis*	2	10/15/2013
TRM 295.9	*Utterbackia imbecillis*	1	10/15/2013

7.2.6 Entrainment and Impingement of Fish

EPA's final rule for CWA Section 316(b) established requirements for cooling water intake structures and procedures for assessing impacts (EPA 2014). Compliance requires the permittee to characterize the aquatic community in the vicinity of the intake structure prior to operation, monitor during normal operation to assess impacts due to entrainment and impingement, and periodically review current operational demands, reservoir operation, and condition of the aquatic community to ensure no significant changes have occurred.

7.2.6.1 Entrainment

Prior to 1980, extensive biological and hydrological studies were conducted to assess the effects of CCW withdrawal on the aquatic community in Wheeler Reservoir (TVA 1978a; TVA 1978b; Buchanan and Barr 1980). Preoperational larval fish studies were conducted during 1971 to 1973 to determine the composition and magnitude of the ichthyoplankton populations in Wheeler Reservoir and to define the seasonal fluctuations and relative abundance of various ichthyoplankton taxa (TVA 1978a). From 1974 to 1977, all three units at BFN became operational. Six years (1974–1979) of entrainment sampling were conducted in the plant intake basin to assess operational effects of BFN on fish eggs and larvae (TVA 1978b; Buchanan and Barr 1980). These studies concluded that estimated plant entrainment under open-cycle, three-unit operation would not add significantly to expected natural mortality of fish eggs and larvae in Wheeler Reservoir (Buchanan and Barr 1980). In 1995, TVA initiated an Integrated Resource Plan (IRP) to assess the most cost effective approach to meeting future power demands (TVA 1995). In concert with the IRP, TVA planned to apply for license renewal and EPU of all units at BFN and as a federal agency subject to NEPA, prepared a FSEIS regarding the decision to pursue license renewal and EPU (TVA 2002). As described in Section 2.1, after an extended shutdown, Unit 2 returned to service in 1991, Unit 3 in 1995, and Unit 1 in 2007. The FSEIS committed to evaluate effects of the 10 percent increase in CCW flow on rate of entrainment of fish eggs and larvae (TVA 2002). As a result, TVA conducted a two-year entrainment study in 2003 and 2004 to evaluate effects of two-unit operation on the fish community and update baseline data prior to the restart of Unit 1 (Baxter et al. 2006). To evaluate the effect of the return of Unit 1 and increased generating levels, TVA conducted additional entrainment monitoring during 2008 and 2009 under the current (105 percent OLTP) three-unit uprated operation (TVA 2012b).

For each of these studies, densities of fish eggs and larvae in the reservoir near the intake and daily volume of water transported past the BFN were compared to daily CCW demand and densities of fish eggs and larvae at the intake skimmer wall to estimate percent entrainment. During 2003 to 2004, freshwater drum eggs comprised 94 percent of the eggs collected and clupeids (shad) comprised 94.5 percent of the larval fish collected (Baxter et al. 2006). During 2008 and 2009, freshwater drum eggs constituted 86.7 percent of the total eggs collected and clupeid eggs made up a majority (13.3 percent) of the remaining eggs collected (TVA 2012b). Clupeid larvae were dominant in samples during 2008 and 2009 (94.6 percent), which was almost identical to collections in 2003 and 2004 (TVA 2012b).

The 2008 and 2009 entrainment estimates (TVA 2012b) and recent fish community assessments (TVA 2014) in Wheeler Reservoir near BFN show no significant impacts from current operation of BFN on the fish community near the plant. Both estimated ichthyoplankton entrainment percentages were comparable to historical levels. Results demonstrate annual variations in the relative abundance and temporal distribution of fish and fluctuations in reservoir flow are common in the vicinity of BFN. Life cycles of the dominant fish species and fluctuation in reservoir flow past BFN are significant factors influencing variations observed in the annual entrainment estimates. Based on the annual RFAI scores for Wheeler Reservoir, a viable and balanced indigenous fish community is present in Wheeler Reservoir in the vicinity of BFN. The proposed EPU will not result in an increase in current intake velocities, therefore future entrainment impacts should be comparable to historical levels after implementation of the EPU.

7.2.6.2 Impingement

Four years (1974-1977) of monitoring were conducted to assess operational effects of BFN on fish impingement (TVA 1978b). During this time, impinged fish were dominated by threadfin shad (76.5 percent) and gizzard shad (12.3 percent). Most species contributed less than 1 percent of total fish impinged (TVA 1978b). These studies concluded that overall impingement did not appear to represent an adverse environmental impact to the Wheeler Reservoir fish community.

TVA conducted a two-year impingement study in 2003 and 2004 to evaluate effects of two unit operation on the fish community and update baseline data prior to the restart of Unit 1 (Baxter et al. 2006). To evaluate the effect of the return of Unit 1 and increased generating levels, TVA conducted additional impingement monitoring from September 2007 to September 2009 (TVA 2010). During 2003 to 2004, impinged fish were dominated by threadfin shad (61 percent), freshwater drum (21.2 percent), and gizzard shad (7.8 percent). During 2007 to 2009, impinged fish were dominated by threadfin shad (96 percent) and gizzard shad (2 percent). These studies also concluded that fish impingement at BFN did not have an adverse effect on the fish community of Wheeler Reservoir.

During historical and most recent impingement studies, threadfin shad was the dominant species impinged. Threadfin shad are highly susceptible to thermal shock during the winter, and when this occurs, they become lethargic and are more susceptible to be drawn into the intake and impinged on the traveling screens (EPRI 2008). Highest impingement rates during historical and more recent studies at BFN occurred during this season. EPRI (2008) provided data indicating that during weather related cold shock events, a substantial proportion of threadfin shad were already dead or moribund before being impinged. McLean et al. (1980) found that even after mass mortality from winter die off and impingement occurred in a Tennessee River reservoir, threadfin shad populations quickly rebounded by autumn of each year. Baxter and Buchanan (1998) noted that in standing stock assessments of Wheeler Reservoir, gizzard shad exhibited the highest biomass, followed by threadfin shad and smallmouth buffalo. This provides additional evidence that two of the species that are most prone to impingement continue to persist in abundance in Wheeler Reservoir. The proposed

EPU will not result in an increase in current intake velocities, therefore future impingement impacts should be comparable to historical levels after implementation of the EPU.

7.2.7 Threatened and Endangered Species – Aquatic

Six federally listed endangered and one federally listed threatened aquatic species are known to occur in the vicinity of BFN (Table 7.2-11). The rough pigtoe (*Pleurobema plenum*), spectaclecase (*Cumberlandia monodonta*), and the pink mucket (*Lampsilis abrupta*) are freshwater mussels that occur in sand, gravel, and cobble substrates in large river habitats in the Tennessee River system. These species are now extremely rare and are primarily found in unimpounded tributary rivers and in the more riverine reaches of the largely impounded main stem Tennessee River. In Wheeler Reservoir, most of the remaining large river habitat occurs upstream of BFN. All recent records of these three species are from upstream of BFN (Ahlstedt and McDonough 1992; Garner 1998 and 2001; Gooch et al. 1979; Henson and Pryor 1982; Yokely 1998).

Three federally listed endangered aquatic snails, armored snail (*Pyrgulopsis [=Marstonia] pachyta*), slender campeloma (*Campeloma decampi*), and Anthony's river snail (*Athearnia anthonyi*), and one federally listed threatened fish, the spring pygmy sunfish (*Elassoma alabamae*), are restricted to tributary streams to Wheeler Reservoir, located upstream from BFN (Haggerty and Garner 2008; Garner and Haggerty 2010; Kuhajda et al. 2009). The federally listed threatened spring pygmy sunfish has designated critical habitat in the Beaverdam creek and Pryor branch systems which are upstream tributaries to Wheeler Reservoir (USFWS 2014). No evidence exists to suggest that populations of these species exist in the main stem of the Tennessee River (Wheeler Reservoir), or in tributary streams downstream of BFN. Biological monitoring data and TVA Natural Heritage database indicated no state or federally listed aquatic species have been collected or are currently known to occur within 0.25 miles of BFN; however, state and federally listed aquatic species have been collected in the Tennessee River and tributaries to Wheeler Reservoir within 10 miles of BFN (Table 7.2-11), (TVA 2014).

TVA concludes that the expected impacts from use of cooling towers in combination with possible derating of BFN on thermal conditions for water quality, reservoir stratification, dissolved oxygen (DO) concentrations, eutrophication, and condition of general reservoir biological communities would be minor, insignificant, and within the bounds of the previously permitted thermal discharge of the plant for three-unit operation. Since no state or federally listed aquatic species have been collected or are currently known to occur within 0.25 miles of BFN, no effects to listed species are expected.

TVA's corporate Environmental Policy commits the agency to protecting environmental resources of the Tennessee Valley. TVA's Environmental Principles include assessing the effects of TVA operations to ensure environmental compliance. TVA has monitored aquatic communities within Wheeler Reservoir since 1985 to assure that plant operation does not adversely impact Wheeler Reservoir. In accordance with the NPDES permit and previous commitments (TVA 1999; TVA 2002), TVA will continue monitoring of reservoir conditions. Biological monitoring is performed in order to demonstrate there has not been significant impact on a balanced indigenous population of fish, shellfish, and wildlife, in and on Wheeler Reservoir caused by the alternative thermal limit granted under the NPDES permit in accordance with

section 316(a) of the CWA as administered by the ADEM. Biological monitoring results are reported to the State of Alabama in accordance with the NPDES permit.

Table 7.2-11: Aquatic Listed Species Known to Occur Within Tributaries to Wheeler Reservoir, in a 10-Mile Radius of BFN, and From Tennessee River Miles 274.9 to 310.7

Common Name	Federal Status	State Status
Snails		
Anthony's river snail	E	AP
Slender campeloma	E	AP
Armored snail	E	AP
Mussels		
Spectaclecase	E	AP
Pink mucket	E	AP
Rough pigtoe	E	AP
Fishes		
Spring pygmy sunfish	T	AP
Tuscumbia darter		AP
Paddlefish		AP
Southern cavefish		AP

Federal Status Codes: E – Endangered; T – Threatened

State Status Codes: First letter – state designation: A – Alabama. Second letter – status in that state: P – Protected (Alabama) – level of endangerment not specified.

7.2.8 References

Ahlstedt, S. A. and T. A. McDonough. 1992. Quantitative Evaluation of Commercial Mussel Populations in The Tennessee River Portion of Wheeler Reservoir, Alabama. Tennessee Valley Authority, Water Resources Aquatic Biology Department.

ADEM (Alabama Department of Environmental Management). 2012. National Pollutant Discharge Elimination System (NPDES), Permit No. AL0022080. Permittee: Tennessee Valley Authority, Browns Ferry Nuclear Plant. Issuance Date: July 3, 2012. Effective Date: July 3, 2012. Expiration Date: July 2, 2017.

ADEM. 2014. Integrated Water Quality Monitoring and Assessment Report.

Baxter, D. S. and J. P. Buchanan. 1998. Browns Ferry Nuclear Plant Thermal Variance Monitoring Program Including Statistical Analyses. Tennessee Valley Authority, Water Management, Environmental Compliance.

Baxter, D. S., J. P. Buchanan, and L. K. Kay. 2006. Biological Assessment: Effects of Condenser Cooling Water Withdrawal on the Fish Community Near the Browns Ferry Nuclear Plant Intake. Knoxville, Tennessee: Tennessee Valley Authority, Aquatic Monitoring and Management.

Buchanan, J. P. and W. C. Barr. 1980. Fish Entrainment and Impingement at Browns Ferry Nuclear Plant, Wheeler Reservoir, Alabama, for Years 1978 and 1979. Norris, Tennessee: Tennessee Valley Authority, Division of Water Resources, Fisheries and Aquatic Ecology Branch.

Buchanan. 1990. Thermal Variance Monitoring for Browns Ferry Nuclear Plant, Wheeler Reservoir, 1987–1989. Tennessee Valley Authority, Water Resources Aquatic Biology Department.

EPRI (Electric Power Research Institute). 2008. The Role of Temperature and Nutritional Status in Impingement of Clupeid Fish Species. Palo Alto, California.

EPA (U.S. Environmental Protection Agency). 2014a. Emerging Contaminants Fact Sheet—PFOS and PFOA; EPA 505-F-14-001. March.

EPA. 2014b. National Pollutant Discharge Elimination System—Final Regulations to Establish Requirements for Cooling Water Intake Structures at Existing Facilities and Amend Requirements at Phase I Facilities; Final Rule. *Federal Register* Vol. 79, No. 158.

Garner, J. T. 1998. Malacologist, Alabama Game and Fish Division (now the Alabama Division of Wildlife and Freshwater Fisheries). Personal Communications. 1998.

Garner, J. T. 2001. Malacologist, Alabama Game and Fish Division (now the Alabama Division of Wildlife and Freshwater Fisheries). Personal Communications. December 2001.

Garner, J. T. 2015. Malacologist, Alabama Division of Wildlife and Freshwater Fisheries. Personal Communication. 2015.

Garner, J. T. and S. W. McGregor. 2001. Current Status of Freshwater Mussels (Unionidae, Margaritiferidae) in the Muscle Shoals Area of the Tennessee River in Alabama (Muscle Shoals revisited again). *American Malacological Bulletin*.

Garner, J. T. and T. M. Haggerty. 2010. Distribution, Density, and Population Dynamics of the Anthony Riversnail (*Athearnia anthonyi*) in Limestone Creek, Limestone County, Alabama. *American Malacological Bulletin* 28.

Gooch, C. H., W. J. Pardue, and D. C. Wade. 1979. Recent Mollusk Investigations on the Tennessee River, 1978. Unpublished Report. Muscle Shoals, Alabama and Chattanooga, Tennessee: Tennessee Valley Authority, Division of Environmental Planning.

Haggerty, T.M. and J.T. Garner. 2008. Distribution of the Armored Snail (*Marstonia pachyta*) and Slender Campeloma (*Campeloma decampi*) in Limestone, Piney, and Round Island Creeks, Alabama. *Southeastern Naturalist* 7(4).

Henson, J. R. and R. J. Pryor. 1982. Browns Ferry Nuclear Plant—Proposed Barge Facility. Unpublished Report. Knoxville, Tennessee: Tennessee Valley Authority, Fisheries and Ecology Branch, Division of Water Resources.

Hickman, G. D. and T. A. McDonough. 1996. Assessing the Reservoir Fish Assemblage Index—A Potential Measure of Reservoir Quality. In *Reservoir Symposium—Multidimensional Approaches to Reservoir Fisheries Managemen*t, edited by D. DeVries. Bethesda, Maryland: American Fisheries Society, Reservoir Committee, Southern Division.

Isom, B. G. 1969. The Mussel Resource of the Tennessee River. *Malacologica* 7.

Jennings, M. J., L. S. Fore, and J. R. Karr. 1995. Biological Monitoring of Fish Assemblages in the Tennessee Valley Reservoirs. *Regulated Rivers* 11:263-274.

Kuhajda, B. R., A. L. George, and J. D. Williams. 2009. The Desperate Dozen: Southeastern Freshwater Fishes on the Brink. *Southeastern Fishes Council Proceedings* 1(51).

Lowery and Poppe. 1992. Thermal Variance Monitoring for Browns Ferry Nuclear Plant, Wheeler Reservoir, 1990–1991. Tennessee Valley Authority, Water Resources Aquatic Biology Department.

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*, edited by T. Simon. Boca Raton, Florida: CRC Press.

McLean, R. B., P. T. Singley, J. S. Griffith, and M. V. McGee. 1980. Threadfin Shad Impingement: Effect of Cold Stress. Report to the U.S. Nuclear Regulatory Commission. Publication No. 1495.

Scruggs, G. D., Jr. 1960. Status of the Freshwater Mussel Stocks in the Tennessee River. U.S. Fish and Wildlife Service Special Scientific Report—Fisheries No. 370.

TVA (Tennessee Valley Authority). 1978a. Browns Ferry Nuclear Plant Preoperational Fisheries Resources Report. Norris, Tennessee: Tennessee Valley Authority, Division of Forestry, Fisheries and Wildlife Development.

TVA. 1978b. Biological Effects of Intake—Browns Ferry Nuclear Plant. Volume 4: Effects of the Browns Ferry Nuclear Plant Cooling Water Intake on the Fish Populations of Wheeler Reservoir.

TVA. 1995. Energy Vision 2020—Integrated Resource Plan Environmental Impact Statement. Three Volumes. Retrieved from: <http://www.tva.gov/environment/reports/energyvision2020/>

TVA. 1999. Browns Ferry Nuclear Plant National Pollutant Discharge Elimination System Permit No. AL 0022080 Renewal Application.

TVA. 2002. *Final Supplemental Environmental Impact Statement for Operating License Renewal of the Browns Ferry Nuclear Plant in Athens, Alabama*.

TVA. 2003. "Browns Ferry Nuclear Plan Units 2 and 3 Extended Power Uprate Project", Final Environmental Assessment, Tennessee Valley Authority. August 2003.

TVA. 2004. "Browns Ferry Nuclear Plan Extended Power Uprate", Environmental Report, Volume 1-UNIT 1, Volume 2-UNITS 2 and 3, Tennessee Valley Authority. June 2004.

TVA. 2005. "Hydrothermal Modeling of Browns Ferry Nuclear Plant with Units 1, 2, and 3 at Extended Power Uprate", Report No. WR2005-1-67-135. Tennessee Valley Authority, River Operations. February 2005

TVA. 2010. Fish impingement at Browns Ferry Nuclear Plant, September 2007 through September 2009. TVA Environmental Stewardship and Policy.

TVA. 2012a. Biological Monitoring of the Tennessee River Near Browns Ferry Nuclear Plant Discharge, Autumn 2011. TVA Biological and Water Resources, Chattanooga, Tennessee.

TVA. 2012b. Entrainment of Ichthyoplankton at Browns Ferry Nuclear Plant During 2008–2009. Knoxville, Tennessee: TVA Biological and Water Resources.

TVA. 2013. Biological Monitoring of the Tennessee River Near Browns Ferry Nuclear Plant Discharge, Autumn 2013.

TVA. 2014. Biological Monitoring of the Tennessee River Near Browns Ferry Nuclear Plant Discharge, Autumn 2013. Knoxville, Tennessee: River and Reservoir Compliance Monitoring Program.

TWRA (Tennessee Wildlife Resources Agency). 2014. Strategic Plan 2014–2020. Nashville, Tennessee. Retrieved from <http://www.state.tn.us/twra/pdfs/businessplan.pdf>

USFWS (U.S. Fish and Wildlife Service). 2014. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Spring Pygmy Sunfish. *Federal Registe*r 79(24): 6871-6874.

USGS (U.S. Geological Survey). 2014. Circular 1395: Mercury in the Nation's Streams—Levels, Trends, and Implications. October.

Yokely, P., Jr. 1998. Mussel Study Near Hobbs Island on the Tennessee River for Butler Basin Marina. Unpublished Report Prepared for MST Engineering, Decatur, Alabama.

8.0 RADIOLOGICAL ENVIRONMENTAL IMPACTS

8.1 Radiological Waste Streams

The radioactive waste systems at BFN Units 1, 2, and 3 are designed to collect, process, and dispose of radioactive wastes in a controlled and safe manner. These systems are designed to limit discharges in accordance with 10 CFR Part 50, Appendix I. The actual performance and operation of installed equipment, as well as reporting of actual offsite releases and doses, are controlled by the requirements of the Offsite Dose Calculation Manual (ODCM) (TVA 2015). The ODCM is subject to NRC inspection and describes the methods and parameters used for calculating offsite doses resulting from radioactive gaseous and liquid effluents, and ensuring compliance with NRC regulations. Adherence to these limits and objectives would continue under the proposed EPU.

Operation at the proposed EPU conditions would not result in any physical changes to the solid waste, liquid waste, or gaseous waste systems. The safety and reliability of these systems would be unaffected by the proposed EPU. Also, the proposed action would not affect the environmental monitoring of any of these waste streams or the radiological monitoring requirements of the BFN Units 1, 2, and 3, Radiation Protection Program. Under normal operating conditions, the proposed action would not introduce any new or different radiological release pathways and would not increase the probability of an operator error or equipment malfunction that would result in an uncontrolled radioactive release from the radioactive waste streams.

BFN Power Uprate Safety Analysis Report (PUSAR) Section 2.5.5.1, Gaseous Waste Management System, PUSAR Section 2.5.5.2, Liquid Waste Management System, and PUSAR Section 2.5.5.3, Solid Waste Management System, provide an assessment of the effect of the proposed EPU on the gaseous, liquid and solid radioactive waste systems and the associated effluents. The assessment is based on a comparison of ANSI/ANS 18.1-1984 based 10 CFR Part 50 Appendix I type analyses for both pre-EPU and EPU conditions using the ANSI/ANS 18.1-1984 Reference BWR concentrations (Table 8.2-1) as the starting point.

The following subsections summarize the results of additional assessment of the effect of the proposed EPU on radwaste effluents and associated doses to the public. The impact of the EPU on the radwaste gaseous and liquid releases and doses to the public is assessed herein by applying EPU scaling factors (NRC 1979) to the radioactive effluent release and dose information reported in the annual Radioactive Effluent Reports for the years 2009 to 2013 for BFN Units 1, 2, and 3 (TVA 2009; TVA 2010; TVA 2011; TVA 2012; TVA 2013). The average effluent releases for the site for the years 2009 to 2013 are reported in Tables 8.1-2 and 8.1-3. It is noted that the sum of the values for activity and volume, reported in Tables 8.1-1 through 8.1-3, represent the combined operations of BFN Units 1, 2, and 3.

8.1.1 Solid Low Level Radioactive Waste

BFN low-level radioactive waste (LLRW) includes solids from reactor coolant systems, solids in contact with liquids or gases from reactor coolant systems, and solids used in support of reactor coolant systems operation. The majority of BFN solid radioactive waste, as documented in Table 8.1-1, is shipped offsite as dry active waste. This waste is from outages, special projects and normal operations for Units 1, 2, and 3. Normal operations is a major contributor for BFN LLRW shipments due to system cleanup activities. Resin is a major contributor for BFN LLRW shipments as the BFN radwaste system utilizes six waste phase separators and three reactor water cleanup phase separators. On average, BFN has 29 spent resin shipments per year.

BFN LLRW includes resins, filters and evaporator bottoms; dry active waste; irradiated components; other waste (combined packages). These four LLRW categories are documented below in Table 8.1-1 in cubic feet, cubic meters and curies. Table 8.1-1 also presents the total average annual LLRW shipped offsite (2009-2013) as well.

BFN future LLRW shipments for processing and disposal will continue to be similar to those in Table 8.1-1 for the 5 year average annual volumes.

BFN PUSAR Section 2.5.5.3, Solid Waste Management System, provides an evaluation of effects the proposed EPU may have on the solid waste management system for BFN. The results of the evaluation indicate that the proposed EPU will result in a 15 percent increase in the total volume of solid waste generated for shipment offsite.

Assessment performed for this supplemental ER indicates that the activity levels of the solid waste would increase proportionately to the increase in activity of long-lived radionuclides in the reactor coolant with an increase of 5-13 percent. This percentage increase reflects the EPU increase in power level and is based on BFN operation at the current licensed thermal power (CLTP) level of 3,458 MWt and EPU operation at the proposed Target Licensed Thermal Power (TLTP) level of 3,952 MWt. EPU does not generate a new type of waste or create a new waste stream. Therefore, the types of radioactive waste that requires shipment are unchanged. Because the solid waste volume increase is small, the current design and operation of the solid waste management system will accommodate the effects of BFN EPU with no changes. The existing equipment and procedures that control radwaste shipments and releases to the environment will continue to ensure that BFN remains within the applicable regulatory guidance. Therefore, there are no significant environmental effects due to EPU.

Table 8.1-1: BFN Average Annual Low-Level Radioactive Waste Shipped Off Site, 2009-2013

Category of Waste	Cubic Feet	Cubic Meters	Curies
Resins, Filters and Evaporator Bottoms	5.04E+03	1.43E+02	4.74E+02
Dry Active Waste	7.95E+04	2.25E+03	5.03E+00
Irradiated Components	3.44E+01	9.76E-01	1.98E+04
Other Waste (Combined Packages)	4.92E+03	1.39E+02	1.11E+01
Total Average Annual Low-Level Radioactive Waste Shipped Off Site (2009–2013)	8.95E+04	2.53E+03	2.03E+04

8.1.2 Liquid Waste

Liquid radioactive wastes include liquids from the reactor process systems and liquids that have become contaminated with process system liquids. Table 8.1-2 presents liquid releases from BFN Units 1, 2 and 3 for the 5 year period from 2009 through 2013. As noted in Table 8.1-2, approximately 289 million liters and 8.0 Ci fission and activation products were released in an average year. The 5 year average includes abnormal releases in 2009, 2010, and 2012. The abnormal releases included the activity from F-18 (T1/2 - 110 minutes). There is significant transit time between the effluent point of release and the nearest water purification facility intake. The abnormal releases are included in the basis for this assessment, but are not expected to occur. If the abnormal releases were excluded the yearly average would be 0.26 Ci.

As indicated in BFN PUSAR Section 2.5.5.2, Liquid Waste Management System, the volume of liquid waste effluents is expected to increase by approximately 3.44 percent due operation at EPU conditions. The increased flow in the condensate demineralizers requires more frequent backwashes due to increased loading of soluble and insoluble species. The total volume of liquid waste (a 3.44 increase of pre-EPU volume) does not significantly challenge the radwaste system's capacity. Therefore, EPU does not have an adverse effect on the processing of liquid and solid radwaste.

The assessment performed indicates that the proposed EPU would have the following impact on the equilibrium radioactivity in the reactor coolant, which would in turn impact the concentrations of radioactive nuclides in the waste management systems. Consistent with ANSI/ANS-18.1-1984, the expected equilibrium concentration of tritium in the reactor coolant and steam is not dependent upon the thermal power level. The inventory of radionuclides with long half-lives increase by approximately 13 percent (due to the power increase). The iodine concentration in reactor coolant would increase by approximately 5 percent.

The assessment performed herein addresses the expected increase due to the EPU based on the reported average annual releases during this five-year period. Consistent with NUREG-0016, the expected total annual release of tritium is a function of the power level. Therefore, the annual release of tritium is expected to increase by approximately 15 percent. The concentration of non-tritiated activity in the reactor coolant system would increase by approximately 13 percent which would result in an estimated annual release of non-tritiated activity of 9.04 Curies.

The assessment also concluded that the projected releases following EPU discussed herein remain bounded by values provided in the BFN PUSAR, which are based on 10 CFR Part 50 Appendix I type analysis that used the radioactive and volumetric source terms identified in ANSI/ANS-18.1-1984. The existing equipment and procedures that control releases to the environment will continue to ensure that BFN remains within applicable limits. There are no significant environmental effects due to EPU.

Section 8.2 addresses the offsite radiation dose consequences of the EPU liquid effluent releases.

Table 8.1-2: Liquid Effluent Releases From BFN, 2009–2013

Year	Volume of Waste Released (Liters)	Activity Released (Ci)	Tritium (Ci)
2009	7.09E+06	3.48E+01[(1)]	8.43E+01[(2)]
2010	1.57E+06	3.82E+00[(1)]	1.09E+01[(2)]
2011	1.98E+06	1.47E-02	5.21E+00
2012	1.39E+09[(3)]	7.81E-02[(1)]	9.58E+00[(2)]
2013	4.40E+07	1.26E+00	8.79E+01
Annual Average	2.89E+08	8.00E+00	3.96E+01

Notes:

1. The sum of the activity released would be 1.99E-02 Ci(2009), 4.13E-03 Ci(2010), and 9.43E-04 Ci(2012) if F-18 from abnormal releases were excluded. The 5-year annual average includes abnormal F-18 releases.
2. The sum of the activity released would be 1.15E+01 Ci(2009), 2.82E+00 Ci(2010), and 1.41E+00 Ci(2012) if H-3 from abnormal releases were excluded. Abnormal releases were included in the 5-year annual average for tritium.
3. The sum of the volume released would be 2.65E+05 Liters(2012) if the volume from abnormal releases were excluded.

8.1.3 Gaseous Waste

Gaseous radioactive wastes mainly include activation gases and fission product radioactive noble gases vented from process equipment and, under certain circumstances, building ventilation exhaust air. Table 8.1-3 presents gaseous releases from BFN Units 1, 2, and 3 from 2009 through 2013. The evaluation presented in BFN PUSAR section 2.5.5.1, Gaseous Waste Management System, indicates that implementation of the proposed EPU does not significantly increase the inventory of nonradioactive carrier gases, such as air, normally processed in the gaseous waste management system. This is because plant system functions are not changing and the volume inputs remain the same.

Calculations of steam activity consistent with NUREG-0016 show that the activity of fission gases is not increased; however, iodine increases by approximately 5 percent and particulates increase approximately 13 percent. Consistent with NUREG-0016, the expected total annual release of tritium is a function of the power level. Therefore, the annual release of tritium is expected to increase by approximately 15 percent. The dose for the different types of airborne releases have been consistently less than 2 percent (TVA 2009; TVA 2010; TVA 2011; TVA 2012; TVA 2013) of the allowable limits. Increasing all of the activity by 15 percent would result in doses which are still less than 2 percent of the allowable limits.

The gaseous effluents are well within limits at original power operation and will remain well within limits following implementation of EPU. There are no significant environmental effects due to EPU.

Table 8.1-3: Gaseous Effluent Releases From BFN, 2009–2013

Year	Fission and Activation Gases (Ci)	Particulates (T1/2> 8 Days) (Ci)	Iodines (Ci)	Tritium (Ci)	C-14 (Ci)
2009	None Detected	2.04E-04	1.35E-03	9.55E+01	None Reported
2010	None Detected	1.03E-03	7.51E-03	3.13E+02	3.52E+01
2011	1.09E-02	5.98E-03	8.36E-03	9.74E+01	3.45E+01
2012	6.93E+02	2.55E-03	8.42E-03	5.97E+02	3.61E+01
2013	None Detected	4.37E-02	5.01E-03	2.87E+02	3.71E+01
Annual Average	1.39E+02	1.07E-02	6.13E-03	2.78E+02	2.86E+01

8.1.4 Spent Fuel

The proposed EPU would increase the average batch size of fuel assemblies needed for a refueling. The impact of EPU on spent fuel storage is that the number of dry storage casks required would increase by approximately 19 percent with EPU implementation. Casks will be loaded to maintain adequate spent fuel pool capacity. Implementation of the independent spent fuel storage installation (ISFSI) was reviewed as part of the TVA FSEIS for license renewal of the three units and restart of BFN Unit 1 (TVA 2002). BFN's proposed plans for an ISFSI dry storage facility included sufficient expansion room to accommodate uncertainty in the DOE schedule for a national repository and additional storage required for license extension, three unit operation, and EPU implementation (TVA 2002). The additional spent fuel would be accommodated in the independent spent fuel storage installation pending shipment of the waste to a permanent disposal facility. Therefore, there are no significant effects on the environment due to EPU.

8.2 Radiation Levels and Offsite Doses

8.2.1 Occupational Radiation Dose (Onsite Dose)

During power operation, the radiation sources in the core are directly related to the fission rate. These sources include radiation from the fission process, accumulated fission products and neutron reactions as a secondary result of fission. Historically, these sources have been defined in terms of energy or activity released per unit of power. Therefore, for a constant pressure power uprate (CPPU), the percent increase in the operating source terms is no greater than the percent increase in power. Core radiation sources increase proportional to the increase in reactor power. Radiation sources in the reactor coolant include activation products, activation corrosion products, and fission products. Scaling factors for major dose contributors were calculated for normal and post-accident doses to address EPU conditions. Normal operation scaling factors were calculated for direct radiation from the core, off-gas, reactor liquid coolant (fission products, activation products, and N-16), the reactor steam, (N-16), Turbine Building (N-16), the reactor water cleanup system (RWCU), and the condensate demineralizers. The calculations are based upon the alternate source term analysis and AREVA ATRIUM-10XM fuel. The EPU scaling factors were applied to the BFN dose calculations to evaluate the impact of EPU implementation.

As indicated in BFN PUSAR Section 2.10.1.2, Occupational and Onsite Radiation Exposure, the normal operation radiation levels increase slightly under EPU conditions. Plant shielding is designed to provide for personnel access to the plant to perform maintenance and carry out operational duties with personnel exposures limited to the criteria established by 10 CFR Part 20. Evaluations at the uprated power level conclude that the pre-uprate values for activity still bound the uprated values. Thus, the increase in radiation levels does not affect radiation zoning or shielding in the various areas of the plant, because it is offset by conservatism in the original design, source terms used, and analytical techniques.

In-plant radiation levels and associated doses are controlled by the BFN Radiation Protection Program to ensure that internal and external radiation exposures to station personnel, and the general population will be as low as reasonably achievable (ALARA), as required by 10 CFR Part 20. The TVA policy is to maintain occupational doses to individuals and the sum of dose equivalents received by all exposed workers ALARA.

Individual worker exposures can be maintained within acceptable limits by controlling access to radiation areas using the site ALARA program. Procedural controls compensate for increased radiation levels. In addition, BFN has previously implemented zinc injection and noble metal chemical addition to limit the increase in normal radiation doses from the implementation of hydrogen water chemistry.

Post-uprate radiation levels in most areas of the plant are expected to increase by no more than the percentage increase in power level. In a few areas near the reactor water piping and liquid radwaste equipment, the increase could be slightly higher due to the increase in production of activated corrosion products. Access to these areas is strictly controlled by existing Radiation Protection procedures. Individual worker exposures are maintained within acceptable limits by controlling access to radiation areas using the site ALARA program. Procedural controls compensate for increased radiation levels. Therefore, no new dose reduction programs are planned and the ALARA program would continue in its current form. Therefore, there are no significant effects on occupational radiation dose due to EPU.

8.2.2 Radiological Impacts Normal Operation (Offsite Dose)

Using scaling techniques of NUREG-0016, this analysis conservatively projects maximum doses from normal operation under the proposed EPU conditions taking into consideration the following:

- The reported gaseous and liquid effluent and dose data during that period
- NUREG-0016 equations and assumptions
- Conservative methodology

Pre-EPU dose estimates are calculated by taking the average 5 year annual organ and whole body dose values for gaseous and liquid effluents during the period from 2009 through 2013 - (TVA 2009; TVA 2010; TVA 2011; TVA 2012; TVA 2013). To predict doses under the proposed EPU conditions, the analysis assumes that the maximum increase in radioactivity content of the liquid and gaseous releases is related to the maximum percentage change per chemical class (NRC 1979) in the reactor and steam coolants over that of the pre-EPU case. To conservatively estimate the offsite dose due to EPU the average value from the annual radioactive effluent release reports is increased by a factor of 1.2.

Following EPU, TVA predicts that the maximum annual total body and organ doses (all pathways) from liquid effluent releases would increase slightly. As demonstrated in Table 8.2-1, the estimated EPU doses due to liquid effluents are significantly below the ODCM and EPA limits. Following EPU, TVA predicts that the maximum annual total body and organ doses (all pathways) from gaseous effluent releases would increase slightly. As demonstrated in Table 8.2-2, the estimated EPU doses due to gaseous effluents are significantly below the ODCM and EPA limits.

The current ISFSI storage pad is projected to be filled on or before 2022, prior to being loaded with EPU fuel. An additional storage pad is anticipated to be required, even if no EPU is approved. ISFSI dose contributions will continue to be monitored using the ODCM process.

The offsite doses due to the ISFSI would be negligibly affected by storage of EPU fuel, as changes in neutron and gamma sources are primarily a function of fuel burn up and cooling time rather than power.

Under pre-EPU conditions, direct radiation measurements made at the site boundary measured by environmental dosimeters deployed around BFN as part of the offsite Radiological Environmental Monitoring Program (REMP) indicated no increase in ambient radiation levels from plant operation. This is expected to continue under EPU conditions.

For CPPU, normal operation gaseous activity levels increase slightly while the level of N-16 in the turbine increase proportional to the rated steam flow. The increased steam flow rate and velocity result in shorter travel time to the turbine and less radioactive decay in transit. This leads to higher radiation levels in and around turbines and offsite skyshine. The typical shielding design more than adequately bounds increases due to power uprate. Although implementation of EPU increases the skyshine component to the offsite doses up to 32 percent due to N-16 in the equipment above grade, the expected post-EPU increase in the in-plant radiation exposure in the turbine building complex has a negligible effect on the estimated doses to members of the public. The turbine building concrete shielding and distance between the turbine building and offsite boundary are such that the post-EPU direct dose contribution from the steam components in the turbine building is negligible. The post-EPU N-16 skyshine dose rate at the nearest boundary is expected to be near the background radiation level. Therefore, it does not significantly impact the total estimated doses to members of the public.

A review was performed to determine the highest dose to a member of the public within the site boundary. The dose to a member of the public consists of the sum of dose commitments from effluent releases as well as any direct radiation dose. The gaseous effluent dose commitment is negligible compared to the direct radiation dose. The direct radiation dose was determined from area environmental dosimeters located onsite. It consisted of gamma dose from the plume, ground contamination, and from equipment sources (i.e., tanks, turbine shine, radioactive material storage areas, etc.). The critical location was determined to be an environmental dosimeter near the Livewell Center (Training Center). The average annual direct radiation dose accounting for background and occupancy was 0.87 mrem during the period of 2009 through 2013. It can be concluded that the dose limit for a member of the public at the site boundary as

specified in 10 CFR 20.1301 would not be exceeded even at the projected 32 percent increase due to skyshine from N-16 after EPU.

The 40 CFR Part 190 annual whole body dose limit of 25 mrem to any member of the public includes the following:

- Contributions from direct radiation (including skyshine) from contained radioactive sources within the facility
- Whole body dose from liquid release pathways
- Whole body dose to an individual via airborne pathways

Taking into consideration the magnitude of the estimated annual EPU doses due to gaseous and liquid effluent releases and the negligible direct shine dose contribution from components within the facilities, ISFSI and skyshine, it is concluded that the 40 CFR Part 190 whole body dose limit of 25 mrem/yr will not be exceeded by operation at EPU conditions. Therefore, there are no significant effects on the environment due to EPU.

Table 8.2-1: Average Offsite Dose Commitments From Liquid Effluents

Type of Dose	ODCM Limit (mrem/year)	EPA Limit (mrem/year)	2009–2013 Average Annual Dose (mrem)	Projected Annual Dose (mrem)	Percentage of ODCM Limit Current / Projected (%)	Percentage of EPA Limit Current / Projected (%)
Total Body	3	25	0.014	0.0168	0.47 / 0.56	0.056 / 0.067
Any Organ	10	25	0.0204	0.0245	0.20 / 0.25	0.082 / 0.098

Table 8.2-2: Average Offsite Dose Commitments From Gaseous Effluents

Type of Dose	ODCM Limit (mrem/year)	EPA Limit (mrem/year)	2009–2013 Average Annual Dose(mrem)	Projected Annual Dose (mrem)	Percentage of ODCM Limit Current / Projected (%)	Percentage of EPA Limit Current / Projected (%)
Gamma Dose in Air (mrad)	10	25	2.28E-6	2.74E-6	0.000023 / 0.000027	0.000009 / 0.000011
Beta Dose in Air (mrad)	20	25	1.54E-6	1.85E-6	0.000008 / 0.000009	0.000006 / 0.000008
Any Organ (mrem)	15	25	9.83E-2	1.18E-1	0.66 / 0.79	0.39 / 0.47

8.3 Radiological Consequences of Accidents

8.3.1 Radiological Impacts—Accident Related

The radiological consequences resulting from the postulated designed basis accidents (DBAs) of loss of coolant accident, main steam line break accident, fuel-handling accident, and the control rod drop accident have been evaluated using NRC accepted methods. The results indicate existing regulatory requirements would continue to be met. Table 8.3-1 presents a summary of the radiological consequences of these postulated DBAs.

On July 31, 2002, in accordance with the provisions of 10 CFR 50.4 and 10 CFR 50.90, TVA submitted a request for a license amendment that supports a full scope application of an Alternative Source Term (AST) methodology for BFN Units 1, 2, and 3. This request was approved on September 27, 2004 (ML042730028). Full scope AST analyses were performed following the guidance in Regulatory Guide 1.183, Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors and Standard Review Plan Section 15.0.1, "Radiological Consequences Analyses using Alternative Source Terms." AST analyses were performed for the four Updated Final Safety Analysis Report (UFSAR) Chapter 14 BFN DBAs that could potentially result in offsite doses, those previously mentioned above. The core inventory assumed for these analyses consisted of choosing the bounding value of each isotope between GE14 fuel and AREVA's ATRIUM-10 fuel at EPU conditions. Subsequent evaluations have shown that the ATRIUM-10XM core inventory is bounded by the combined GE14/ATRIUM-10 source term. Bounding results appear in Table 8.3-1.

The analyses demonstrated that using AST methodologies, post-accident offsite doses remain within regulatory limits.

Table 8.3-1: Summary of Radiological Consequences of Postulated Accidents

Design Basis Accident	Offsite Dose at Exclusion Area Boundary (Rem TEDE)		Offsite Dose at Low Population Zone (Rem TEDE)	
	Value	**Limit**	**Value**	**Limit**
Loss of Coolant (LOCA)	1.71	25	2.38	25
Main Steam Line Break				
3.2 µCi/g DE I-131	0.13	2.5	0.07	2.5
32 µCi/g DE I-131	1.30	25	0.65	25
Fuel Handling	0.86	6.3	0.43	6.3
Control Rod Drop	1.17	6.3	0.70	6.3

Notes:
Rem = Roentgen Equivalent Man
TEDE =Total Effective Dose Equivalent
µCi/g = micro Curies per gram
DE = Dose Equivalent
I-131 = Iodine 131

8.4 References

ANSI/ANS 18.1 - 1984. American National Standard Radioactive Source Term for Normal Operation of Light Water Reactors.

NRC (U.S. Nuclear Regulatory Commission). 1979. *Calculation of Releases of Radioactive Materials I Gaseous and Liquid Effluents from Boiling Water Reactors*. (BWR-GALE CODE). NUREG-0016, January 1979. Accession No. ML091910213.

NRC 2000. Regulatory Guide 1.183. *Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors*.

TVA (Tennessee Valley Authority). 2002. *Final Supplemental Environmental Impact Statement for Operating License Renewal of the Browns Ferry Nuclear Plant in Athens, Alabama*. March 2002.

TVA. 2009. Browns Ferry Nuclear Plant Units 1, 2, and 3 2009 Radiological Impact Assessment Report, January 1, 2009 through December 31, 2009. Accession No. ML101260470

TVA. 2010. Browns Ferry Nuclear Plant Units 1, 2, and 3 2010 Radiological Impact Assessment Report, January 1, 2010 through December 31, 2010. Accession No. ML111250450.

TVA. 2011. Browns Ferry Nuclear Plant Units 1, 2, and 3 2011 Radiological Impact Assessment Report, January 1, 2011 through December 31, 2011. Accession No. ML12123A017.

TVA. 2012. Browns Ferry Nuclear Plant Units 1, 2, and 3 2012 Effluent and Waste Disposal Report, January 1, 2012 through December 31, 2012. Accession No. ML13126A100.

TVA. 2013. Browns Ferry Nuclear Plant Units 1, 2, and 3 2013 Annual Radioactive Effluent Release Report, January 1, 2013 through December 31, 2013. Accession No. ML14122A344.

TVA. 2015. Tennessee Valley Authority Browns Ferry Nuclear Plant Offsite Dose Calculation Manual, 0-ODCM-001, Revision 22. Browns Ferry Nuclear Plant. February 17, 2015.

9.0 ENVIRONMENTAL EFFECTS OF URANIUM FUEL CYCLE ACTIVITIES AND FUEL AND RADIOACTIVE WASTE TRANSPORT

Table S-3 of 10 CFR 51.51 provides the basis for evaluating the contribution of the environmental effects of the uranium fuel cycle to the environmental impacts of licensing nuclear power plants. Summary Table S-4 of 10 CFR 51.52 lists the environmental impacts of transporting nuclear fuel and waste to and from one light-water-cooled nuclear power plant under both normal conditions and accidents. However, since the 1970s when these tables were developed, most nuclear plants have increased both uranium-235 enrichment and fuel burnup limits, which are fundamental parameters that affect environmental impacts of the uranium fuel cycle, including transport.

In 1988, the NRC generically evaluated the impacts of increased enrichment and extended burnup fuel on the uranium fuel cycle, including transportation of nuclear fuel and wastes, to determine whether higher burnup and enrichment could result in environmental impacts greater than those described in Tables S-3 and S-4. The EA and FONSI (53 FR 6040) concluded that uranium enrichments up to 5 percent uranium-235 and burnup limits of up to 60,000 MWd/MTU would have no significant adverse environmental effects on the uranium fuel cycle or the transport of nuclear fuel and wastes, and would not change the impacts presented in Tables S-3 and S-4.

In 1999, in connection with the generic EIS (GEIS) for license renewal of nuclear power plants, the NRC examined the transport of spent fuel having higher initial enrichment (up to 5 percent) and higher discharge burnup (up to 62,000 MWd/MTU) to a geologic repository (NRC 1999). The conclusion of that evaluation was that the environmental impacts would be consistent with the values presented in Table S-4 and that the impacts in Table S-4 are bounding.

Increasing the electrical output of a BWR power plant is accomplished primarily by generating higher steam flow in the reactor and supplying it to the turbine generator. The higher steam flow is achieved by increasing the reactor power level and the feedwater flowing to the reactor. The additional reactor energy requirements for EPU are met primarily by increasing the reload fuel batch size and changing the fuel loading pattern and planned deployment of fuel enrichment and burnable poison, supplemented by adjustments to core management control rod pattern and/or core flow. The increase in core thermal power is achieved with a more uniform (flattened) power distribution such that EPU does not require any changes to fuel design limits.

Design studies project that, compared with the current re-load batch size at the current power level, EPU will require more assemblies per re-load, resulting in a slight increase in cycle dose associated with the production, handling, and storage of more fresh and spent fuel. However, because the burn-up limit is unchanged (the upper exposure limit is bounded by maintaining the fuel within the NRC-approved vendor-specific exposure limits) for EPU, and the U-235 enrichment limit of 5 percent also remains the same, the BFN fuel

cycles will remain bounded by the impacts listed in Tables S-3 and S-4 of 10 CFR Part 51. For the purpose of bounding the impacts, TVA used a range of fuel vendor specifications for this analysis. TVA concludes, therefore, that impacts to the uranium fuel cycle and transport of nuclear fuel from the proposed action would be insignificant and not require mitigation.

While the analysis discussed above was based on a range of fuel vendor specifications, the analysis discussed below is based on a single vendor, TVA's current fuel vendor for Units 1, 2, and 3, AREVA NP.

On February 14, 2001, TVA published a notice of adoption in the *Federal Register* for the FEIS, "Disposition of Surplus Highly Enriched Uranium," prepared by the U.S. Department of Energy (DOE), Office of Fissile Materials. TVA's actions related to the preferred alternative include entering into an interagency agreement with DOE to obtain approximately 33 metric tons of highly enriched uranium (HEU) for blend down and subsequently to use the low enriched uranium (LEU) in the form of nuclear reactor fuel at BFN. TVA actions related to the preferred alternative also include entering into contracts with a consortium composed of AREVA NP of Lynchburg, Virginia and Richland, Washington, and Nuclear Fuel Services of Erwin, Tennessee, to process and blend the uranium and to fabricate the fuel. After analysis of the adequacy and applicability and subsequent adoption of the DOE's FEIS, and following recirculation of the DOE's FEIS and consideration of public comments received on its adoption by TVA, TVA decided to implement the actions (as described above) related to the preferred alternative identified in DOE's FEIS. The decision was based on the substantial savings to TVA ratepayers in nuclear fuel costs in the years 2005–2015 without significantly impacting the environment, and that the environmental impacts associated with producing and transporting an equivalent amount of LEU from 14 million pounds of natural uranium (as U_3O_8) that, in turn, would require mining of 140,000 tons of ore would be avoided. The ROD for this action was published in the *Federal Register* on November 19, 2001 (66 FR 57997). The first fuel resulting from these processing, blending, and fabrication contracts was loaded into Unit 2 during the spring 2005, and the last full reload is expected to occur in the fall 2016 in Unit 1. (There may be partial core reloads later, depending on material availability, which may or may not occur during EPU operations.)

For blended low enriched uranium (BLEU) fuel, there is a higher percentage of the uranium-236 (U-236) isotope than for virgin uranium. U-236 is a neutron poison, requiring the enrichment to be increased as a compensation for reactivity loss. For fresh fuel with BLEU, the number of assemblies to be shipped increases, and the associated handling doses are increased due to the presence of the U-236 (surface contact source term increases from 4 to 8 mR/hr with commercial grade uranium to 10 to 15 mR/hr with BLEU). However, because the maximum enrichment and discharge burnup remain within the 5 percent and 62,000 MWd/MTU limits, respectively, the BFN fuel cycles with BLEU will still remain bounded by the impacts of Tables S-3 and S-4 of 10 CFR Part 51.

9.1 References

53 FR 6040. Extended Burnup Fuel Use in Commercial LWRs; Environmental Assessment and Finding of No Significant Impact. *Federal Register* 53:6040 (.

66 FR 57997. Blending of Surplus Highly Enriched Uranium From the Department of Energy, to Low Enriched Uranium for Subsequent Use as Reactor Fuel at the Tennessee Valley Authority's Browns Ferry Nuclear Plant. *Federal Register* 66:57997 (November 19, 2001).

NRC (U.S. Nuclear Regulatory Commission). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Vol. 1, Addendum 1, Main Report Section 6.3—Transportation, Table 9.1 Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants. August 1999.

10.0 EFFECTS OF DECOMMISSIONING

In 2002, NRC published NUREG-0586, Supplement 1, *Final GEIS on Decommissioning of Nuclear Facilities*, that discusses decommissioning of nuclear power reactors. The conclusion of NUREG-0586, Supplement 1, is that the environmental impacts of decommissioning are generally small and that only two environmental issues would require site specific evaluation: threatened and endangered species and environmental justice. (NRC 2002)

Prior to the projected end of operations, TVA would submit a preliminary decommissioning plan describing decommissioning activities, any environmental impacts of those activities, a schedule, and estimated costs. Implementation of EPU does not affect the ability of TVA to maintain sufficient financial reserves for decommissioning.

The slight potential for increase in environmental impacts due to decommissioning attributable to EPU is due to increases in the feedwater flow rate and increased neutron fluence. These increases in flow rate and neutron fluence could increase the amount of activated reactor vessel and corrosion products, respectively, and consequently, increase post-shutdown radiation levels. However, increases in radiation levels are expected to be insignificant, and would be addressed in the post-shutdown decommissioning activities report.

10.1 References

NRC (U.S. Nuclear Regulatory Commission). 2002. Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors. NUREG-0586, Supplement 1. Volume 1: Main Report, Appendices A through M.

ENCLOSURE 3

Draft Environmental Assessment and Finding of No Significant Impact
Change Markup

[7590-01-P]

NUCLEAR REGULATORY COMMISSION

[Docket Nos. 50-259, 50-260, and 50-296; NRC-2016-0244]

Tennessee Valley Authority;

Browns Ferry Nuclear Plant, Units 1, 2, and 3

AGENCY: Nuclear Regulatory Commission.

ACTION: Draft environmental assessment and draft finding of no significant impact; request for comment.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is considering issuance of amendments to Renewed Facility Operating License Nos. DPR-33, DPR-52, and DPR-68 issued to Tennessee Valley Authority (TVA, the licensee) for operation of Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN) located in Limestone County, Alabama. The proposed amendments would increase the maximum licensed thermal power level for each reactor from 3,458 megawatts thermal (MWt) to 3,952 MWt. This change, referred to as an extended power uprate (EPU), represents an increase of approximately 14.3 percent above the current licensed thermal power limit. The NRC is issuing a draft environmental assessment (EA) and draft finding of no significant impact (FONSI) for public comment associated with the proposed EPU.

DATES: Submit comments by **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**. The NRC can only ensure that its staff considers comments received on or before this date. Comments received after this date will be considered if it is practicable to do so.

ADDRESSES: You may submit comments by any of the following methods (unless this document describes a different method for submitting comments on a specific subject):

- **Federal Rulemaking Web Site:** Go to http://www.regulations.gov and search for Docket ID NRC-2016-0244. Address questions about NRC dockets to Carol Gallagher; telephone: 301-415-3463; e-mail: Carol.Gallagher@nrc.gov. For technical questions, contact the individual listed in the FOR FURTHER INFORMATION CONTACT section of this document.
- **Mail comments to:** Cindy Bladey, Office of Administration, Mail Stop: OWFN-12-H08, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

For additional direction on obtaining information and submitting comments, see "Obtaining Information and Submitting Comments" in the SUPPLEMENTARY INFORMATION section of this document.

FOR FURTHER INFORMATION CONTACT: Siva P. Lingam, telephone: 301-415-1564; e-mail: Siva.Lingam@nrc.gov; or Briana Grange, telephone: 301-415-1042; e-mail: Briana.Grange@nrc.gov. Both are staff members of the Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

SUPPLEMENTARY INFORMATION:

I. Obtaining Information and Submitting Comments

A. Obtaining Information

Please refer to Docket ID NRC-2016-0244 when contacting the NRC about the availability of information for this action. You may obtain publicly available information related to this action by any of the following methods:

- **Federal Rulemaking Web Site:** Go to http://www.regulations.gov and search for Docket ID NRC-2016-0244.

- **NRC's Agencywide Documents Access and Management System (ADAMS):** You may obtain publicly-available documents online in the NRC Public Documents collection at http://www.nrc.gov/reading-rm/adams.html. To begin the search, select "ADAMS Public Documents" and then select "Begin Web-based ADAMS Search." For problems with ADAMS, please contact the NRC's Public Document Room (PDR) reference staff at 1-800-397-4209, 301-415-4737, or by e-mail to pdr.resource@nrc.gov. The ADAMS accession number for each document referenced in this notice (if it is available in ADAMS) is provided in a table in the section of this notice entitled, "Availability of Documents."

- **NRC's PDR:** You may examine and purchase copies of public documents at the NRC's PDR, Room O1-F21, One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852.

B. Submitting Comments

Please include Docket ID NRC-2016-0244 in the subject line of your comment submission, in order to ensure that the NRC is able to make your comment submission available to the public in this docket.

The NRC cautions you not to include identifying or contact information that you do not want to be publicly disclosed in your comment submission. The NRC posts all comment submissions at http://www.regulations.gov as well as entering the comment submissions into ADAMS. The NRC does not routinely edit comment submissions to remove identifying or contact information.

If you are requesting or aggregating comments from other persons for submission to the NRC, then you should inform those persons not to include identifying or contact information that

they do not want to be publicly disclosed in their comment submission. Your request should state that the NRC does not routinely edit comment submissions to remove such information before making the comment submissions available to the public or entering the comment submissions into ADAMS.

II. Introduction

The NRC is considering issuance of amendments to Renewed Facility Operating License Nos. DPR-33, DPR-52, and DPR-68 issued to TVA for operation of BFN located in Limestone County, Alabama. The licensee submitted its license amendment request in accordance with section 50.90 of title 10 of the *Code of Federal Regulations* (10 CFR), by letter dated September 21, 2015 (TVA 2015a). The licensee subsequently supplemented its application as described under “Description of the Proposed Action” in Section III of this document. If approved, the license amendments would increase the maximum thermal power level at each of the three BFN units from 3,458 MWt to 3,952 MWt. The NRC staff prepared a draft EA for comment to document its findings related to the proposed EPU in accordance with 10 CFR 51.21. Based on the results of the draft EA contained in Section III of this document, the NRC did not identify any significant environmental impacts associated with the proposed amendments and has, therefore, prepared a FONSI in accordance with 10 CFR 51.32. The NRC staff is issuing its FONSI as a draft for public review and comment in accordance with 10 CFR 51.33. The draft EA and draft FONSI are being published in the *Federal Register* (FR) with a 30-day public comment period ending **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**. Publishing these documents as drafts for comment is in accordance with NRC Review Standard 001 (RS-001), Revision 0, “Review Standard for Extended Power Uprates” (NRC 2003).

III. Draft Environmental Assessment

Plant Site and Environs

The BFN site encompasses 840 acres (ac) (340 hectares (ha)) of Federally owned land that is under the custody of TVA in Limestone County, Alabama. The site lies on the north shore of Wheeler Reservoir at Tennessee River Mile (TRM) 294 and is situated approximately 10 miles (mi) (16 kilometers [km]) south of Athens, Alabama, 10 mi (16 km) northwest of Decatur, Alabama, and 30 mi (48 km) west of Huntsville, Alabama.

Each of BFN's three nuclear units is a General Electric boiling-water reactor that produces steam to turn turbine to generate electricity. The BFN uses a once-through (open-cycle) condenser circulating water system with seven helper cooling towers to dissipate waste heat. Four of the original six cooling towers that serve BFN have undergone replacement, and TVA plans to replace the remaining two towers in fiscal years 2018 and 2019. Additionally, TVA constructed a seventh cooling tower in May 2012 (TVA 2016a).

Wheeler Reservoir serves as the source of water for condenser cooling and for most of BFN's auxiliary water systems. Pumps and related equipment to supply water to plant systems are housed in BFN's intake structure on Wheeler Reservoir. The reservoir is formed by Wheeler Dam, which is owned and operated by TVA, and it extends from Guntersville Dam at TRM 349.0 downstream to Wheeler Dam at TRM 274.9. Wheeler Reservoir has an area of 67,070 ac (27,140 ha) and a volume of 1,050,000 acre-feet (1,233 cubic meters) at its normal summer pool elevation of 556 feet (ft) (169 meters (m)) above mean sea level (TVA 2016a).

The Alabama Department of Environmental Management (ADEM) establishes beneficial uses of waters of the State and has classified the majority of the reservoir for use as a public water supply, for recreational use, and as a fish and wildlife resource. The reservoir is currently included on the State of Alabama's Federal Water Pollution Control Act (i.e., Clean Water Act

(CWA)) of 1972, as amended, Section 303(d) list of impaired waters as partially supporting its designated uses due to excess nutrients from agricultural sources. The CWA Section 303(d) requires states to identify all "impaired" waters for which effluent limitations and pollution control activities are not sufficient to attain water quality standards. The 303(d) list includes those water quality-limited bodies that require the development of maximum pollutant loads to assure future compliance with water quality standards (ADEM 2016; TVA 2016a). Water temperature in Wheeler Reservoir naturally varies from around 35 degrees Fahrenheit (°F) (1.6 degrees Celsius (°C)) in January, to 88 to 90 °F (31 to 32 °C) in July and August, and temperature patterns near BFN are typically well mixed or exhibit weak thermal stratification (TVA 2016a).

The BFN intake structure draws water from Wheeler Reservoir at TRM 294.3. The intake forebay includes a 20-feet (6-meters)-high gate structure that can be raised or lowered depending on the operational requirements of the plant. The flow velocity through the openings varies depending on the gate position. When the gates are in a full open position and the plant is operating in either open or helper modes, the average flow velocity through the openings is about 0.2 meters per second (m/s) (0.6 feet per second (fps)) for the operation of one unit, 0.34m/s (1.1 fps) for the operation of two units, and 0.52 m/s (1.7 fps) for the operation of all three units assuming a water withdrawal rate of approximately 734,000 gallons per minute (gpm) (46.3 cubic meters per second (m^3/s)) per unit, for a total withdrawal of about 2,202,000 gpm (4,906 cubic feet per second (cfs); 138.6 m^3/s) of water for all three units (NRC 2005; TVA 2016b). BFN's total per-unit condenser circulating water system flow is generally higher than the original design values due to system upgrades that included the refit of the condensers with larger diameter and lower resistance tubes (NRC 2005; TVA 2016a, 2016b).

The licensee maintains a Certificate of Use (Certificate No. 1058.0, issued December 5, 2005) for its surface water withdrawals. The Alabama Department of Economic and Community Affairs, Office of Water Resources issues this certificate to register large water

users (i.e., those with a water withdrawal capacity of 100,000 gallons per day (380 cubic meters)) within the State. The licensee periodically notifies the Office of Water Resources of facility data updates and submits annual water use reports for BFN as specified under the Certificate of Use as part of TVA's efforts to voluntarily cooperate with the State of Alabama's water management programs. The licensee most recently submitted an application to renew BFN's Certificate of Use in September 2015. Based on the staff's review of BFN water use reports submitted by TVA to the State for the period of 2011 through 2015, BFN's total water withdrawals from Wheeler Reservoir have averaged 1,848,000 gpm (4,117 cfs; 116.3 m^3/s). For 2015, BFN's total surface water withdrawal rate averaged 1,991,200 gpm (4,437 cfs; 125 m^3/s) (TVA 2016b).

Once withdrawn water has passed through the condensers for cooling, it is discharged back to Wheeler Reservoir via three large submerged diffuser pipes. The pipes range in diameter from 5.2 to 6.2 m (17 to 20.5 ft) and are perforated to maximize mixing into the water column. Water exits the pipes through 7,800 individual 5-centimeter (2-inch) ports. This straight-through flow path is called "open mode." As originally designed, the maximum thermal discharge back to the reservoir from the once-through condenser circulating water system operated in open mode is 25 °F (13.9 °C) above the intake temperature (NRC 2005). Some of the heated water can also be directed through cooling towers to reduce its temperature, as necessary to comply with State environmental regulations and BFN's ADEM-issued National Pollutant Discharge Elimination System (NPDES) Permit No. AL0022080 (ADEM 2012), in what is called "helper mode." The plant design also allows for a closed mode of operation in which water from the cooling towers is recycled directly back to the intake structure without discharge to the reservoir. However, TVA has not used this mode for many years due to the difficulty in maintaining temperature limits in the summer months (NRC 2005).

To operate BFN, TVA must comply with the CWA, including associated requirements imposed by the State as part of the NPDES permitting system under CWA Section 402. The BFN NPDES permit (ADEM 2012) specifies that at the downstream end of the mixing zone, which lies 2,400 ft (732 m) downstream of the diffusers, operation of the plant shall not cause the:

- measured 1-hour average temperature to exceed 93 °F (33.9 °C),
- measured daily average temperature to exceed 90 °F (32.2 °C), or
- measured daily average temperature rise relative to ambient to exceed 10 °F (5.6 °C).

In cases where the daily average ambient temperature of the Tennessee River as measured 3.8 mi (6.1 km) upstream of BFN exceeds 90 °F (32.2 °C), the daily average downstream temperature may equal, but not exceed, the upstream value. In connection with such a scenario, if the daily average upstream ambient river temperature begins to cool at a rate of 0.5 °F (0.3 °C) or more per day, the downstream temperature is allowed to exceed the upstream value for that day.

When plant operating conditions create a river temperature approaching one of the NPDES limits specified in the preceding paragraphs, TVA shifts BFN from open mode to helper mode. The three units can be placed in helper mode individually or collectively. Thus, the amount of water diverted to the cooling towers in helper mode depends on the amount of cooling needed for the plant to remain in compliance with the NPDES permit limits. If helper mode operation is not sufficient to avoid the river temperature approaching the NPDES permit limits, TVA reduces (i.e., derates) the thermal power of one or more of the units to maintain regulatory compliance (TVA 2016a).

The licensee performed hydrothermal modeling to compare the impacts of BFN operations at the current licensed thermal power level (i.e., 105 percent of the original licensed

thermal power, or 3,458 MWt) to 120 percent original licensed thermal power as requested under the proposed EPU. Under current operations and based on river flow, meteorological, and ambient river temperature data for the 6-year period 2007 through 2012, the modeling results indicate that the temperature of water exiting the diffusers and entering Wheeler Reservoir is an average of 86.9 °F (30.5 °C) during warm summer conditions. The river temperature at the NPDES compliance depth at the downstream end of the mixing zone is an average of 70.8 °F (21.6 °C) with a 1-hour average temperature maximum of 92.1 °F (33.4 °C) and a daily average temperature maximum of 89.4 °F (31.9 °C). On average, TVA operates the cooling towers 66 days per year. The licensee derates BFN approximately 1 in every 6 summers for a maximum of 185 hours in order to maintain compliance with the NPDES permit (TVA 2016a). By comparison, for the period 2011 through 2015, TVA operated BFN's cooling towers an average of 73 days per year and had incurred derates during two of the years (2011 and 2015) (TVA 2016b).

The BFN site, plant operations, and environs are described in greater detail in Chapter 2 of NRC's June 2005 NUREG–1437, Supplement 21, Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Browns Ferry Nuclear Plant, Units 1, 2, and 3—Final Report (herein referred to as "BFN FSEIS") (NRC 2005). Updated information that pertains to the plant site and environs and that is relevant to the assessment of the environmental impacts of the proposed EPU is included throughout this draft EA, as appropriate.

Power Uprate History

The BFN units were originally licensed to operate in 1973 (Unit 1), 1974 (Unit 2), and 1976 (Unit 3) at 3,293 MWt per unit. In 1997, TVA submitted a license amendment request to the NRC for a stretch power uprate (SPU) to increase the thermal output of Units 2 and 3 by 5 percent (to 3,458 MWt per unit). The NRC prepared an EA and FONSI for the SPU, which was

published in the FR on September 1, 1998 (NRC 1998, 63 FR 46491), and NRC subsequently issued the amendments later that month.

In June 2004, TVA submitted license amendment requests for uprates at all three units (TVA 2004a, 2004b). The licensee requested a 15 percent EPU at Units 2 and 3 and a 20 percent EPU at Unit 1 such that if the proposed EPU was granted, each unit would operate at 3,952 MWt (120 percent of the original licensed power level). In September 2006, TVA submitted a supplement to the EPU application that requested interim operation of Unit 1 at 3,458 MWt (the Units 2 and 3 SPU power level) (TVA 2006). The NRC prepared a draft EA and FONSI, which were published for public comment in the FR on November 6, 2006 (NRC 2006b, 71 FR 65009). The draft EA and FONSI addressed the impacts of operating all three BFN units at EPU levels. The NRC received comments from TVA and the U.S. Fish and Wildlife Service (FWS), which the staff addressed in the NRC's final EA and FONSI dated February 12, 2007 (NRC 2007a, 72 FR 6612). The NRC issued an amendment approving the SPU for Unit 1 in March 2007 (NRC 2007b); the staff's 2007 final EPU EA was used to support the SPU. Subsequently, in September 2014, TVA withdrew the 2004 EPU license amendment requests and stated that it would submit a new, consolidated EPU request by October 2015 (TVA 2014).

Separately, on May 4, 2006, the NRC approved TVA's application for renewal of the BFN operating licenses for an additional 20-year period (NRC 2006a). As part of its environmental review of the license renewal application, the NRC issued the BFN FSEIS (NRC 2005). In the BFN FSEIS, the NRC staff analyzed the environmental impacts of license renewal, the environmental impacts of alternatives to license renewal, and mitigation measures available for reducing or avoiding any adverse impacts. Although the NRC did not evaluate impacts associated specifically with the then-pending EPU in the BFN FSEIS, it performed an evaluation of the impacts of license renewal assuming that all three BFN units would operate at the EPU level of 3,952 MWt during the 20-year period of extended operations.

Description of the Proposed Action

The proposed action is the NRC's issuance of amendments to the BFN operating licenses that would increase the maximum licensed thermal power level for each reactor from 3,458 MWt to 3,952 MWt. This change, referred to as an EPU, represents an increase of approximately 14.3 percent above the current licensed thermal power level and would result in BFN operating at 120 percent of the original licensed thermal power level (3,293 MWt). The proposed action is in accordance with TVA's application dated September 21, 2015 (TVA 2015a) as supplemented by letters, which affected the EA, dated November 13, 2015 (TVA 2015b), December 15, 2015 (TVA 2015c), December 18, 2015 (TVA 2015d), April 22, 2016 (TVA 2016b), and May 27, 2016 (TVA 2016c).

Plant Modifications and Upgrades

An EPU usually requires significant modifications to major balance-of-plant equipment. The proposed EPU for BFN would require the modifications described in Attachment 47 to the licensee's application entitled "List and Status of Plant Modifications, Revision 1" (TVA 2016e), which include replacement of the steam dryers, replacement of the high pressure turbine rotors, replacement of reactor feedwater pumps, installation of higher capacity condensate booster pumps and motors, modifications to the condensate demineralizer system, modifications to the
modifications to the main generator excitation system,
feedwater heaters, and upgrade of miscellaneous instrumentation, setpoint changes, and software modifications.

All onsite modifications associated with the proposed action would be within the existing structures, buildings, and fenced equipment yards. All deliveries of materials to support EPU-related modifications and upgrades would be by truck, and equipment and materials would be temporarily stored in existing storage buildings and laydown areas. The licensee anticipates no changes in existing onsite land uses or disturbance of previously undisturbed onsite land (TVA 2016a).

According to TVA's current schedule, modifications and upgrades related to the proposed EPU would be completed at Unit 1 during the fall 2018 refueling outage, at Unit 2 during the spring 2019 outage, and at Unit 3 during the spring 2018 outage. If the NRC approves the proposed EPU, TVA would begin operating each unit at the uprated power level following these outages.

Cooling Tower Operation and Thermal Discharge

Operating BFN at the EPU power level of 3,952 MWt per unit would increase the heat generated by the plant's steam turbines, which would in turn increase the amount of waste heat that must be dissipated. The licensee would increase its use of the cooling towers (i.e., operate in helper mode) to dissipate some of this additional heat; the remaining heat would be discharged to Wheeler Reservoir. If helper mode operation were to be insufficient to keep the reservoir temperatures within BFN's NPDES permit limits, TVA would reduce (i.e., derate) the thermal power of one or more of the units to maintain regulatory compliance, a practice which TVA currently employs at BFN as necessary. Currently, TVA personnel examine forecast conditions for up to a week or more into the future and determine when and for how long TVA might need to operate BFN in helper mode operation and/or derate the BFN units to ensure compliance with the NPDES permit. TVA would maintain this process under EPU conditions.

The licensee simulated possible future discharge scenarios under EPU conditions using river flows and meteorological data for the 6-year period 2007 through 2012. This period included the warmest summer of record (2010) as well as periods of extreme drought conditions (2007 and 2008). For years with warm summers, TVA predicts that the temperature of water exiting the diffusers and entering Wheeler Reservoir (assuming all BFN units are operating at the full EPU power level) would be 2.6 °F (1.4 °C) warmer on average than current operations. The river temperature at the NPDES compliance depth at the downstream end of the mixing zone would be 0.6 °F (0.3 °C) warmer on average. The licensee predicts that it would operate

the cooling towers in helper mode an additional 22 days per year on average (88 days total) and that the most extreme years could result in an additional 39 days per year of cooling tower helper mode operation (121 days total).

Transmission System Upgrades

The EPU would require several upgrades to the transmission system and the BFN main generator excitation system to ensure transmission system stability at EPU power levels. The

January, 2017

licensee performed a Revised Interconnection System Impact Study in May 2016, which determined that the EPU would require the following transmission upgrades: (1) replacement of

a minimum of

six 500-kilovolt (kV) breaker failure relays, (2) installation of 764 megavolt-ampere reactive

reactive compensation

(MVAR) capacitor banks in five locations throughout TVA transmission system, and (3) modification of the excitation system of all three BFN main generators (TVA 2016c). These upgrades are described in more detail as follows.

<u>Breaker Failure Relay Replacements</u>

The licensee would replace the 500-kV breaker failure relays at BFN for breakers 5204, 5208, 5254, 5258, 5274, and 5278 to mitigate potential transmission system issues resulting from specific fault events on the transmission system. The relays are located in panels in the relay room inside the BFN control building, and physical work would be limited to this area. TVA would complete the breaker failure relay replacements prior to spring 2018 (TVA 2016c, 2016e).

<u>MVAR Capacitor Bank Installations</u>

a minimum of

The licensee would install 764 MVAR capacitor banks in five locations throughout TVA

of reactive compensation

service area to address MVAR deficiencies associated with the additional power generation that

The reactive compensation consists of one static VAR compensator (SVC) at one substation and mulitple capacitor banks at four separate substations.

would occur at EPU power levels. The proposed locations are the Clayton Village 161-kV Substation in Oktibbeha County, Mississippi; Holly Springs 161-kV Substation in Marshall

500

County, Mississippi; Corinth 161-kV Substation in Alcorn County, Mississippi; East Point 161-kV

(161 kV line) Limestone Limestone

Substation in Cullman County, Alabama; and Wilson 500-kV Substation in Wilson County,

Alabama

Tennessee. Two of the five capacitor bank installations (Clayton Village and East Point substations) would be within existing substation boundaries, while three installations (Holly
Limestone
Springs, Corinth, and Wilson substations) would require expansion of the existing substation footprint and additional grading and clearing. The licensee expects to purchase approximately 2.5 ac (1 ha) of land and disturb 2.25 ac (0.9 ha) of land for the Holly Springs Substation expansion. For the Corinth Substation expansion, TVA would purchase 3.5 ac (1.4 ha) of land
Limestone
and disturb 3 ac (1.2 ha) of land. For the Wilson Substation expansion, TVA owns the land that
25 ac (10 ha)
would be required for expansion, and TVA anticipates disturbing a total of 5 ac (2 ha). The
SVC and 2020
licensee would complete the MVAR capacitor bank installations by spring 2019, although TVA's transmission system operator does not preclude BFN from operating at EPU levels during the capacitor bank installations (TVA 2016c, 2016e).

BFN Main Generator Excitation System Modifications

modify for all three units.

The licensee would replace the BFN main generator Alterrex excitation system with a bus-fed static excitation system consisting of a 3-phase power potential transformer, an automatic voltage regulator, and a power section. Physical work to complete these modifications would be performed within existing BFN structures and would not involve any previously undisturbed land. The licensee is in the preliminary phase of the design change notice development for these modifications; therefore, TVA has not yet developed a specific timeline for implementation of the main generator excitation system modifications. However,
2021 2020
TVA projects that these upgrades would be completed by 2020 (Unit 1), 2023 (Unit 2), and 2024 (Unit 3) (TVA 2016c, 2016e).

The Need for the Proposed Action

As stated by the licensee in its application, the proposed action would allow TVA to meet the increasing power demand forecasted in TVA service area. The licensee estimates that

energy consumption in this area will increase at a compound annual growth rate of 1.2 percent until 2020 with additional moderate growth continuing after 2020.

Environmental Impacts of the Proposed Action

This section addresses the radiological and non-radiological impacts of the proposed EPU. Separate from this EA, the NRC staff is evaluating the potential radiological consequences of an accident that may result from the proposed action. The results of the NRC staff's safety analysis will be documented in a safety evaluation, which will be issued with the license amendment package approving the license amendment, if granted.

Radiological Impacts

<u>Radioactive Gaseous and Liquid Effluents and Solid Waste</u>

The BFN's waste treatment systems collect, process, recycle, and dispose of gaseous, liquid, and solid wastes that contain radioactive material in a safe and controlled manner within the NRC and U.S. Environmental Protection Agency (EPA) radiation safety standards. Although there may be a small increase in the volume of radioactive waste and spent fuel, the proposed EPU would not result in changes in the operation or design of equipment in the gaseous, liquid, or solid waste systems.

<u>Radioactive Gaseous Effluents</u>

The Gaseous Waste Management System manages radioactive gases generated during the nuclear fission process. Radioactive gaseous wastes are principally activation gases and fission product radioactive noble gases resulting from process operations. The licensee's evaluation submitted as part of TVA's EPU application determined that implementation of the proposed EPU would not significantly increase the inventory of carrier gases normally processed in the Gaseous Waste Management System since plant system functions are not changing and the volume inputs remain the same. The analysis showed that the proposed EPU

would result in an increase in radioiodines of approximately 5 percent and particulates by approximately 13 percent. The expected increase in tritium is linear with the proposed power level increase and is, therefore, estimated to increase by 14.3 percent (TVA 2016a).

The licensee's evaluation (TVA 2016a) concluded that the proposed EPU would not change the radioactive gaseous waste system's design function and reliability to safely control and process waste. The projected gaseous release following implementation of the EPU would remain bounded by the values given in the BFN FSEIS. The existing equipment and plant procedures that control radioactive releases to the environment would continue to be used to maintain radioactive gaseous releases within the dose limits of 10 CFR 20.1302 and the as low as is reasonably achievable (ALARA) dose objectives in Appendix I to 10 CFR part 50. Therefore, the NRC staff concludes that the increase in offsite dose due to gaseous effluent release following implementation of the EPU would not be significant.

Radioactive Liquid Effluents

The Liquid Waste Management System collects, processes, and prepares radioactive liquid waste for disposal. During normal operation, the liquid effluent treatment systems process and control the release of liquid radioactive effluents to the environment such that the doses to individuals offsite are maintained within the limits of 10 CFR part 20 and 10 CFR part 50, appendix I. The Liquid Waste Management System is designed to process the waste and then recycle it within the plant as condensate, reprocess it through the radioactive waste system for further purification, or discharge it to the environment as liquid radioactive waste effluent in accordance with State and Federal regulations. The licensee's evaluation shows that implementation of the proposed EPU would increase the volume of liquid waste effluents by approximately 3.44 percent due to increased flow in the condensate demineralizers requiring more frequent backwashes. The current Liquid Waste Management System would be able to process the 3.44 percent increase in the total volume of liquid radioactive waste without any

modifications. The licensee's evaluation determined that implementation of the proposed EPU would result in an increase in reactor coolant inventory of radioiodines of approximately 5 percent and an increase in radionuclides with long half-lives of approximately 13 percent. The expected increase in tritium is linear with the proposed power level increase and is, therefore, estimated to increase by 15 percent (TVA 2016a).

Since the composition of the radioactive material in the waste and the volume of radioactive material processed through the system are not expected to significantly change, the current design and operation of the Liquid Waste Management System would accommodate the effects of the proposed EPU. The projected liquid effluent release following the EPU would remain bounded by the values given in the BFN FSEIS. The existing equipment and plant procedures that control radioactive releases to the environment would continue to be used to maintain radioactive liquid releases within the dose limits of 10 CFR 20.1302 and ALARA dose standards in appendix I to 10 CFR part 50. Therefore, the NRC staff concludes that there would not be a significant environmental impact from the additional volume of liquid radioactive waste generated following EPU implementation.

Solid Low-Level Radioactive Waste

Radioactive solid wastes at BFN include solids from reactor coolant systems, solids in contact with liquids or gases from reactor coolant systems, and solids used in support of reactor coolant systems operation. The licensee evaluated the potential effects of the proposed EPU on the Solid Waste Management System. The low-level radioactive waste (LLRW) consists of resins, filters and evaporator bottoms, dry active waste, irradiated components, and other waste (combined packages). The majority of BFN solid LLRW is shipped offsite as dry active waste. This LLRW is generated from outages, special projects and normal BFN operations. Normal operations at BFN are also a contributor to solid LLRW shipments due to system cleanup activities. This is due to resins from six waste phase separators and three reactor water

cleanup phase separators. The licensee states (TVA 2016a) that BFN has approximately 29 spent resin shipments per year. The licensee's evaluation determined that implementation of the proposed EPU would result in an increase in activity of the solid wastes proportionate to an increase of 5 to 13 percent in the activity of long-lived radionuclides in the reactor coolant. The results of the licensee's evaluation also determined that the proposed EPU would result in a 15 percent increase in the total volume of solid waste generated for shipment offsite.

Since the composition and volume of the radioactive material in the solid wastes are not expected to significantly change, they can be handled by the current Solid Waste Management System without modification. The equipment is designed and operated to process the waste into a form that minimizes potential harm to the workers and the environment. Waste processing areas are monitored for radiation, and there are safety features to ensure worker doses are maintained within regulatory limits. The proposed EPU would not generate a new type of waste or create a new waste stream. Therefore, the NRC staff concludes that the impact from the proposed EPU on the management of radioactive solid waste would not be significant.

Occupational Radiation Dose at EPU Conditions

The licensee states (TVA 2016a) that in-plant radiation sources are expected to increase approximately linearly with the proposed increase in core power level of 14.3 percent. To protect the workers, the BFN Radiation Protection Program monitors radiation levels throughout the plant to establish appropriate work controls, training, temporary shielding, and protective equipment requirements to minimize worker doses.

Plant shielding is designed to provide for personnel access to the plant to perform maintenance and carry out operational duties with minimal personnel exposures. In-plant radiation levels and associated doses are controlled by the BFN Radiation Protection Program to ensure that internal and external radiation exposures to station personnel, and the general

population exposure level would be ALARA, as required by 10 CFR part 20. Access to radiation areas is strictly controlled by existing Radiation Protection Program procedures. Furthermore, it is TVA policy to maintain occupational doses to individuals and the sum of dose equivalents received by all exposed workers ALARA.

Based on the preceding paragraphs, the NRC staff concludes that the proposed EPU is not expected to significantly affect radiation levels within BFN and, therefore, there would not be a significant radiological impact to the workers.

Offsite Doses at EPU Conditions

The primary sources of offsite dose to members of the public from BFN are radioactive gaseous, liquid effluents, and skyshine from Nitrogen-16 (N-16). As previously discussed, operation under proposed EPU conditions would not change the radioactive waste management systems' abilities to perform their intended functions. Also, there would be no change to the radiation monitoring system and procedures used to control the release of radioactive effluents in accordance with NRC radiation protection standards in 10 CFR part 20 and appendix I to 10 CFR part 50.

The licensee states (TVA 2016a) that the contribution of radiation shine from the implementation of the proposed EPU from N-16 would increase linearly with the EPU. The licensee estimates that this increase could result in offsite doses up to 32 percent greater than current operating levels. However, since current offsite doses due to N-16 skyshine are on average less than 1 millirem, doses would still be well within the 10 CFR 20.1301 and 40 CFR part 190 dose limits to members of the public following implementation of the proposed EPU. Further, any increase in radiation would be monitored at the on-site environmental thermoluminescent dosimeter stations at BFN to make sure offsite doses would remain in regulatory compliance (TVA 2016a).

Based on the preceding paragraphs, the NRC staff concludes that the impact of offsite radiation dose to members of the public at EPU conditions would continue to be within the NRC and EPA regulatory limits and would not be significant.

Spent Nuclear Fuel

Spent fuel from BFN is stored in the plant's spent fuel pool and in dry casks in the independent spent fuel storage installation (ISFSI). The licensee estimates that the impact on spent fuel storage from operating at EPU conditions would increase the number of dry storage casks necessary for storage by approximately 19 percent. The licensee also states that the current ISFSI storage pad is projected to be filled on or before 2022 prior to being loaded with EPU fuel. An additional storage pad is anticipated to be required even if no EPU is approved. Since BFN's initial ISFSI plans included sufficient room for any necessary ISFSI expansion, the additional dry casks necessary for spent fuel storage at EPU levels can be accommodated on site and, therefore, would not have any significant environmental impact (TVA 2016a).

Approval of the proposed EPU would not increase the maximum fuel enrichment above 5 percent by weight uranium-235. The average fuel assembly discharge burnup for the proposed EPU is not expected to exceed the maximum fuel rod burnup limit of 62,000 megawatt days per metric ton of uranium. The licensee's fuel reload design goals would maintain the fuel cycles within the limits bounded by the impacts analyzed in 10 CFR part 51, Table S-3, "Table of Uranium Fuel Cycle Environmental Data," and Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light Water-Cooled Nuclear Power Reactor," as supplemented by the findings documented in Section 6.3, "Transportation," Table 9.1, "Summary of findings on NEPA [National Environmental Policy Act] issues for license renewal of nuclear power plants" in NRC (1999). Therefore, the NRC staff concludes that the environmental impacts of the EPU would remain bounded by the impacts in Tables S-3 and S-4, and would not be significant.

Postulated Accident Doses

As a result of implementation of the proposed EPU, there would be an increase in the source term used in the evaluation of some of the postulated accidents in the BFN FSEIS. The inventory of radionuclides in the reactor core is dependent upon power level; therefore, the core inventory of radionuclides could increase by as much as 14.3 percent. The concentration of radionuclides in the reactor coolant may also increase by as much as 14.3 percent; however, this concentration is limited by the BFN Technical Specifications. Therefore, the reactor coolant concentration of radionuclides would not be expected to increase significantly. This coolant concentration is part of the source term considered in some of the postulated accident analyses. Some of the radioactive waste streams and storage systems evaluated for postulated accidents may contain slightly higher quantities of radionuclides (TVA 2016a).

In 2002, TVA requested a license amendment to allow the use of Alternate Source Term (AST) methodology for design basis accident analyses for BFN. The licensee conducted full-scope AST analyses, which considered the core isotopic values for the current and future vendor products under EPU conditions. The licensee concluded that the calculated post-accident offsite doses for the EPU using AST methodologies meet all the applicable acceptance criteria of 10 CFR 50.67 and the NRC Regulatory Guide 1.183, “Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors” (NRC 2000). The NRC staff is reviewing the licensee’s analyses and performing confirmatory calculations to verify the acceptability of the licensee’s calculated doses under accident conditions. The results of the NRC staff’s calculations will be presented in the safety evaluation to be issued with the license amendment, if approved, and the EPU would not be approved by NRC unless the NRC staff’s independent review of dose calculations under postulated accident conditions determines that dose is within regulatory limits. Therefore, the NRC staff concludes that the EPU would not

significantly increase the consequences of accidents and would not result in a significant increase in the radiological environmental impact of BFN from postulated accidents.

Radiological Impacts Summary

The proposed EPU would not significantly increase the consequences of accidents, would not result in a significant increase in occupational or public radiation exposure, and would not result in significant additional fuel cycle environmental impacts. Accordingly, the NRC staff concludes that there would be no significant radiological environmental impacts associated with the proposed action.

Non-Radiological Impacts

Land Use Impacts

The potential impacts associated with land use for the proposed action include effects from onsite EPU-related modifications and upgrades that would take place between spring 2018 and spring 2019 and impacts of the transmission system upgrades previously described in the "Description of the Proposed Action" section of this document.

The onsite plant modifications and upgrades would occur within existing structures, buildings, and fenced equipment yards and would use existing parking lots, road access, lay-down areas, offices, workshops, warehouses, and restrooms in previously developed areas of the BFN site. Thus, existing onsite land uses would not be affected by onsite plant modifications and upgrades (TVA 2016a).

Regarding transmission system upgrades, the breaker failure relay replacements and BFN main generator excitation system modifications would occur within existing BFN structures
SVC and
and would not involve any previously undisturbed land. The MVAR capacitor bank installations would occur at five offsite locations throughout TVA service area as described previously. Two of the capacitor bank installations would be within existing substation boundaries and would, therefore, not affect any previously undisturbed land or alter existing land uses (TVA 2016d).

The remaining three SVC and capacitor bank installations would require expansion of the existing substation footprints and would require additional grading and clearing (TVA 2016d). TVA expects that the expansions would disturb 2.25 ac (0.9 ha), 3 ac (1.2 ha), and 5 ac (2 ha) and 25 ac (10 ha) of land at the Holly Springs, Corinth, and Limestone Wilson substations, respectively (TVA 2016d). The affected land currently contains terrestrial habitat or other semi-maintained natural areas, but none of the three land parcels contain wetlands, ecologically sensitive or important habitats, prime or unique farmland, scenic areas, wildlife management areas, recreational areas, greenways, or trails. TVA would implement Best Management Practices (BMPs) to minimize the duration of soil exposure during clearing, grading, and construction (TVA 2016d). TVA would also revegetate and mulch the disturbed areas as soon as practicable after each disturbance (TVA 2016d). The NRC staff did not identify any significant environmental impacts related to altering land uses within the small parcels of land required for the SVC and capacitor bank installations.

Following the necessary plant modifications and transmission system upgrades, operation of BFN at the EPU power level would not affect onsite or offsite land uses.

The NRC staff concludes that the proposed EPU would not result in significant impacts on onsite or offsite land use.

Visual Resource Impacts

No residential homes occur within foreground viewing distance of the BFN site to the north and east. A small residential development located to the northwest and another residential development located across Wheeler Reservoir to the southwest have at least partial views of the BFN site. Additionally, the site can be seen from the Mallard Creek public use area directly across the reservoir. Two earthen berms lie adjacent to the cooling tower complex that block views of the northern and eastern plant areas. The berms, as well as portions of the cooling tower complex, are visible to motorists traveling on Shaw Road (TVA 2016b).

Plant modifications and upgrades associated with the proposed EPU are unlikely to result in additional visual resource impacts beyond those already occurring from ongoing operation of BFN for several reasons. First, the BFN site is already an industrial-use site. Therefore, the short-term, intensified use of the site that would be required to implement EPU-related modifications and upgrades is unlikely to be noticeable to members of the public within the site's viewshed. Second, TVA would implement all EPU-related modifications and upgrades during scheduled refueling outages when additional machinery and heightened activity would already be occurring on the site. Accordingly, the NRC staff does not expect that EPU-related modifications and upgrades would result in significant impacts to visual resources.

Regarding transmission system upgrades, the breaker failure relay replacements and BFN main generator excitation system modifications would occur within existing BFN structures and thus would not result in visual impacts. The SVC and MVAR capacitor bank installations would result in short-term visual impacts at the three sites for which substation expansion would be required. However, these areas are industrial-use sites, and use of machinery and equipment for ongoing maintenance and upgrades is common.

Following the necessary plant modifications and transmission system upgrades, operation of BFN at the EPU power level would not significantly affect visual resources. The licensee estimates that the EPU would require cooling tower operation 22 more days per year on average, which would increase the number of days in which a plume would be visible. However, given that the cooling towers are already operated intermittently, the additional use of the cooling towers following the EPU would not result in significantly different visual impacts that those experienced during current operations.

The NRC staff concludes that the temporary visual impacts during implementation of EPU modifications and upgrades and capacitor bank installations would be minor and of short duration, and would not result in significant impacts to visual resources. The additional cooling

tower operation following implementation of the EPU would also result in minor and insignificant visual impacts.

Air Quality Impacts

Onsite non-radioactive air emissions from BFN are primarily from operation of the emergency diesel generators. Emissions occur when these generators are tested or are used to supply backup power. The licensee (2016a) does not anticipate an increase in use of the emergency diesel generators as a result of the proposed EPU, nor is it planning to increase the frequency or duration of the emergency diesel generator surveillance testing. Additionally, TVA (2016a) maintains a Synthetic Minor Source Air Operating Permit for its diesel generators issued and enforced by the ADEM, and TVA would continue to comply with the requirements of this permit under EPU conditions. Accordingly, the NRC staff does not expect that onsite emission sources attributable to the EPU would result in significant impacts to air quality.

Offsite non-radioactive emissions related to the proposed EPU would result primarily from personal vehicles of EPU-related workforce members driving to and from the site and from work vehicles delivering supplies and equipment to the site. The licensee (2016a) estimates that of the additional workers that would be present on the site during each of the refueling outages, 80 to 120 workers or less would be dedicated to implementing EPU-related modifications and upgrades. The licensee (2016a) generally ramps up outage staffing two to three weeks prior to the outage start and ramps down staffing beginning 21 to 28 days from the start of the outage. Major equipment and materials to support the EPU-related modifications and upgrades would be transported to the site well before the start of each outage period, and smaller EPU supplies will be delivered on trucks that routinely supply similar tools and materials to support BFN operations (TVA 2016a). The SVC and capacitor bank installations associated with the proposed EPU would result in additional minor air quality impacts from construction vehicle

emissions and fugitive dust from ground disturbance and vehicle travel on unpaved roads (TVA 2016d). These impacts would be temporary and controlled through TVA's BMPs (TVA 2016d).

Following the necessary plant modifications and transmission system upgrades, operation at EPU levels would result in no additional air emissions as compared to operations at the current licensed power levels.

The NRC staff concludes that the temporary increase in air emissions during
SVC and
implementation of EPU modifications and upgrades and capacitor bank installations would be minor and of short duration, and would not result in significant impacts to air quality.

<u>Noise Impacts</u>

The potential noise impacts related to the proposed action would be primarily confined to those resulting from the use of construction equipment and machinery during the EPU outage periods. However, implementation of EPU-related modifications and upgrades during these periods is unlikely to result in additional noise impacts beyond those already occurring from ongoing operation because the BFN site is already an industrial-use site and because TVA would implement all EPU-related modifications and upgrades during scheduled refueling outages when additional machinery and heightened activity would already be occurring on the site. Accordingly, the NRC staff does not expect that EPU-related modifications and upgrades would result in significant noise impacts.

Regarding transmission system upgrades, the breaker failure relay replacements and BFN main generator excitation system modifications would occur within existing BFN structures,
SVC and
and would, therefore, not result in noise impacts. The MVAR capacitor bank installations would result in short-term and temporary noise impacts associated with construction equipment and machinery use at the three sites for which substation expansion would be required. However, these areas are industrial-use sites, and periodic noise impacts associated with ongoing maintenance and upgrades are common.

Following the EPU outages, operation of BFN at EPU levels would result in an average of 22 additional days per year of cooling tower operation, which would slightly increase the duration for which residents nearest the BFN site would experience cooling tower-related noise during the warmer months. The NRC staff reviewed information submitted by TVA (2016a) regarding an environmental sound pressure level assessment performed in 2012 at the BFN site in 2012. The assessment found that background noise levels without cooling tower operation was 59.7 decibels A-weighted scale (dBA), and that the noise levels with operation of six of the seven cooling towers was 61.9 dBA, an increase of 2.2 dBA. The licensee compared this level with the Federal Interagency Committee on Noise's (FICON) recommendation that a 3-dBA increase in noise indicates a possible impact and the need for further analysis. Based on this criteria, TVA determined that the noise level emitted by operation of the cooling towers is acceptable. Additionally, TVA (2016c) is planning to conduct additional sound monitoring following the replacement of Cooling Towers 1 and 2, which are scheduled for replacement in fiscal years 2018 and FY 2019. The licensee will continue to meet FICON guidelines by working with the cooling tower vendor to ensure noise attenuating features, such as low-noise fans, lower speed fans, and sound attenuators, are incorporated as required to meet the guidelines. In the event that TVA (2016a) finds that the resulting noise levels exceed the FICON guidelines, TVA would develop and implement additional acoustical mitigation, such as modifications to fans and motors or the installation of barriers. The licensee will also continue to comply with Occupational Safety and Health Administration (OSHA) regulations to protect worker health onsite.

The NRC staff concludes that the implementation of EPU modifications and upgrades,
SVC and
the capacitor bank installations, and additional operation of the cooling towers following implementation of the EPU would not result in significant noise impacts. Additionally, TVA would continue to comply with FICON guidelines and OSHA regulations regarding noise

impacts, which would further ensure that future cooling tower operation would not result in significant impacts on the acoustic environment and human health.

<u>Water Resources Impacts</u>

As previously described, EPU-related modifications at BFN to include replacement and upgrades of plant equipment would occur within existing structures, buildings, and fenced equipment yards. The licensee does not expect any impact on previously undisturbed land. Any ground-disturbing activity would be subject to BFN's BMP Plan, which TVA must maintain as a condition of the BFN site NPDES permit (ADEM 2012). The licensee must implement and maintain the BMP Plan to prevent or minimize the potential for the release of pollutants in site runoff, spills, and leaks to waters of the State from site activities and operational areas. Consequently, the NRC staff concludes that onsite EPU activities at BFN would have no significant effect on surface water runoff and no impact on surface water or groundwater quality.

Implementation of the EPU would also require upgrades to TVA's transmission system,
a minimum of reactive compensation
including installation of 764 MVAR capacitor banks at five sites throughout TVA service area
Reactive Compensation
(see "MVAR Capacitor Bank Installations" under "Description of the Proposed Action"). At two of the substations, new equipment installation would take place outdoors but within the confines of existing substation enclosures with ground disturbance limited to previously disturbed areas. As appropriate, TVA would use standard BMPs to minimize any potential impacts to surface water and groundwater. The licensee's BMPs address preventive measures such as use of proper containment, treatment, and disposal of wastewaters, stormwater runoff, wastes, and other potential pollutants. The BMPs would also address soil erosion and sediment control and prevention and response to spills and leaks from construction equipment that could potentially
SVC and
runoff or infiltrate to underlying groundwater. After installation, the capacitor banks would result in no wastewater discharges (TVA 2016d). Therefore, there would be no operational impact on water resources.

and SVC

Capacitor installation work at three substations (Holly Springs and Corinth in Mississippi
Limestone Alabama
and Wilson in Tennessee) would require expansion of the existing substation footprints and additional grading and clearing. Projected new ground disturbance for these substation expansions would range from approximately 2.25 ac (0.9 ha) of land for the Holly Springs,
25 10 Limestone, Alabama
Mississippi Substation to 5 ac (2 ha) at the Wilson, Tennessee Substation. The substation expansion projects would have no impact on perennial surface water features. A small portion of the expanded footprint of the Wilson Substation lies within the 100-year floodplain, but TVA proposes no construction activities in the floodplain. At the Holly Springs substation, TVA staff
at Holly springs substation and three ephemeral streams at the Limestone substation
identified an ephemeral stream that may lie within the expansion footprints. However, adherence by TVA to project specifications and application of appropriate BMPs would ensure that there would be no impacts to hydrologic features or conditions. The licensee would also conduct all construction activities in accordance with standard BMPs as previously described and would perform specific work elements as further discussed below (TVA 2016d).

To support substation expansion work, water would be required for such uses as potable and sanitary use by the construction workforce and for concrete production, equipment washdown, dust suppression, and soil compaction. The NRC staff assumes that the modest volumes of water needed would be supplied from local sources and transported to the work sites. Use of portable sanitary facilities, typically serviced offsite by a commercial contractor, would serve to reduce the volume of water required to meet the sanitary needs of the construction workforce.

The licensee would obtain any necessary construction fill material from an approved borrow pit, and TVA would place any spoils generated from site grading, trenching, or other excavation work in a permitted spoil area on the substation property, or the material would be spread or graded across the site. Areas disturbed by construction work and equipment installation would be stabilized by applying new gravel or resurfacing the disturbed areas (TVA

2016d). Consequently, following the completion of construction, disturbed areas would lie within the footprint of the expanded substation footprint and otherwise overlain by equipment or hard surfaces and would not be subject to long-term soil erosion and with little potential to impact surface water or groundwater resources.

The expansion projects at all three substations would also be subject to various permits and approvals, which TVA would obtain. Construction stormwater runoff from land disturbing activities of 1 ac (0.4 ha) or more is subject to regulation in accordance with Section 402 of the CWA. Section 402 establishes the NPDES permit program. Mississippi and Alabama Tennessee administer these regulatory requirements through State NPDES general permits. Specifically, State construction stormwater general permits will be required for construction activities at the Holly Springs, Corinth, and Limestone Wilson substations. Additionally, for the Wilson Substation, a Wilson County Land Disturbance permit will also be required (TVA 2016d). For NPDES general permits, permit holders must also develop and implement a Stormwater Pollution Prevention Plan to ensure the proper design and maintenance of stormwater and soil erosion BMPs to prevent sediment and other pollutants in stormwater discharges and ensure compliance with State water quality standards.

Based on the foregoing, the NRC staff finds that the transmission system upgrades and associated substation expansion projects would have negligible direct impacts on water resources and would otherwise be conducted in accordance with TVA standard BMPs to minimize environmental impacts. The licensee’s construction activities would also be subject to regulation under NPDES general permits for stormwater discharges associated with construction activity. Accordingly, the NRC staff concludes that EPU-related transmission system upgrades would not result in significant impacts on surface water or groundwater resources.

The EPU implementation at BFN would result in operational changes with implications for environmental conditions. As further detailed under "Plant Site and Environs" of this EA, BFN withdraws surface water from Wheeler Reservoir to supply water for condenser cooling and other in-plant uses. Total water withdrawals by BFN have averaged 1,848,000 gpm (4,117 cfs; 116.3 m/s) over the last 5 years, although the average withdrawal rate in 2015 exceeded the average rate (TVA 2016b). The BFN uses a once-through circulating water system for condenser cooling aided by periodic operation of helper cooling towers. Normally, during once-through (open cycle) operation, BFN returns nearly all of the water it withdraws back to the reservoir, albeit at a higher temperature, through three, submerged diffuser pipes. When necessary throughout the course of the year, BFN's return condenser cooling water is routed through one or more of the helper cooling towers based on the level of cooling needed so that the resulting discharge to the river meets thermal limits as stipulated in TVA's NPDES permit. The licensee may also derate one or more BFN generating units in order to ensure compliance with NPDES thermal limits, as previously described (TVA 2016a).

Following implementation of the EPU, TVA predicts that BFN would need to operate helper cooling towers an additional 22 days per year on average (for a total of 88 days per year) to maintain compliance with NPDES thermal limits, as compared to a projected average of 66 days per year at current power levels (TVA 2016b; TVA 2016a). When helper cooling towers are used, a portion of the water passing through the towers is consumptively used (lost) due to evaporation and cooling tower drift. The results of TVA's hydrothermal modeling, as previously described, indicate that approximately 3 percent of the cooling water flow passed through the helper towers is consumptively used (TVA 2016a). Thus, for an additional 22 days per year on average, BFN's cooling water return flows to Wheeler Reservoir would be reduced by approximately 3 percent following the proposed EPU as compared to current operations. This is

a negligible percentage of the total volume of water passing through Wheeler Reservoir and that is otherwise diverted by TVA to meet BFN cooling and other in-plant needs (TVA 2016a).

Operations at EPU power levels would not require any modifications to BFN's circulating water system, residual heat removal service water system, emergency equipment cooling water system, raw cooling water, or raw water systems. Therefore, TVA expects no changes in the volume of water that would be withdrawn from Wheeler Reservoir during operations (TVA 2016b). The EPU operations would result in an increase in the temperature of the condenser cooling water discharged to Wheeler Reservoir. The licensee's hydrothermal modeling predicts that the average temperature of the return discharge through BFN's submerged diffusers would be 2.6 °F (1.4 °C) warmer than under current operations and that the average temperature at the downstream edge of the mixing zone prescribed by BFN's NPDES permit would increase by 0.6 °F (0.3 °C). Nevertheless, these thermal changes would continue to meet BFN's NPDES permit limits, including temperate change limitations within the prescribed mixing zone (TVA 2016b, 2016a). In addition, there would also be no change in the use of cooling water treatment chemicals or other changes in the quality of other effluents discharged to Wheeler Reservoir in conjunction with implementation of the EPU (TVA 2016b).

In summary, implementation of the EPU at BFN and associated operational changes would not affect water availability or impair ambient surface water or groundwater quality. The NRC staff concludes that the proposed EPU would not result in significant impacts on water resources.

Terrestrial Resource Impacts

The BFN site's natural areas include riparian areas, upland forests, and wetlands that have formed on previously disturbed land cleared prior to BFN construction. Onsite plant modifications and upgrades would not disturb these areas because the EPU-related modifications and upgrades would not involve any new construction outside of the existing

facility footprint, as previously described under "Land Use Impacts." For this reason, sediment transport and erosion are also not a concern. The modifications and upgrades would result in additional noise and lighting, which could disturb wildlife. However, such impacts would be similar to and indistinguishable from what nearby wildlife already experience during normal operations because the upgrades and modifications would take place during regularly scheduled outages, which are already periods of heightened site activity.

Regarding transmission system upgrades, the breaker failure relay replacements and BFN main generator excitation system modifications would occur within existing BFN structures and would not involve any previously undisturbed land. These upgrades would result in no impacts on terrestrial resources. The SVC and MVAR capacitor bank installations would occur at five offsite locations throughout TVA service area as described previously. Three of the five capacitor bank installations would require expansion of the existing substation footprints and additional grading and clearing, as described in the "Land Use Impacts" section. The affected land currently contains terrestrial habitat or other semi-maintained natural areas, and TVA (2016d) reports that all three areas are likely to contain primarily non-native, invasive botanicals. None of the three land parcels contain wetlands, ecologically sensitive or important habitats, prime or unique farmland, scenic areas, wildlife management areas, recreational areas, greenways, or trails. The licensee (2016d) also reports that no bird colonies or aggregations of migratory birds have been documented within 3 mi (4.8 km) of the substation footprints. The licensee would implement BMPs to minimize the duration of soil exposure during clearing, grading, and construction (TVA 2016d). The licensee would also revegetate and mulch the disturbed areas as soon as practicable after each disturbance, and TVA's landscaping BMPs require revegetation with native plants or non-invasive species (TVA 2016d). The NRC staff did not identify any significant environmental impacts to terrestrial resources related to altering land uses within the small parcels of land required for the SVC and capacitor bank installations.

Following the necessary plant modifications and transmission system upgrades, operation at EPU levels would result in no additional or different impacts on terrestrial resources as compared to operations at the current licensed power levels. The NRC assessed the impacts of continued operation of BFN through the period of extended operation in the BFN FSEIS (NRC 2005) and determined that impacts on terrestrial resources would be small (i.e., effects would not be detectable or would be so minor that they would neither destabilize nor noticeably alter any important attribute of the resource).

The NRC staff concludes that the temporary noise and lighting during implementation of EPU modifications and upgrades and small areas of land disturbance associated with the SVC and MVAR capacitor bank installations would be minor and would not result in significant impacts to terrestrial resources.

Aquatic Resource Impacts

Aquatic habitats associated with the site include Wheeler Reservoir and 14 related tributaries, of which Elk River, located 10 mi (16 km) downstream of BFN, is the largest. Onsite plant modifications and upgrades would not affect aquatic resources because EPU-related modifications and upgrades would not involve any new construction outside existing facility footprints and would not result in sedimentation or erosion or any other disturbances that would otherwise affect aquatic habitats.

Regarding transmission system upgrades, the breaker failure relay replacements and BFN main generator excitation system modifications would occur within existing BFN structures and would, therefore, not affect aquatic resources. Although three of the five SVC and MVAR capacitor bank installations would require expansion of existing substation footprints as described previously, TVA (2016d) reports that the expansions would not affect the flow, channels, or banks of any nearby streams. As described previously in the “Water Resource Impacts” section, the substation expansions would have negligible direct impacts on water resources,

and TVA would implement BMPs, as appropriate, and be subject to regulations under NPDES general permits during any construction activities. Accordingly, the NRC staff did not identify any significant environmental impacts related to aquatic resources with respect to transmission system upgrades.

Following the necessary plant modifications and transmission system upgrades, operation at EPU levels would result in additional thermal discharge to Wheeler Reservoir. As described in the “Cooling Tower Operation and Thermal Discharge” and “Water Resources Impacts” sections of this document, TVA predicts that the temperature of water entering Wheeler Reservoir would be 2.6 °F (1.4 °C) warmer on average than current operations and that the river temperature at the NPDES compliance depth at the downstream end of the mixing zone would be 0.6 °F (0.3 °C) warmer on average. In the BFN FSEIS, the NRC (2005) evaluated the potential impacts of thermal discharges in Section 4.1.4, “Heat Shock,” assuming continued operation at EPU power levels. The NRC (2005) found that the BFN thermal mixing zone constitutes a small percentage of the Wheeler Reservoir surface area, that the maximum temperatures at the edge of the mixing zone do not exceed the upper thermal limits for common aquatic species, and that continued compliance with the facility’s NPDES permit would ensure that impacts to aquatic biota are minimized. Since the time the NRC staff performed its license renewal review, the ADEM has issued a renewed BFN NPDES permit. The CWA requires the EPA or States, where delegated, to set thermal discharge variances such that compliance with the NPDES permit assures the protection and propagation of a balanced, indigenous community of shellfish, fish, and wildlife in and on the body of water into which the discharge is made, taking into account the cumulative impact of a facility’s thermal discharge together with all other significant impacts on the species affected. Under the proposed action, TVA would remain subject to the limitations set forth in the renewed BFN NPDES permit. The NRC staff finds it reasonable to assume that TVA’s continued compliance with, and the State’s continued

enforcement of, the BFN NPDES permit would ensure that Wheeler Reservoir aquatic resources are protected.

Regarding impingement and entrainment, in Sections 4.1.2 and 4.1.3 of the BFN FSEIS, the NRC (2005) determined that impingement and entrainment during the period of extended operation would be small. The proposed EPU would not increase the volume or rate of water withdrawal from Wheeler Reservoir and no modifications to the current cooling system design would be required. Thus, the NRC finds that the proposed EPU would not change the rate of impingement or entrainment of fish, shellfish, or other aquatic organisms compared to current operations.

Regarding chemical effluents, the types and amounts of effluents would not change under the proposed EPU, and effluent discharges to Wheeler Reservoir would continue to be regulated by the ADEM under the facility's NPDES permit. Thus, the NRC concludes that compared to current operations, the proposed EPU would not change the type or concentration of chemical effluents that could impact aquatic resources.

The NRC staff concludes that onsite plant modifications and transmission system upgrades associated with the proposed EPU would not affect aquatic resources. Although operation at EPU levels would increase thermal effluent to Wheeler Reservoir, the NRC staff concludes that any resulting impacts on aquatic resources would not be significant because thermal discharges would remain within the limits imposed by the BFN NPDES permit.

<u>Special Status Species and Habitats Impacts</u>

Under section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. § 1531 *et seq.*) (ESA), Federal agencies must consult with the FWS or the National Marine Fisheries Service, as appropriate, to ensure that actions the agency authorizes, funds, or carries out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat.

The FWS lists 31 Federally endangered, threatened, or candidate species as potentially occurring near the BFN site. Of these species, 11 are terrestrial. As described under "Terrestrial Resource Impacts," the NRC determined that the proposed EPU would not have significant impacts on the terrestrial environment. The NRC staff did not identify any unique or different impacts that might affect Federally listed or candidate terrestrial species, and as such, the NRC staff concludes that the proposed EPU would have no effect on any listed or candidate terrestrial species. Terrestrial species are not addressed in detail in this EA, but a list of these species can be viewed in the FWS's (2016) Environmental Conservation Online System Information for Planning and Conservation report (FWS 2016). The remaining 20 species are aquatic and are listed in Table 1 of this document. No proposed or designated critical habitat occurs near the BFN site (FWS 2016).

Table 1. Federally Listed Aquatic Species with the Potential to Occur Near the BFN Site

Species	Common Name	Federal Status [(a)]	Known to Occur in the Vicinity of BFN? [(b)]
Fishes			
Elassoma alabamae	spring pygmy sunfish	FT	Y
Etheostoma boschungi	slackwater darter	FT	–
Etheostoma phytophilum	rush darter	FE	–
Etheostoma wapiti	Boulder darter	FE	–
Freshwater Mussels			
Cumberlandia monodonta	spectaclecase	FE	Y
Cyprogenia stegaria	fanshell	FE	–
Epioblasma triquetra	snuffbox mussel	FE	–
Hemistena lata	cracking pearlymussel	FE	–
Lampsilis abrupta	pink mucket	FE	Y
Lampsilis perovalis	orangenacre mucket	FT	–
Medionidus acutissimus	Alabama moccasinshell	FT	–
Pegias fabula	littlewing pearlymussel	FE	–
Plethobasus cyphyus	sheepnose	FE	–
Pleurobema furvum	dark pigtoe	FE	–

Pleurobema perovatum	ovate clubshell	FE	–
Pleurobema plenum	rough pigtoe	FE	Y
Ptychobranchus greenii	triangular kidneyshell	FE	–
Snails			
Athearnia anthonyi	Anthony's riversnail	FE	Y
Campeloma decampi	slender campeloma	FE	Y
Pyrgulopsis pachyta	armored snail	FE	Y

[a] FE = Federally endangered under the ESA; FT = Federally threatened under the ESA; FC = Candidate for listing under the ESA

[b] Y = yes; – = no. Occurrence information is based on species identified in TVA's (2016a) supplemental environmental report submitted as part of its EPU application as occurring within tributaries to Wheeler Reservoir, within a 10-mi (16-km) radius of BFN, or from Tennessee River Mile 274.9 to 310.7.

Sources: FWS 2016; TVA 2016a

Action Area

The implementing regulations for section 7(a)(2) of the ESA define "action area" 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 action area effectively bounds the analysis of ESA-protected species and habitats because only species that occur within the action area may be affected by the Federal action.

For the purposes of the ESA analysis for the proposed BFN EPU, the NRC staff considers the action area to be the full bank width of Wheeler Reservoir from the point of water withdrawal downstream to the edge of the mixing zone (2,400 ft (732 m) downstream of the diffusers). The NRC staff expects all direct and indirect effects of the proposed action to be contained within this area. The NRC staff recognizes that while the action area is stationary, Federally listed species can move in and out of the action area. For instance, a migratory fish species could occur in the action area seasonally as it travels up and down the river past BFN.

The NRC staff are not including the areas that would be affected by the Holly Springs,
Limestone
Corinth, and Wilson substation expansions in the BFN EPU action area. The licensee, as a Federal agency, must itself comply with ESA section 7. The NRC has no authority over

transmission upgrades. Therefore, prior to undertaking the expansions, TVA, and not NRC, would conduct section 7 consultation with0 the FWS, if necessary, to address any potential impacts to Federally listed species and critical habitats related to the substation expansions. Tennessee Valley Authority's (2016d) preliminary review did not identify any Federally listed species or critical habitats within the vicinity of the three substations.

Impact Assessment

Since the 1970s, TVA has maintained a Natural Heritage Database that includes data on sensitive species and habitats, including Federally threatened and endangered species, in TVA's power service area. Based on its Natural Heritage Database, TVA (2016a) reports that seven Federally listed aquatic species occur in the vicinity of the BFN site (see Table 1).

Tennessee Valley Authority (2016a) Natural Heritage Database records indicate that three freshwater mussels—spectaclecase (*Cumberlandia monodonta*), pink mucket (*Lampsilis abrupta*), and rough pigtoe (*Pleurobema plenum*)—occur within the vicinity of BFN. These species occur in sand, gravel, and cobble substrates in large river habitats within the Tennessee River system. All three species are now extremely rare and are primarily found in unimpounded tributary rivers and in more riverine reaches of the main stem Tennessee River (TVA 2016a). Most of the remaining large river habitat in Wheeler Reservoir occurs upstream of the BFN action area. Section 5.2 of the NRC's (2004) biological assessment for license renewal describes Tennessee River collection records for these three species, which date back to the 1990s. Relict shells of spectaclecase were collected in Wheeler Reservoir in 1991 (Ahlstedt and McDonough 1992). Pink mucket and rough pigtoe were collected near Hobbs Island (over 64 km (40 mi) upstream of BFN) in 1998 (Yokely 1998). Tennessee Valley Authority (2016a) reports no more recent records of these three species in its supplemental environmental report submitted as part of the EPU application, and the NRC staff did not identify any studies or information suggesting that populations of these species exist in Wheeler Reservoir in the

vicinity of the BFN action area. Because these species do not occur in the action area, the NRC staff concludes that the proposed BFN EPU would have *no effect* on spectaclecase, pink mucket, and rough pigtoe.

Tennessee Valley Authority (2016a) Natural Heritage Database records indicate that three aquatic snails—Anthony's snail (*Athearnia anthonyi*), slender campeloma (*Campeloma decampi*), and armored snail (*Pyrgulopsis pachyta*)—and one fish—spring pygmy sunfish (*Elassoma alabamae*)—occur in the vicinity of BFN. However, these species are restricted to tributary streams that feed into Wheeler Reservoir upstream of BFN (TVA 2016a). The NRC staff did not identify any studies or information suggesting that populations of these species exist in the main stem of the Tennessee River (i.e., Wheeler Reservoir). Because these species do not occur in the action area, the NRC staff concludes that the proposed BFN EPU would have *no effect* on Anthony's snail, slender capeloma, armored snail, or spring pygmy sunfish.

ESA Effect Determination

The NRC staff concludes that the proposed EPU would have *no effect* on Federally endangered, threatened, or candidate species. Federal agencies are not required to consult with the FWS if they determine that an action will not affect listed species or critical habitats (FWS 2013). Thus, the ESA does not require consultation for the proposed EPU, and the NRC considers its obligations under ESA section 7 to be fulfilled for the proposed action.

<u>Historic and Cultural Resource Impacts</u>

The National Historic Preservation Act of 1966, as amended (16 U.S.C. § 470 *et seq.*), requires Federal agencies to consider the effects of their undertakings on historic properties, and the proposed EPU is an undertaking that could potentially affect historic properties. Historic properties are defined as resources eligible for listing in the National Register of Historic Places (NRHP). The criteria for eligibility are listed in 36 CFR 60.4 and include (1) association with significant events in history; (2) association with the lives of persons significant in the past; (3)

embodiment of distinctive characteristics of type, period, or construction; and (4) sites or places that have yielded, or are likely to yield, important information.

According to the BFN FSEIS (NRC 2005), the only significant cultural resources in the proximity of BFN are Site 1Li535 and the Cox Cemetery, which was moved to accommodate original construction of the plant. Tennessee Valley Authority (2016a) researched current historic property records and found nothing new within 3 mi (4.8 km) of the plant. As described under "Description of the Proposed Action," all onsite modifications associated with the proposed action would be within existing structures, buildings, and fenced equipment yards, and TVA anticipates no disturbance of previously undisturbed onsite land. Thus, historic and cultural resources would not be affected by onsite power plant modifications and upgrades at BFN.

Regarding transmission system upgrades, Tennessee Valley Archaeological Research (TVAR) performed Phase I Cultural Surveys to determine if the expansion of the Holly Springs, and
substations.
Corinth, and Wilson substations would affect any historic or cultural resources. Tennessee
and Office of Archaeological Research, The University of Alabama Museums
Valley Archaeological Research's findings are summarized in the following paragraphs.

During its Phase I Cultural Resource Survey for the Holly Springs Substation (Karpynec et al. 2016b), TVAR revisited two NRHP-listed historic districts, the Depot-Compress Historic District and the East Holly Springs Historic District, within the survey radius. Tennessee Valley Archaeological Research determined that the historic districts are outside the viewshed of the proposed substation expansion. During the survey, TVAR also identified 14 potentially historic properties, none of which were found to be eligible for listing on the NRHP due to their lack of architectural and historic significance. Tennessee Valley Archaeological Research concluded that no historic properties would be affected by the Holly Spring Substation expansion.

During its Phase I Cultural Resource Survey for the Corinth Substation (Karpynec et al. 2016b), TVAR identified 13 properties within the area of potential effect, none of which were

The Office of Archaeological Research, The University of Alabama Museums (OAR) performed a Phase I Cultural Survey to determine if the expansion of the Limestone substation would affect any historic cultural resources.

determined to be eligible for listing on the NRHP due to their lack of architectural distinction and loss of integrity caused by modern alterations or damage. Tennessee Valley Archaeological Research concluded that no historic properties would be affected by the Corinth Substation expansion.

Limestone

During its Phase I Cultural Resources Survey for the Wilson Substation (Karpynec et al.

OAR

2016c), TVAR identified one property within the area of potential effect, which was determined

not to be TVA determined that no historic properties would be affected by the proposed expansion

as eligible for listing on the NRHP. under Criteria A and C for its historical and archaeological significance. Tennessee Valley Archaeological Research concluded that the Wilson Substation expansion would have a visual effect on the property. However, the effect would not be adverse due to the fact that the existing substation and modern development located immediately northwest and southeast of the property have already established a visual effect.

Following power plant modifications and substation upgrades, operation of BFN at EPU power levels would have no effect on existing historic and cultural resources. Further, TVA has procedures in place to ensure that BFN operations would continue to protect historic and cultural resources, and the proposed action would not change such procedures (NRC 2005). Therefore, the NRC staff concludes that EPU-related power plant modifications and substation upgrades would not result in significant impacts to historic and cultural resources.

<u>Socioeconomic Impacts</u>

Potential socioeconomic impacts from the proposed EPU include increased demand for short-term housing, public services, and increased traffic due to the temporary increase in the size of the workforce required to implement the EPU at BFN and upgrade affected substations. The proposed EPU also could generate increased tax revenues for the State and surrounding counties due to increased "book" value of BFN and increased power generation.

During outages, the workforce at BFN increases by 800 to 1,200 workers for an average of 1,000 additional workers onsite. Normally, outage workers begin to arrive at BFN 2 to 3

weeks prior to the start of the outage, and the total number of onsite workers peaks at about the 3rd day of the 21- to 28-day outage. The EPU outage for each unit would last 35 days or less (TVA 2016a). Once EPU-related plant modifications have been completed, the size of the workforce at BFN would return to pre-EPU levels approximately 1 week after the end of the outage with no significant increases during future outages. The size of the operations workforce would be unaffected by the proposed EPU.

Most of the EPU plant modification workers are expected to relocate temporarily to the Huntsville metropolitan area during outages, resulting in short-term increased demands for public services and housing. Because plant modification work would be temporary, most workers would stay in available rental homes, apartments, mobile homes, and camper-trailers.

The additional number of outage workers and truck material and equipment deliveries needed to support EPU-related power plant modifications could cause short-term level-of-service impacts (restricted traffic flow and higher incident rates) on secondary roads in the immediate vicinity of BFN. However, only small traffic delays are anticipated during the outages.

The BFN currently makes payments in lieu of taxes to states and counties in which power operations occur and on properties previously subjected to state and local taxation. The licensee pays a percentage of its gross power revenues to such states and counties. Only a very small share of TVA payment is paid directly to counties; most is paid to the states, which use their own formulas for redistribution of some or all of the payments to local governments to fund their respective operating budgets. In general, half of TVA payment is apportioned based on power sales and half is apportioned based on the “book” value of TVA property. Therefore, for a capital improvement project such as the EPU, the in-lieu-of-tax payments are affected in two ways: (1) as power sales increase, the total amount of the in-lieu-of-tax payment to be distributed increases, and (2) the increased “book” value of BFN causes a greater proportion of

the total payment to be allocated to Limestone County. The state's general fund, as well as all of the counties in Alabama that receive TVA in-lieu-of-tax distributions from the State of Alabama, benefit under this method of distribution (TVA 2016a).

Due to the short duration of EPU-related plant modification and substation upgrade activities, there would be little or no noticeable effect on tax revenues generated by additional workers temporarily residing in Limestone County and elsewhere. In addition, there would be little or no noticeable increased demand for housing and public services or level-of-service traffic impacts beyond what is experienced during normal refueling outages at BFN. Therefore, the NRC staff concludes that there would be no significant socioeconomic impacts from EPU-related plant modifications, substation upgrades, and power plant operations under EPU conditions.

Environmental Justice Impacts

The environmental justice impact analysis evaluates the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations that could result from activities associated with the proposed EPU at BFN. Such effects may include human health, biological, cultural, economic, or social impacts. Minority and low-income populations are subsets of the general public residing in the vicinity of BFN, and all are exposed to the same health and environmental effects generated from activities at BFN.

Minority Populations in the Vicinity of the BFN

According to the 2010 Census, an estimated 22 percent of the total population (approximately 978,000 individuals) residing within a 50-mile radius of BFN identified themselves as a minority (MCDC 2016). The largest minority populations were Black or African American (approximately 135,000 persons or 14 percent), followed by Hispanic, Latino, or Spanish origin of any race (approximately 44,000 persons or 4.5 percent). According to the U.S. Census Bureau's 2010 Census, about 21 percent of the Limestone County population

identified themselves as minorities, with Black or African Americans comprising the largest minority population (approximately 13 percent) (U.S. Census Bureau (USCB) 2016). According to the USCB's 2015 American Community Survey 1-Year Estimates, the minority population of Limestone County, as a percent of the total population, had increased to about 23 percent with Black or African Americans comprising 14 percent of the total county population (USCB 2016).

Low-income Populations in the Vicinity of BFN

According to the USCB's 2010–2014 American Community Survey 5-Year Estimates, approximately 32,000 families and 154,000 individuals (12 and 16 percent, respectively) residing within a 50-mile radius of BFN were identified as living below the Federal poverty threshold (MCDC 2016). The 2014 Federal poverty threshold was $24,230 for a family of four (USCB 2016).

According to the USCB's 2015 American Community Survey 1-Year Estimates, the median household income for Alabama was $44,765, while 14 percent of families and 18.5 percent of the state population were found to be living below the Federal poverty threshold (USCB 2016). Limestone County had a higher median household income average ($55,009) and a lower percentage of families (12 percent) and persons (15 percent) living below the poverty level, respectively (USCB 2016).

Impact Analysis

Potential impacts to minority and low-income populations would consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts) and radiological effects. Radiation doses from plant operations after implementation of the EPU are expected to continue to remain well below regulatory limits.

Noise and dust impacts would be temporary and limited to onsite activities. Minority and low-income populations residing along site access roads could experience increased commuter vehicle traffic during shift changes. Increased demand for inexpensive rental housing during the

EPU-related plant modifications could disproportionately affect low-income populations; however, due to the short duration of the EPU-related work and the availability of housing, impacts to minority and low-income populations would be of short duration and limited. According to 2015 American Community Survey 1-Year Estimates, there were approximately 4,016 vacant housing units in Limestone County (USCB 2016).

Based on this information and the analysis of human health and environmental impacts presented in this EA, the NRC staff concludes that the proposed EPU would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of BFN.

Cumulative Impacts

The Council on Environmental Quality defines cumulative impacts under the NEPA of 1969, as amended (42 U.S.C. § 4321 *et seq.*) 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). Cumulative impacts may result when the environmental effects associated with the proposed action are overlaid or added to temporary or permanent effects associated with other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. For the purposes of this cumulative analysis, past actions are related to the resource conditions when BFN was licensed and constructed; present actions are related to the resource conditions during current operations; and future actions are those that are reasonably foreseeable through the expiration of BFN's renewed facility operating licenses (i.e., through 2033, 2034, and 2036 for Units 1, 2, and 3, respectively).

In Section 4.8 of the BFN FSEIS (NRC 2005), the NRC staff assessed the cumulative impacts related to continued operation of BFN through the license renewal term assuming

operation of BFN at EPU levels. In its analysis, the NRC (2005) considered changes and modifications to the Tennessee River; current and future water quality; current and future competing water uses, including public supply, industrial water supply, irrigation, and thermoelectric power generation; the radiological environment; future socioeconomic impacts; historic and cultural resources; and cumulative impacts to Federally endangered and threatened species. The NRC (2005) determined that the contribution of BFN continued operations at EPU levels to past, present, and reasonably foreseeable future actions would not be detectable or would be so minor as to not destabilize or noticeably alter any important attribute of the resources.

Because the proposed EPU would either not change or result in significant impacts to the radiological environment, onsite or offsite land uses, visual resources, air quality, noise, terrestrial resources, special status species and habitats, historical and cultural resources, socioeconomic conditions, or environmental justice populations, the NRC concludes that implementation of the proposed action would not incrementally contribute to cumulative impacts to these resources. Regarding water resources and aquatic resources, although the proposed EPU would result in more thermal effluent, discharges would remain within the limits set forth in the current BFN NPDES permit, and no other facilities discharge thermal effluent within the BFN mixing zone that would exacerbate thermal effects. As described in this document, the NRC (2005) determined cumulative impacts to these resources would not be detectable or would be so minor as to not destabilize or noticeably alter any important attribute of the resources. Accordingly, the NRC staff finds that cumulative impacts on water resources and aquatic resources under the proposed action would not be significant.

Additionally, for those resources identified as potentially impacted by activities associated with the proposed EPU (i.e., water resources and aquatic resources), the NRC staff also considered current resource trends and conditions, including the potential impacts of

climate change. The NRC staff considered the U.S. Global Change Research Program's (USGCRP's) most recent compilation of the state of knowledge relative to global climate change effects (USGCRP 2009, 2014).

Water Resources

Predicted changes in the timing, intensity, and distribution of precipitation would be likely to result in changes in surface water runoff affecting water availability across the Southeastern United States. Specifically, while average precipitation during the fall has increased by 30 percent since about 1900, summer and winter precipitation has declined by about 10 percent across the eastern portion of the region, including eastern Tennessee (USGCRP 2009). A continuation of this trend coupled with predicted higher temperatures during all seasons (particularly the summer months), would reduce groundwater recharge during the winter, produce less runoff and lower stream flows during the spring, and potentially lower groundwater base flow to rivers during the drier portions of the year (when stream flows are already lower). As cited by the USGCRP, the loss of moisture from soils because of higher temperatures along with evapotranspiration from vegetation is likely to increase the frequency, duration, and intensity of droughts across the region into the future (USGCRP 2009, USGCRP 2014).

Changes in runoff in a watershed along with reduced stream flows and higher air temperatures all contribute to an increase in the ambient temperature of receiving waters. Annual runoff and river-flow are projected to decline in the Southeast region (USGCRP 2014). Land use changes, particularly those involving the conversion of natural areas to impervious surface, exacerbate these effects. These factors combine to affect the availability of water throughout a watershed, such as that of the Tennessee River, for aquatic life, recreation, and industrial uses. While changes in projected precipitation for the Southeast region are uncertain, the USGCRP has reasonable expectation that there will be reduced water availability due to the increased evaporative losses from rising temperatures alone (USGCRP 2014). Nevertheless,

when considering that the Tennessee River System and associated reservoirs are closely operated, managed, and regulated for multiple uses which include thermoelectric power generation, the incremental contribution of the proposed EPU on climate change impacts is not significant.

Aquatic Resources

The potential effects of climate change described in preceding paragraphs for water resources, whether from natural cycles or man-made activities, could result in changes that would affect aquatic resources in the Tennessee River. Increased air temperatures could result in higher water temperatures in the Tennessee River reservoirs. For instance, TVA found that a 1 °F (0.5 °C) increase in air temperature resulted in an average water temperature increase between 0.25 °F and 0.5 °F (0.14 °C and 0.28 °C) in the Chickamauga Reservoir (NRC 2015). Higher water temperatures would increase the potential for thermal effects on aquatic biota and, along with altered river flows, could exacerbate existing environmental stressors, such as excess nutrients and lowered dissolved oxygen associated with eutrophication. Even slight changes could alter the structure of aquatic communities. Invasions of non-native species that thrive under a wide range of environmental conditions could further disrupt the current structure and function of aquatic communities (NRC 2015). Nevertheless, when considering that the Tennessee River System and associated reservoirs are closely operated, managed, and regulated for multiple uses that include thermoelectric power generation, the incremental contribution of the proposed EPU on climate change impacts is not significant.

Alternatives to the Proposed Action

As an alternative to the proposed action, the NRC staff considered denial of the proposed license amendments (i.e., the “no-action” alternative). Denial of the application would result in no change in current environmental conditions or impacts. However, if the EPU were

not approved, other agencies and electric power organizations might be required to pursue other means of providing electric generation capacity, such as fossil fuel or alternative fuel power generation, to offset future demand. Construction and operation of such generating facilities could result in air quality, land use, ecological, and waste management impacts significantly greater than those identified for the proposed EPU.

Alternative Use of Resources

The action does not involve the use of any different resources than those previously considered in NUREG–1437, Supplement 21, Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Browns Ferry Station, Units 1, 2, and 3—Final Report (NRC 2005).

Agencies and Persons Consulted

The NRC staff did not enter into consultation with any other Federal or State agency regarding the environmental impact of the proposed action. However, on October 6, 2016, the NRC notified the Alabama State official, Mr. David Walter, Director of Alabama Office of Radiation Control of the proposed amendments, requesting his comments by October 13, 2016. If the State official has any comments, the comments will be addressed and resolved in the final EA. The NRC will also forward copies of this draft EA and FONSI to the EPA, FWS, and ADEM and publish the draft EA and FONSI in the FR for comment. The NRC will address any comments received during the comment period in the final EA.

IV. Finding of No Significant Impact

The NRC is considering issuing amendments for Renewed Facility Operating License Nos. DPR-33, DPR-52, and DPR-68, issued to TVA for operation of BFN to increase the maximum licensed thermal power level for each of the three BFN reactor units from 3,458 MWt to 3,952 MWt.

On the basis of the EA included in Section III of this document and incorporated by reference in this finding, the NRC concludes that the proposed action would not have significant effects on the quality of the human environment. The NRC's evaluation considered information provided in the licensee's application and associated supplements as well as the NRC's independent review of other relevant environmental documents. Section of this document lists the environmental documents related to the proposed action and includes information on the availability of these documents. Based on its findings, the NRC has decided not to prepare an environmental impact statement for the proposed action.

V. Availability of Documents

The following table identifies the environmental and other documents cited in this document and related to the NRC's FONSI. Documents with an ADAMS accession number are available for public inspection online through ADAMS at http://www.nrc.gov/reading-rm/adams.html or in person at the NRC's PDR as previously described.

DOCUMENT	ADAMS ACCESSION NUMBER, FRN, OR URL REFERENCE
Steven A. Ahlstedt and Thomas A. McDonough. Quantitative Evaluation of Commercial Mussel Populations in the Tennessee River Portion of Wheeler Reservoir, Alabama. Dated October 1992. (Prepared by Ahlstedt and McDonough 1992)	ML042790392

Alabama Department of Environmental Management. National Pollutant Discharge Elimination System Permit No. AL0022080, Tennessee Valley Authority, Browns Ferry Nuclear Plant. Dated July 3, 2012. (ADEM 2012)	ML16159A040
Alabama Department of Environmental Management. Alabama's Draft 2016 §303(d) List Fact Sheet. Dated February 7, 2016. (ADEM 2016)	ML16259A186
Karpynec T, Rosenwinkel H, Weaver M, Wright K, and Crook E. A Phase I Cultural Resources Surveys of Tennessee Valley Authority's Corinth and Holly Springs Substation Expansions in Alcorn and Marshall Counties, Mississippi. Dated May 2016. (Karpynec et al. 2016b)	ML16197A563
Karpynec T., Rosenwinkel H., Weaver M., Wright K., and Crook E. A Phase I Cultural Resources Survey of the Wilson Substation Expansion Project in Wilson County, Tennessee. Dated May 2016. (Karpynec et al. 2016c)	ML16197A563
Missouri Census Data Center. Circular Area Profiles (CAPS), 2010 Census Summary File 1, Aggregated Census Block Group Hispanic or Latino and Race data and 2010–2014 American Community Survey (ACS) data, Summary of Aggregated Census Tract data in a 50-mile (80-kilometer) radius around BFN (Latitude= 34.703889355505075, Longitude= -87.11862504482272). Accessed September 2016. (MCDC 2016)	http://mcdc.missouri.edu/websas/caps10c.html
Tennessee Valley Authority. Browns Ferry Nuclear Plant Units 2 and 3 – Proposed Technical Specifications Change TS-418 – Request for License Amendment Extended Power Uprate (EPU) Operation. Dated June 25, 2004. (TVA 2004a)	ML041840301

Tennessee Valley Authority. Browns Ferry Nuclear Plant Unit 1 – Proposed Technical Specifications Change TS-431 – Request for License Amendment – Extended Power Uprate (EPU) Operation. Dated June 28, 2004. (TVA 2004b)	ML042800186
Tennessee Valley Authority. Browns Ferry Nuclear Plant—Unit 1—Technical Specifications Change TS-431, Supplement 1—Extended Power Uprate (EPU). Dated September 22, 2006. (TVA 2006)	ML062680459
Tennessee Valley Authority. Technical Specifications Changes TS-431 and TS-418 –Extended Power Uprate (EPU) – Withdrawal of Requests and Update to EPU Plans and Schedules. Dated September 18, 2014. (TVA 2014)	ML14265A487
Tennessee Valley Authority. Proposed Technical Specifications Change TS-505 – Request for License Amendments – Extended Power Uprate, Cover Letter. Dated September 21, 2015. (TVA 2015a)	ML15282A152
Tennessee Valley Authority. Proposed Technical Specification Change TS-505 – Request for License Amendments – Extended Power Uprate – Supplemental Information. Dated November 13, 2015. (TVA 2015b)	ML15317A361
Tennessee Valley Authority. Proposed Technical Specifications (TS) Change TS-505 – Request for License Amendments – Extended Power Uprate (EPU) – Supplement 2, MICROBURN-B2 Information. Dated December 15, 2015. (TVA 2015c)	ML15351A113

Tennessee Valley Authority. Proposed Technical Specifications (TS) Change TS-505 – Request for License Amendments – Extended Power Uprate (EPU) – Supplement 3, Interconnection System Impact Study Information. Dated December 18, 2015. (TVA 2015d)	ML15355A413
Tennessee Valley Authority. Proposed Technical Specifications (TS) Change TS-505 – Request for License Amendments – Extended Power Uprate, BFN EPU LAR, Attachment 42, Supplemental Environmental Report, Revision 1. Dated May 27, 2016. (TVA 2016a)	ML16197A563
Tennessee Valley Authority. Proposed Technical Specifications (TS) Change TS-505 – Request for License Amendments – Extended Power Uprate (EPU) – Supplement 13, Responses to Requests for Additional Information. Dated April 22, 2016. (TVA 2016b)	ML16159A040
Tennessee Valley Authority. Proposed Technical Specifications (TS) Change TS-505 – Request for License Amendments – Extended Power Uprate (EPU) – Supplement 18, Responses to Requests for Additional Information and Updates Associated with Interconnection System Impact Study Modifications. Dated May 27, 2016. (TVA 2016c)	ML16197A563
Tennessee Valley Authority. Browns Ferry Nuclear Plant, RERP-RAI-GE-2 Response, Attachment 1: Supplemental Environmental Information for Transmission System and BFN Main Generator Upgrades. Dated May 27, 2016. (TVA 2016d)	ML16197A563
Tennessee Valley Authority. BFN EPU LAR, Attachment 47, List and Status of Plant Modifications, Revision 1 (Enclosure 10). Dated May 27, 2016. (TVA 2016e)	ML16197A563

U.S. Census Bureau. American FactFinder, Table DP-1, "Profile of General Population and Housing Characteristics: 2010, 2010 Census Summary File 1" for Limestone County, Alabama; American FactFinder, Table DP05, "ACS Demographic and Housing Estimates, 2015 American Community Survey 1-Year Estimates" for Limestone County, Alabama; and Table DP03 – "Selected Economic Characteristics, 2015 American Community Survey 1-Year Estimates" for Alabama and Limestone County, and Table B25002 – "Occupancy Status, 2015 American Community Survey 1-Year Estimates" for Limestone County, Alabama. Accessed September 2016. (USCB 2016)	http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t
U.S. Fish and Wildlife Service. Endangered Species Consultations Frequently Asked Questions. Dated July 15, 2013. (FWS 2013)	ML16120A505
U.S. Fish and Wildlife Service. Updated List of Threatened and Endangered Species That May Occur in Your Proposed Project Location for Browns Ferry EPU. Dated February 1, 2016. (FWS 2016)	ML16032A044
U.S. Global Change Research Program. Global Climate Change Impacts in the United States. Dated June 2009. (USGCRP 2009)	ML100580077
U.S. Global Change Research Program. Climate Change Impacts in the United States: The Third National Climate Assessment. Dated May 2014. (USGCRP 2014)	ML14129A233
U.S. Nuclear Regulatory Commission. Browns Ferry Nuclear Plant, Units 2 and 3—Environmental Assessment Regarding Power Uprate. Dated September 1, 1998. (NRC 1998)	63 FR 46491

U.S. Nuclear Regulatory Commission. Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG–1437, Volume 1, Addendum 1). Dated August 1999. (NRC 1999)	ML040690720
U.S. Nuclear Regulatory Commission. Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors (Regulatory Guide 1.183). Dated July 2000. (NRC 2000)	ML003716792
U.S. Nuclear Regulatory Commission. Review Standard for Extended Power Uprates (RS-001). Revision 0. Dated December 2003. (NRC 2003)	ML033640024
U.S. Nuclear Regulatory Commission. Biological Assessment, Browns Ferry Nuclear Power Plant, License Renewal Review, Limestone County, Alabama. Dated October 2004. (NRC 2004)	ML042990348
U.S. Nuclear Regulatory Commission. Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Browns Ferry Plant, Units 1, 2, and 3—Final Report (NUREG-1437, Supplement 21). Dated June 30, 2005. (NRC 2005)	ML051730443
U.S. Nuclear Regulatory Commission. Issuance of Renewed Facility Operating License Nos. DPR-33, DPR-52, and DPR-68 for Browns Ferry Nuclear Plant, Units 1, 2, and 3. Dated May 4, 2006. (NRC 2006a)	ML060970332

U.S. Nuclear Regulatory Commission. Browns Ferry Nuclear Plant, Units 1, 2, and 3—Draft Environmental Assessment and Finding of No Significant Impact Related to the Proposed Extended Power Uprate. Dated November 6, 2006. (NRC 2006b)	71 FR 65009
U.S. Nuclear Regulatory Commission. Browns Ferry Nuclear Plant, Units 1, 2, and 3—Final Environmental Assessment and Finding of No Significant Impact Related to the Proposed Extended Power Uprate. Dated February 12, 2007. (NRC 2007a)	72 FR 6612
U.S. Nuclear Regulatory Commission. Browns Ferry Nuclear Plant, Unit 1—Issuance of Amendment Regarding Five Percent Uprate. Dated March 6, 2007. (NRC 2007b)	ML063350404
U.S. Nuclear Regulatory Commission. Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Sequoyah Nuclear Plant, Unit 1 and 2 — Final Report (NUREG-1437, Supplement 53). Dated March 2015. (NRC 2015)	ML15075A438

Yokely P Jr. Mussel Study near Hobbs Island on the Tennessee River for Butler Basin Marina. Dated April 1998. (Yokely 1998)	ML042800176

Dated at Rockville, Maryland, this 21st day of November 2016.

For The Nuclear Regulatory Commission

/RA/

Jeanne A. Dion, Acting Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation