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FUKUSHIMA RESPONSE STRATEGY
ENVIRONMENTAL ASSESSMENT
Hamilton and Rhea Counties, Tennessee and Limestone County, Alabama

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Symbols, Acronyms, and Abbreviations

AC	Alternating Current
BFN	Browns Ferry Nuclear Plant
BWR	Boiling Water Reactor
CST	Condensate Storage Tank
EDMG	Emergency Damage Mitigation Guideline
EIS	Environmental Impact Statement
EOP	Emergency Operating Procedure
EPRI	Electric Power Research Institute
ESA	Endangered Species Act
ESBO	Extended Station Blackout
FRP	Flood Risk Profile
FSEIS	Final Supplemental Environmental Impact Statement
HAR	Hazard Assessment Report
ISFSI	Independent Spent Fuel Storage Installation
kVA	Kilovolt-ampere
msl	Mean Sea Level
MW	Megawatt
NHPA	National Historic Preservation Act
NRC	Nuclear Regulatory Commission
NTTF	Near Term Task Force
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
SAMG	Severe Accident Management Guideline
SBO	Station Blackout
SFP	Spent Fuel Pool
SHPO	State Historic Preservation Office
SPRA	Seismic Probabilistic Risk Assessment
SQN	Sequoyah Nuclear Plant
SSC	Structures, Systems, and Components
SR	State Route
TRM	Tennessee River Mile
TVA	Tennessee Valley Authority
UHS	Ultimate Heat Sink
UPS	Uninterruptible Power Supply
U.S.	United States
USFWS	U.S. Fish and Wildlife Service
WBN	Watts Bar Nuclear Plant

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CHAPTER 1 – PURPOSE AND NEED FOR ACTION

The Tennessee Valley Authority (TVA) proposes to develop, implement, and maintain a strategy to improve the ability of each TVA operating nuclear plant to cope with a Beyond Design Basis[1] external event (also termed a "severe accident") by the deadlines established in the Nuclear Regulatory Commission (NRC) Order EA-12-049 described below. The proposed strategy would incorporate lessons learned from the March 2011 events at the Fukushima Dai-ichi nuclear power plant in Japan. Implementing the proposed strategy would improve TVA's abilities to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities at its operating nuclear plants in the event of a severe accident. The specific actions to be implemented under the proposed strategy are described in detail in Section 2.1.2 below. The proposed strategy would apply directly to TVA generating facilities at Watts Bar Nuclear Plant (WBN) Unit 1, Sequoyah Nuclear Plant (SQN) Units 1 and 2, and Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3. The NRC recommendations also apply to WBN Unit 2, which is under construction. The NRC strategic requirements would be satisfied through the licensing process for WBN Unit 2. A location map of these generating facilities is provided as Figure 1-1.

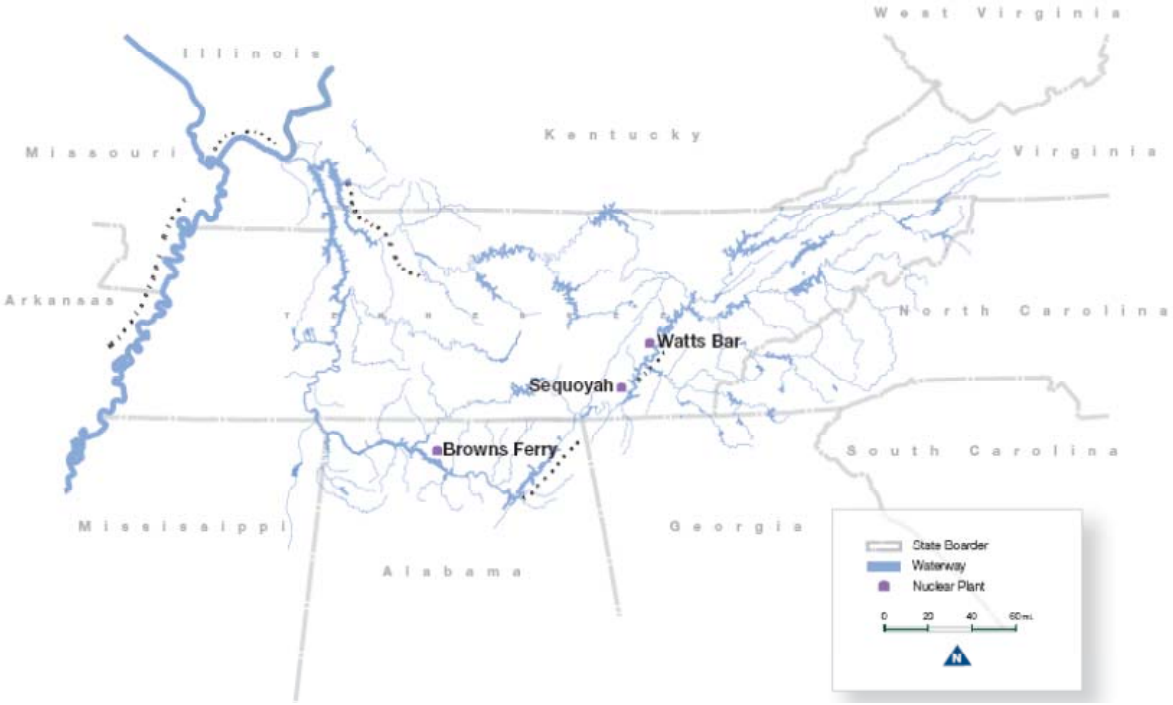

Figure 1-1. Location of Browns Ferry, Sequoyah, and Watts Bar Nuclear Plants

1.1 Background

On March 11, 2011, a 9.0-magnitude earthquake struck Japan and was soon followed by a tsunami, estimated to have exceeded 45 feet in height. These events resulted in extensive damage to four of the six nuclear reactors at the Fukushima Dai-ichi electrical power

[1] "Design basis" refers to the standards and requirements taken into account in designing a facility. With nuclear power plants, unlikely, but possible, events such as earthquakes, floods, and tornados are taken into account in the design of the plant to provide an acceptable margin of safety.

station. This situation was exacerbated by the loss of adequate electrical power necessary to operate monitors, control devices, and other essential electrically-powered equipment.

The NRC subsequently established the Near Term Task Force (NTTF) to determine lessons learned from the accident and review NRC regulations to determine if additional measures need to be taken immediately to ensure the safety of nuclear plants in the United States (U.S.).

In its report (NRC 2011a), the NTTF concluded that continued operation and licensing activities posed no imminent risk. The NTTF also concluded that enhancements to safety and emergency preparedness are warranted and proposed various recommendations for NRC consideration. NRC Staff ("Staff") subsequently prioritized and expanded upon the NTTF recommendations as documented in SECY-11-0137 (NRC 2011b). In that document, Staff identified eight of the NTTF recommendations as "Tier 1[2]" (listed below). The number in parenthesis corresponds to the NTTF recommendation number.

- (2.1) Seismic and flood hazard reevaluations
- (2.3) Seismic and flood walkdowns
- (4.1) Station blackout regulatory actions
- (4.2) Equipment covered under Title 10 of the Code of Federal Regulations (10 CFR) 50.54(hh)(2)
- (5.1) Reliable hardened[3] vents for Mark I and Mark II containments
- (7.1) Spent fuel pool instrumentation
- (8) Strengthening and integration of emergency operating procedures, severe accident management guidelines, and extensive damage mitigation guidelines
- (9.3) Emergency preparedness regulatory actions (staffing and communications)

Staff further prioritized NTTF recommendations into "Tier 2" and Tier 3" actions. The Tier 2 recommendations are those NTTF recommendations that could not be initiated in the near term due to factors that include the need for further technical assessment and alignment, dependence on resolution of Tier 1 issues, or availability of critical skill sets. These actions do not require long-term study and can be initiated when sufficient technical information and applicable resources become available.

The Tier 3 recommendations consist of those NTTF recommendations that require further staff study to support a regulatory action, have an associated shorter-term action that needs to be completed to inform the longer-term action, are dependent on the availability of critical skill sets, or are dependent on the resolution of NTTF Recommendation 1. The NTTF's Tier 2 and Tier 3 recommendations are not considered in this environmental assessment.

On March 12, 2012, the NRC issued Order NRC-12 -049 *Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events*

[2] Tier 1 recommendations are those actions which should be started without unnecessary delay and for which sufficient resource flexibility, including availability of critical skill sets, exists.

[3] As used here, "hardening" refers to reinforcing the vessels and vents to withstand the pressure and temperature of the steam generated early in an accident. Vents must be capable of withstanding fires and explosions if they are used to release hydrogen following an accident. Vents must be reliable enough to operate with the loss of electrical power of if other hazardous conditions exist.

(Effective Immediately). This order requires holders of NRC nuclear operating licenses, including TVA, to develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment and SFP cooling capabilities following a Beyond Design Basis external event. The resulting strategies must be capable of mitigating a simultaneous loss of all alternating current (AC) power and the loss of normal access to the ultimate heat sink[4] (UHS) and have adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities at all units on a site. Licensees must provide reasonable protection for the associated equipment from external events. Such protection must demonstrate that there is adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities at all units on a site. Licensees must be capable of implementing the strategies in all modes of operation.

The NTTF recommendations prioritized by Staff as Tier 1 are described below. These Tier 1 recommendations are considered within the scope of this environmental assessment, and the potential environmental effects of developing and implementing strategies for these recommendations are documented in Chapter 4.

Seismic and flood hazard reevaluations (NTTF recommendation 2.1)

The NTTF recommended the NRC require licensees to reevaluate and upgrade, as necessary, the design-basis seismic and flooding protection of structures, systems, and components (SSCs) for each operating reactor. More specifically, the NTTF recommended that NRC:

> *order licensees to reevaluate the seismic and flooding hazards at their sites against current NRC requirements and guidance, and if necessary, update the design basis and SSCs important to safety to protect against the updated hazards*.

Seismic and flood walkdowns (NTTF recommendation 2.3)

The NTTF recommended that the NRC require licensees to reevaluate and upgrade, as necessary, the design-basis seismic and flooding protection of SSCs for each operating reactor. The NTTF recommended that NRC:

> *order licensees to perform seismic and flood protection walkdowns to identify and address plant-specific vulnerabilities and verify the adequacy of monitoring and maintenance for protection features such as watertight barriers and seals in the interim period until longer-term actions are completed to update the design basis for external events.*

The NTTF recommended that the NRC strengthen station blackout (SBO) mitigation capability of all operating and new reactors for Design Basis and Beyond Design Basis external events. The intent is to further enhance the ability of nuclear power plants to deal with the effects of prolonged SBO conditions at single and multiunit sites without damage to the nuclear fuel in the reactor or SFP and without the loss of reactor coolant system or primary containment integrity. The two recommendations were proposed.

Station blackout regulatory actions (NTTF recommendation 4.1)

> *NRC should initiate rulemaking to revise 10 CFR 50.63 to require each operating and new reactor licensee to: (1) establish a minimum coping time of 8 hours for a*

[4] "Ultimate heat sink" is a virtually unlimited supply of cooling water, usually a lake or river, which can be used to dissipate heat from the vital systems and primary containment of a nuclear reactor after a normal reactor shutdown or a shutdown following a design basis accident.

loss of all alternating current (ac) power, (2) establish the equipment, procedures, and training necessary to implement an "extended loss of all ac" coping time of 72 hours for core and spent fuel cooling and for reactor coolant system and primary containment integrity as needed, and (3) preplan and pre-stage offsite resources to support uninterrupted core and spent fuel pool cooling, and reactor coolant system and containment integrity as needed, including the ability to deliver the equipment to the site in the time period allowed for extended coping, under conditions involving significant degradation of offsite transportation infrastructure associated with significant natural disasters.

Equipment covered under Title 10 of the Code of Federal Regulations (10 CFR) 50.54(hh)(2) (NTTF recommendation 4.2)

NRC should order licensees to provide reasonable protection for equipment currently provided pursuant to 10 CFR 50.54(hh)(2) from the effects of design-basis external events and to add equipment as needed to address multiunit events while other requirements are being revised and implemented.

Reliable hardened vents for Mark I containments (NTTF recommendation 5.1)

The NTTF recommended requiring hardened vent designs in Boiling Water Reactor (BWR) reactor facilities with Mark I and Mark II containments. (TVA's BFN utilizes a BWR with this type containment.) NTTF recommended that NRC:

order licensees to include a reliable hardened vent in BWR Mark I and Mark II containments. This order should include performance objectives for the design of hardened vents to ensure reliable operation and ease of use (both opening and closing) during a prolonged SBO.

Spent fuel pool (SFP) instrumentation (NTTF recommendation 7.1)

The NTTF recommended enhancing SPF makeup capability and instrumentation for the SFP. Specifically, the NTTF recommended that NRC:

order licensees to provide sufficient safety-related instrumentation, able to withstand design-basis natural phenomena, to monitor key SFP parameters (i.e., water level, temperature, and area radiation levels) for the control room.

Strengthening and integration of emergency operating procedures, severe accident management guidelines (SAMGs), and extensive damage mitigation guidelines (NTTF recommendation 8)

The NTTF recommended strengthening and integrating onsite emergency response capabilities such as emergency operating procedures (EOPs), severe accident management guidelines (SAMGs), and extensive damage mitigation guidelines (EDMGs). Measures included the recommendations that NRC:

(8.1) *order licensees to modify the EOP technical guidelines (required by Supplement 1, Requirements for Emergency Response Capability, to NUREG-0737, issued January 1983 (GL 82-33), to (1) include EOPs, SAMGs, and EDMGs in an integrated manner, (2) specify clear command and control strategies for their implementation, and (3) stipulate appropriate qualification and training for those who make decisions during emergencies.*

(8.2) *modify Section 5.0, Administrative Controls, of the Standard Technical Specifications for each operating reactor design to reference the approved EOP technical guidelines for that plant design.*

(8.3) *order Licensees to modify each plant's technical specifications to conform to the above changes.*

(8.4) *initiate rulemaking to require more realistic, hands-on training and exercises on SAMGs and EDMGs for all staff expected to implement the strategies and those licensee staff expected to make decisions during emergencies, including emergency coordinators and emergency directors*.

Emergency preparedness regulatory actions (staffing and communications) (NTTF recommendation 9.3)

NTTF recommended that the NRC require that facility emergency plans address prolonged SBO and multiunit events. Specifically, the NTTF recommended NRC to:

order licensees to do the following until rulemaking is complete:

- *Determine and implement the required staff to fill all necessary positions for response to a multi-unit event.*
- *Provide a means to power communications equipment needed to communicate onsite (e.g., radios for response teams and between facilities) and offsite (e.g., cellular telephones and satellite telephones) during a prolonged SBO.*

1.2 Decision to be Made

In order to maintain its nuclear operating licenses, TVA will comply with NRC Order EA-12-049, which requires provisions for mitigation strategies for coping with Beyond Design Basis external events. The decision before TVA is how to develop and implement specific mitigation strategies for dealing with one or more Beyond Design Basis events at its three nuclear power plants in compliance with this Order.

1.3 Related Environmental Reviews

The following environmental documents are relevant to this environmental review. Portions of these documents have been incorporated by reference into this environmental assessment.

Draft Environmental Impact Statement, Dam Safety Modifications at Cherokee, Fort Loudoun, Tellico, and Watts Bar Dams, Grainer, Jefferson, Loudon, Rhea, and Meigs Counties, Tennessee, (TVA 2012)

Final Supplemental Environmental Impact Statement, Sequoyah Nuclear Plant Units 1 and 2 License Renewal, Hamilton County, Tennessee (TVA 2011)

Final Supplemental Environmental Impact Statement, Completion and Operation of Watts Bar Nuclear Plant Unit 2, Rhea County, Tennessee (TVA 2009)

Final Environmental Assessment, Browns Ferry Nuclear Plant Units 2 and 3 Extended Power Uprate Project, Limestone County, Alabama (TVA 2003)

Final Supplemental Environmental Impact Statement for Operating License Renewal of the Browns Ferry Nuclear Plant in Athens, Alabama (TVA 2002)

1.4 Scope of the Environmental Assessment

Developing and implementing strategies to address the Tier 1 recommendations are within the scope of this environmental assessment. Future actions associated with the implementation of Tier 2 and 3 recommendations are not currently within the scope of this environmental review. As future strategies are developed and specific proposed actions are defined, they will be subjected to appropriate environmental review.

Based on internal scoping, TVA determined that various TVA actions in response to NRC Order EA-12-049 would have minimal, if any, direct environmental effects. Such actions include inspection of facilities and equipment, reevaluation of procedures and capabilities, and onsite equipment replacement or upgrades. Conversely, construction activities such as the construction of new FLEX[5] equipment storage buildings at BFN, SQN, and WBN, upgrades to the vent system at BFN, hardening the condensate storage tanks (CSTs), and the installation and operation of emergency generators could affect environmental resources.

The following environmental resources could potentially be affected under the proposed action:

- Air quality and greenhouse gases
- Solid waste and hazardous/radiological waste
- Floodplains and flood risks
- Wetlands
- Endangered and threatened species
- Cultural resources (i.e., archaeological and historic resources)

Other environmental resources that could possibly be affected, but that are not likely to be affected by the proposed actions include:

- Radiological impacts/benefits
- Seismic risk
- Aesthetic quality (noise, visual character)
- Socioeconomics/environmental justice
- Groundwater quality and supply
- Surface water quality and aquatic life
- Terrestrial life
- Transportation/navigation

[5] "FLEX" is a generic term used in the nuclear power industry that refers to a flexible strategy for responding to unlikely events that could cause the loss of cooling capability or electrical power at a nuclear facility. The strategy includes the use of portable pumps, generators, and associated emergency equipment.

1.5 Necessary Permits or Licenses

The proposed action would be subject to the following environmental permit requirements and regulations. The drilling of bore holes for seismic testing along existing roads at BFN, SQN, and WBN would not require permits.

- Air permitting regulations by Alabama Department of Environmental Management (BFN), Hamilton County Air Pollution Control Bureau (SQN), and Tennessee Department of Environment and Conservation (WBN) require TVA to secure an *Air Pollution Control Permit to Construct* prior to the construction of the proposed stationary engines. After start-up of the emission source, an *Air Pollution Control Permit to Operate* also may be required.
- A Storm Water Permit issued by the Tennessee Department of Environment and Conservation under the Clean Water Act would be required prior to commencement of construction activities that disturb an area of 1 acre or more at any given time at SQN and WBN.
- A Storm Water Permit issued by the Alabama Department of Environmental Management under the Clean Water Act would be required prior to commencement of construction activities that disturb an area of 1 acre or more at any given time at BFN.

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CHAPTER 2 - ALTERNATIVES

Preliminary internal scoping by TVA has determined that from the standpoint of the National Environmental Policy Act (NEPA), two feasible alternatives are available to TVA. These are the No Action Alternative and the Action Alternative. NEPA requires consideration of the alternative of no action. This "No Action" alternative serves as a baseline against which the potential effects of implementing the Action Alternative may be compared.

These two alternatives are described below. A comparison of the environmental consequences of implementing the two alternatives is also provided in this chapter.

2.1 Description of Alternatives

2.1.1 The No Action Alternative

Under the No Action Alternative, TVA would not implement the actions stipulated in NRC Order EA-12-049 regarding the implementation of mitigation strategies for Beyond Design Basis events. Thus, under this alternative, operations at BFN, SQN, and WBN would continue, at least in the near term, under current conditions, guidelines, and procedures.

This alternative is not practicable or reasonable because TVA must comply with all applicable NRC regulations in the operation of its nuclear generating facilities. In reality, implementation of this alternative would result in the loss of TVA's NRC-issued Operating License for these facilities.

However, in order to provide a baseline for comparing the potential environmental effects of implementing a "no action" alternative and the proposed Action Alternative, as required under NEPA, the assumption was made that operations at the three TVA nuclear generating facilities would continue indefinitely in the absence of TVA's implementation of the actions required under NRC Order EA-12-049.

2.1.2 The Action Alternative

Under the Action Alternative, TVA would implement the actions consistent with NRC Order EA-12-049 at its nuclear facilities (i.e., WBN, SQN, and BFN) to strengthen the agency's ability to avoid or mitigate the effects of a severe accident using lessons learned from the Fukushima-Dai-ichi accident. These specific actions are described in detail below.

Seismic and Flood Hazard Re-evaluations (NTTF Recommendation 2.1)

TVA would inspect each operating nuclear plant site and prepare a Hazard Assessment Report (HAR) to re-evaluate the flooding hazard using present day methodologies and NRC guidance. The HAR would compare the new flood elevations to current design basis flood elevations. These evaluations would not involve impacts to the environment.

Results of the HAR could indicate the need for modifications at one or more nuclear plant sites. If TVA were to propose undertaking these modifications, those proposed actions would be subject, as appropriate, to future environmental review as part of their planning and design.

For each of its operating nuclear plant sites, TVA would reevaluate seismic hazards for new earthquake spectra through the application of Seismic Probabilistic Risk Assessment (SPRA) methods recently promulgated under NRC guidelines. A probabilistic risk assessment uses a computer model to evaluate the probabilities and consequences of

various scenarios associated with seismic risks. Performing the SPRA would not result in adverse environmental effects. Seismic hazards would be evaluated against current NRC requirements and guidance. If necessary, the design basis and SSCs would be updated to protect against the updated hazards. Any physical or operational modifications to the sites would be subject, as appropriate, to future environmental review as part of planning and design of the modification. To avoid having its nuclear plants being categorized as high-risk plants requiring an SPRA within 3 years, TVA proposes to:

a. Resolve Individual Plant Examination of External Events outliers under NTTF recommendation 2.3 (see **Seismic and Flood Walkdowns** section below).

b. Work with the Electrical Power Research Institute (EPRI) to determine the need for better definition of the onsite geotechnical properties at BFN, SQN, and WBN, possibly through additional soil borings.

c. Continue to work with the Nuclear Energy Institute and EPRI seismic task forces and working groups to better understand the process and develop cost-effective and effective plans.

Seismic and Flood Walkdowns (NTTF Recommendation 2.3)
TVA would perform walkdowns (i.e., onsite, on-the-ground inspections) of all SSCs designed to withstand a design basis flood. These walkdowns would include structures, systems, and components required for flood mode operation, such as the SQN Diesel Generator Building and the Essential Raw Cooling Water Intake Structure, and the WBN thermal barrier booster pump and intake pumping station.

With respect to the current design basis floods, TVA would evaluate the procedural effectiveness for monitoring, maintenance, and responding to a flood including training, etc. as part of the ongoing process within the Nuclear Power Group Emergency Preparedness organization. Undertaking these inspections and procedure evaluations would not cause any environmental effects.

TVA would implement NRC guidance to inspect equipment necessary to achieve safe shutdown of the plant, the spent fuel pool, and the ultimate heat sink equipment. Results of the inspection could identify modifications necessary to maintain and enhance the seismic margin of the equipment. TVA plans to resolve all current and newly-identified deficiencies and outliers to the extent possible prior to final submittal to the NRC. Where resolution prior to submittal is not possible, TVA would develop and submit plans for later refined analysis. TVA would resolve an identified deficiency at SQN by implementing DCN T40717A to replace PCB-containing transformers for the diesel generator shutdown board to resolve BFN's only current outlier. There are no identified outliers at this time at WBN.

TVA would also evaluate procedural effectiveness for responding to design basis earthquakes. The inspections and procedural evaluations would not result in any environmental effects. Results of the walkdowns could indicate the need for additional modifications at one or more nuclear plant sites. Any such modifications would be subject, as appropriate, to future environmental review as part of planning and design of the modification.

Station Blackout Regulatory Actions (NTTF Recommendation 4.1) and Equipment Covered Under Title 10 of the Code of Federal Regulations (10 CFR)50.54(hh)(2) (NTTF Recommendation 4.2)

TVA's strategy would be to have the necessary equipment on site to cope with Extended Station Blackout (ESBO) events. This equipment would be located on each nuclear site and would be available for deployment with minimal set-up. Some of the proposed actions listed below have the potential to cause environmental effects. To implement this strategy, TVA would perform the following measures.

- Construct a FLEX equipment storage building at each nuclear plant site. Each building would be constructed of concrete and would be approximately 96 feet wide, 100 to 120 feet long, and 30 feet tall. These buildings would be constructed by a vendor to commercial standards consistent with International Building Codes and would meet regulatory guidelines for seismic, tornado winds and debris, and current Probable Maximum Flood (PMF) levels. The buildings would be sited in a suitable location above the PMF elevation for each site. The current controlling PMF elevations (including wind wave values) are 578.0 feet mean sea level (msl) for BFN, 726.2 feet msl for SQN, and 742.3 feet msl at WBN. Each building would contain an independent heating, ventilation, and air conditioning system, fire protection, and electrical system with suitable entrances to allow movement of equipment. Each building would house emergency equipment necessary to mitigate and cope with an ESBO of 72 hours or longer. All emergency equipment would be portable to allow safe shutdown of the plant and protection of the containment, nuclear fuels, and the SFP. The connection points include shutdown boards, specific equipment, and/or piping systems. Typical equipment would consist of the following:
    - Large diesel generators (1 for each unit). These generators would have a rating of approximately 3 MW. In addition to an integral 2,900-gallon double-walled fuel tank, each ESBO diesel generator set would be fueled via a buried connection to the plant 7-day tanks using a transfer pump powered by the 3 MW diesels generators. For extended coping times, procedures and strategies would be in place to refuel emergency equipment. Except for periodic routine testing, the generators would be operated only in the event of loss of AC power to the site. Test operations are expected to be 1 hour per month and another test quarterly, with one 24-hour test run per fuel cycle.
    - 1 trailer for fire hoses and fittings per site
    - 1 portable meteorological tower per site
    - "Sealand" containerized storage units - 1 per unit
    - Diesel-powered portable pumps (i.e., "FLEX" pumps) and satellite booster pumps – 1 set per unit and 1 spare FLEX pump per site
    - Diesel driven high pressure pump – 1 per unit (SQN and WBN only)
    - Small portable generators (5 each at SQN and WBN; 10 at BFN)
    - Nitrogen bottles - 10 per unit
    - 1 tow vehicle per site
    - Disaster kits to support 268 people for 7 days at each site (water, food, sleeping bags, cots, modesty clothing, and first aid supplies).
    - Portable fans
- Install multiple air-cooled diesel generators for charging vital batteries and powering vital instruments during emergency conditions. These generators would have a

rating of approximately 225 kVA. As many as three 225-kVA generators would installed on the roofs of existing buildings at each site, such as the diesel generator buildings at BFN, or the Auxiliary Building at SQN. Each generator would have an attached 100-gallon double-walled fuel tank. Additionally, a fuel oil line would be connected to the generators from existing 7-day diesel fuel storage tanks utilizing transfer pumps powered by the 225-kVA generators. Adequate protection would be provided around the diesel generators to meet regulatory guidelines for seismic, wind, tornado, and missiles. Except for periodic routine testing, the generators would be operated only in the event of loss of AC power to the site.

- Harden the CSTs at BFN, SQN, and WBN and associated piping to the pumps and equipment necessary to ensure reactor pressure vessel cooling water is available during seismic, flood, tornado, high winds, and loss of all AC power events. The method of accomplishing this has not been determined. A concrete or metal enclosure could be built around the existing CSTs or, more likely, replacement CSTs with more robust designs could be constructed. Other options for mitigating damage to the CSTs, such as constructing moats or dikes around the CSTs are also being considered. TVA is considering the upgrade of the CST at BFN as a future project as guidance develops.

General construction-type activities associated with minor upgrades to existing systems could be performed anywhere within the environmental impact study area for the respective sites. The environmental impact study areas are illustrated in Figures 3-1, 3-2, and 3-3 in Chapter 3. These activities include:

- Excavation for building foundations or piping/conduit.
- Soil Boring. Each boring would be 6 inches in diameter. Most borings would go to the bedrock, and some would be drilled up to 20 feet into the bedrock, for a total boring depth of approximately 40 to 60 feet. As part of the drilling operation, small volumes of soil are removed from the ground and accumulate around the boring hole. Once drilling is completed, most of this soil would be placed back into the borehole along with bentonite clay chips as needed to provide a stable plug for the borehole. Any residual soil left after the boreholes are plugged with the soil/clay would be evenly spread across the ground around the boreholes to provide a smooth surface. An undetermined number of borings may be required along existing plant roads at each of the three sites to determine the seismic characteristics of the roads. Thus, some borings could be outside the environmental impact study areas.
- Installation of buried pipes, wires, or other structures.
- Installation of concrete or metal foundations/footings.
- Covering bare dirt ground with pavement or gravel.
- Temporarily installing work trailers.

In addition to the physical changes described above, the strategy for coping with ESBO events would include a number of procedural and administrative activities that would not involve impacts to the environment. These activities include the following:

- Developing a strategy for deploying and operating FLEX pumps.

- Developing a Control Room lighting strategy.
- Develop a strategy for coping with a loss of pneumatic supply to the Main Steam Relief Valves.
- Developing a strategy for extending battery capability by reducing the demand on batteries during an emergency and by use of more energy efficient emergency lighting.
- Developing procedure upgrades for coping with an ESBO.
- Providing direct current-backed instrumentation for dry well temperature and suppression pool levels.
- Developing strategies for repowering the integrated computer system to mitigate station blackout (using 225-kVA diesel generators or 3-MW diesel generators).
- Developing a Reactor Core Isolation Cooling/High Pressure Coolant Injection strategy - evaluating equipment reliability and strategies for enduring extended loss of AC power.
- Providing uninterruptible power supplies (UPS) for radio repeater systems.
- Maintaining computerized business systems and computer access.

Reliable Hardened Vent Systems Mark I Containment Systems for Boiling Water Reactors (NTTF Recommendation 5.1)

The three units at BFN are boiling water reactors that use Mark I containment systems. Currently, the three BFN units vent to a common 14-inch diameter pipe that begins at the wet well building and extends to the plant stack. The pipe is partially buried. The vent is designed to discharge through the plant stack in the event of an emergency. Under normal operations, no liquid or vapor is vented through this system. The purpose of the vent system is to prevent the build-up of hydrogen gas. This vent path is not monitored for radioactive release during a loss of AC power. TVA's strategy to address this issue involves working with the Boiling Water Reactors Owners Group to develop modifications to prevent cross flow between units and to provide for the simultaneous venting of all units. Proposed modifications include removing the existing common vent pipe and constructing three new pipes (one for each unit) between the wet well and the stack. Associated fixtures such as access ladders and platforms, a chain operator, and possibly other minor equipment would be added to existing buildings. A remote station may be provided that houses a pneumatic supply to allow manual operation from a location protected from heat and radiation. This work would involve excavation for the installation of buried pipe and/or electrical cables.

TVA plans to use a wetwell[6] vent. The wetwell vent would be used for initial response after a severe accident event to mitigate high pressure in the containment vessel and the subsequent increased temperature in the wetwell. A drywell[7] vent would also be installed to be used if the water level in the wetwell rises to the point that the wetwell vent becomes inoperable.

[6] A wetwell is a water-filled volume located within the primary containment below the reactor pressure vessel.
[7] A drywell is the containment structure that encloses the reactor vessel and recirculation system of a boiling-water reactor. The drywell provides a pressure suppression system.

Use of the stack for the hardened vent release point would result in an offsite dose reduction by a factor of 100,000 and would ensure that releases do not migrate into the Main Control Room and Technical Support Center air intakes.

TVA would perform modifications to maintain the operation of the effluent radiation monitor during an ESBO or install a new radiation monitoring system with uninterruptible power.

TVA is evaluating potential designs for an optional engineered filter that could potentially be added to the Hardened Containment Vent System downstream of the piping as it exists in the Reactor Building. Although the precise location and specific design for the filter are not known at this time, the filter would be located above the PMF elevation.

Spent Fuel Pool Cooling (NTTF Recommendation 7.1)
TVA proposes to install instrumentation in the spent fuel pool to allow remote indication of pool water levels. Two channels of Spent Fuel Pool Level Instrumentation that are physically separated from each other and are supplied with reliable, battery backed power would be procured and installed. This instrumentation would be located above the PMF elevation. The installation of this instrumentation would not result in adverse effects to the environment.

Strengthening and Integration of Emergency Operating Procedures, Severe Accident Management Guidelines and Extensive Damage Mitigation Guidelines (NTTF Recommendation 8.0)
NRC has directed nuclear plant operators to develop an integrated set of emergency guidelines to address catastrophic events and challenges to critical safety function such as loss of all AC power, seismic events, the PMF, tornados, high winds, and fires. Following NRC rulemaking and working group development of guidelines, TVA would develop plant-specific procedures to be implemented by 2016. These could include strengthening and integration of EOPs, SAMGs, and EDMGs. Developing these emergency procedures would not cause impacts to the environment. However, any physical or operational modifications to the sites would be subject, as appropriate, to future environmental review as part of planning and design of new or updated procedures.

Emergency Preparedness Regulatory Actions (NTTF Recommendation 9.3)
TVA would determine necessary staffing levels and obtain the required personnel to fill all necessary positions for response to a multi-unit event and provide a means to power communications equipment needed to communicate onsite (e.g., radios for response teams and between facilities) and offsite (e.g., cellular telephones and satellite telephones) during an ESBO. TVA would assess current communications equipment used during an emergency to ensure power is maintained during a large scale natural event. The communications portion has been expanded to include a systems level view of the equipment and the means to provide power to it. The proposed assessment of communications equipment would not cause any adverse environmental effects. Any physical or operational modifications to the sites would be subject, as appropriate, to future environmental review as part of new or updated communication equipment or procedures.

2.1.3 Alternatives Considered but Eliminated From Further Discussion

No other feasible alternatives were identified in this environmental review.

2.2 Comparison of Alternatives

Table 2-1. Summary and Comparison of Alternatives by Resource Area

Resource Area	Impacts From Implementing the No Action Alternative	Impacts From Implementing the Action Alternative
Air Quality and Greenhouse Gases (GHGs)	No changes from the current situation are anticipated.	Equipment would generate particulates and GHGs for the duration of construction and any time generators are operated post-construction.
Solid Waste Streams	No changes from the current situation are anticipated.	Construction debris and some low-level radioactive wastes would be generated.
Floodplains and Flood Risk	No changes from the current situation are anticipated.	Proposed actions would be consistent with Executive Order 11988 (Floodplain Management). New safety-related structures would be located above the PMF elevation.
Wetlands	No effects to any onsite wetlands at BFN, SQN or WBN.	No effects to any onsite wetlands at BFN, SQN or WBN are anticipated.
Endangered and Threatened Species	No changes from the current situation are anticipated.	No effects to any terrestrial or aquatic state-listed or federally listed endangered or threatened species are anticipated.
Cultural Resources	No changes from the current situation are anticipated.	No effects to historic properties, including NRHP-eligible sites, are anticipated.
Radiological Concerns	No changes from the current situation are anticipated.	The likelihood of the release of radioactive materials following a Beyond Design Basis event would be reduced.
Seismic Risk	No changes from the current situation are anticipated.	Upgrades would improve the ability to cope with seismic events.
Aesthetic Quality	No changes from the current situation are anticipated.	Onsite changes would be minor and consistent with the existing industrial character of the sites.
Socioeconomic Issues	No changes from the current situation are anticipated (assuming plant operations continue indefinitely). Loss of operating rights from non-compliance could have long-term economic effects due to displaced workers.	No disproportionate impacts to disadvantaged populations are anticipated. A small positive temporary effect to some local businesses could occur. There would be a permanent increase in the safety level for plant personnel and the surrounding community.
Groundwater	No changes from the current situation are anticipated.	With implementation of appropriate spill prevention and control measures, potential effects to groundwater would be minor.
Surface Water and Aquatic Life	No changes from the current situation are anticipated.	With application of best management practices during construction, effects to surface water and aquatic life would be minor and temporary.

Resource Area	Impacts From Implementing the No Action Alternative	Impacts From Implementing the Action Alternative
Vegetation and Wildlife	No changes from the current situation are anticipated.	Potential effects to local wildlife and plant communities would be minimal and temporary.
Transportation and Navigation	No changes from the current situation are anticipated.	No surface road closures are anticipated to deliver heavy equipment. No barge transportation would be required.

2.3 Identification of Mitigation Measures

Three routine measures would be implemented to reduce the potential for adverse effects.

- If necessary, dust emissions from open construction areas and paved/unpaved roads would be mitigated by spraying water on the roadways.

- Appropriate best management practices will be implemented during soil-disturbing construction activities to prevent erosion and sedimentation of adjacent water bodies.

- Disturbed areas requiring revegetation would be revegetated with native or non-native, non-invasive species to prevent the introduction or spread non-native plant species.

- In accordance with NRC requirements, TVA would take appropriate measures to avoid adverse effects to onsite drainage following a Probable Maximum Precipitation[8] (PMP) event. These measures include locating and constructing the FLEX equipment storage buildings such that the floor elevations will be above the controlling PMF elevation. Similarly,construction or hardening of CSTs at BFN, SQN, and WBN, as well as the hardening of the Mark I vent system at BFN, will be planned and designed such that this equipment and associated structures do not interfere with PMP site drainage or adversely affect onsite PMP elevations.

2.4 The Preferred Alternative

The Action Alternative is TVA's preferred alternative.

[8] "Probable Maximum Precipitation" is defined as the greatest depth (amount) of precipitation, for a given storm duration, that is theoretically possible for a particular area and geographic location.

CHAPTER 3 – AFFECTED ENVIRONMENT

The proposed actions would be undertaken at TVA's Browns Ferry Nuclear Plant, Sequoyah Nuclear Plant, and the Watts Bar Nuclear Plant. Aerial views of the portion of each plant where the proposed actions would occur are provided in the figures below.

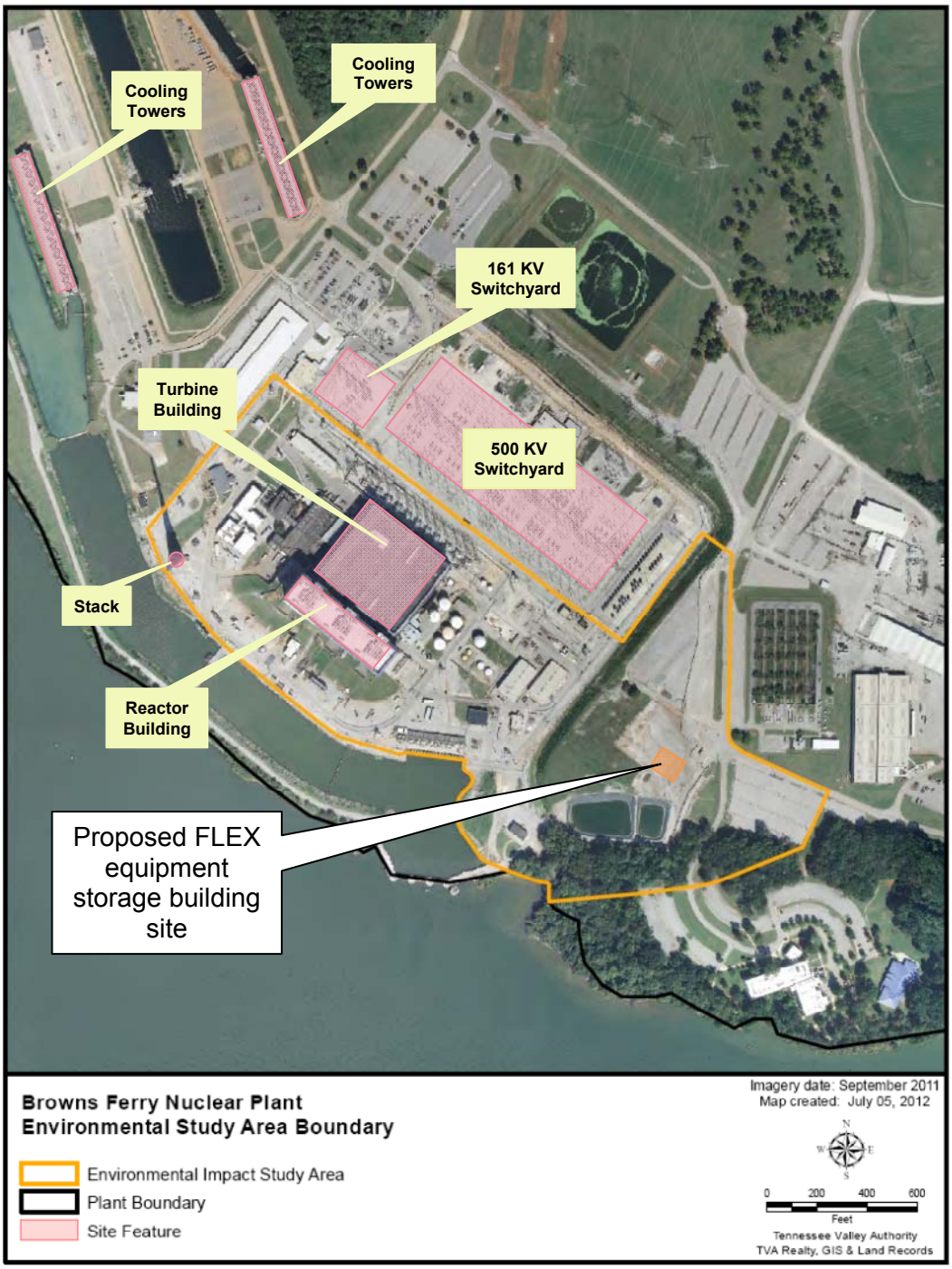

Figure 3-1. Aerial View of the Browns Ferry Nuclear Plant

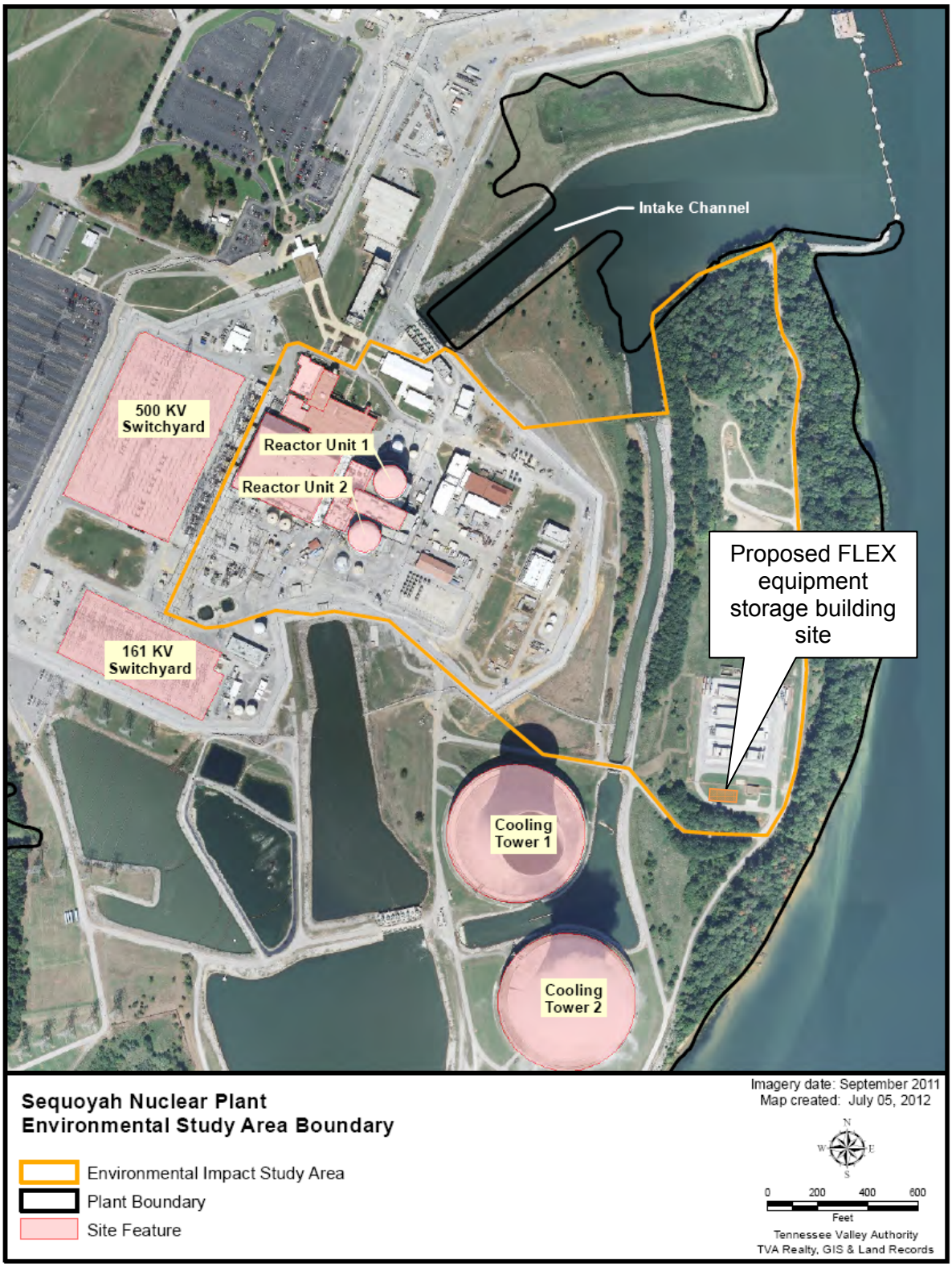

Figure 3-2. Aerial View of the Sequoyah Nuclear Plant

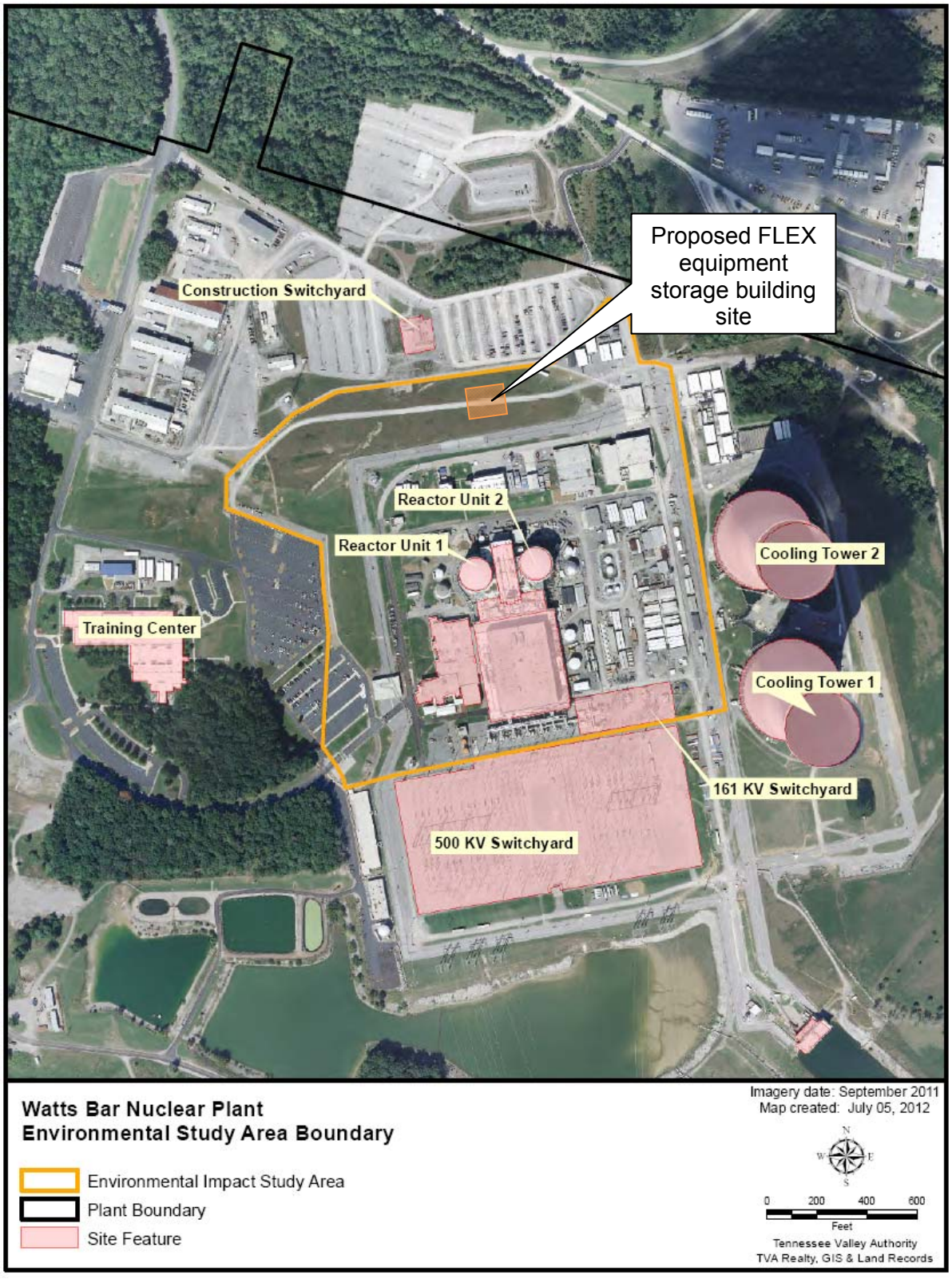

Figure 3-3. Aerial View of the Watts Bar Nuclear Plant

The potentially affected environmental resources and amenities that were considered in detail in this environmental review included air quality, solid wastes (including radiological wastes), floodplains and flood risk, wetlands, endangered and threatened species, and cultural resources. Likewise, potential effects with respect to radiological concerns, seismic risk, visual character, socioeconomic conditions, groundwater, surface water, terrestrial life, and local transportation were also considered. However, due to the nature of the proposed actions, potential effects to this second group of resources are very unlikely. Therefore, these resources were considered in less detail.

3.1 Air Quality and Greenhouse Gases

Through its passage of the Clean Air Act, Congress has mandated the protection and enhancement of the nation's air quality resources. National Ambient Air Quality Standards (NAAQS) for the following criteria pollutants have been established to protect the public health and welfare:

- sulfur dioxide (SO_2)
- ozone
- nitrogen dioxide (NO_2)
- particulate matter whose particles are less than or equal to 10 micrometers (PM_{10})
- particulate matter whose particles are less than or equal to 2.5 micrometers ($PM_{2.5}$)
- carbon monoxide (CO)
- lead

The primary NAAQS were promulgated to protect the public health, and the secondary NAAQS were promulgated to protect the public welfare from any known or anticipated adverse effects associated with the presence of pollutants in the ambient air. Areas in violation of the NAAQS are designated as nonattainment areas. New sources of air pollution to be located in or near nonattainment areas may be subject to more stringent air permitting requirements.

The BFN plant site is in attainment with respect to all seven criteria pollutants. The SQN plant site (Hamilton County, Tennessee) is in attainment with the NAAQS, with the exception of nonattainment for $PM_{2.5}$, according to the 1997 annual standard. WBN is in attainment for all the criteria pollutants under the NAAQS. None of these three plants are considered Major Sources of air pollution under the Clean Air Act.

New Source Performance Standards (NSPS) are federal standards promulgated for major and minor sources of air pollution. The NSPS imposes uniform requirements on new and modified sources. These standards are based on the best demonstrated technology. Any new source of air pollution must install the best control system currently in use within that industry. All new sources must undergo a review process known as the New Source Review.

New Source Review is required whether the major source or modification is planned for an area where the NAAQS are exceeded (nonattainment areas) or an area where air quality is acceptable (attainment and unclassifiable areas). Permits for sources in attainment areas are referred to as prevention of significant air quality deterioration (PSD) permits while

permits for sources located in nonattainment areas are referred to as NAA permits. No source or modification subject to PSD review may be constructed without a permit. PSD permits mandate the installation of pollution controls that represent the best available control technology.

Greenhouse gases (GHGs) are any of the atmospheric gases that absorb infrared solar radiation, thereby contributing to the warming of the Earth's surface. Common GHGs include carbon dioxide, methane, nitrous oxide, and water vapor. Combustion of carbon-based fuels such as coal, natural gas, and petroleum products is a major source of GHGs.

3.2 Solid, Hazardous, and Radiological Wastes

Solid wastes generated in conjunction with the operation of TVA's nuclear facilities typically include the following wastes:

- Construction and demolition debris
- Municipal solid waste (e.g., paper, plastics, garbage, etc.)
- Waste generated for transmission line clearing and maintenance
- Hazardous and universal wastes as defined under the Resource Conservation and Recovery Act (RCRA), including paints, solvents, batteries.
- Special wastes as regulated by the Tennessee Department of Environment and Conservation (TDEC) and the Alabama Department of Environmental Management.
- Low-level radioactive solid wastes that consist of spent resins and dry active waste (e.g., contaminated protective clothing, paper, rags, and trash)
- Spent fuel (i.e., high-level radioactive waste)

3.2.1 Browns Ferry

BFN operates a state-permitted construction/demolition debris landfill onsite. This landfill is permitted to accept non-hazardous, non-radioactive wastes such as scrap lumber and metals, glass, roofing materials, and other such materials. Construction/demolition wastes and bulk industrial wastes are often sent to a local landfill under a state-issued Special Waste Approval. Municipal solid wastes generated during routine plant operations are managed by a licensed waste disposal contractor.

BFN is classified as a large quantity generator of hazardous waste. All hazardous wastes generated at BFN are shipped to TVA's hazardous waste storage facility (HWSF) in Muscle Shoals, Alabama, for consolidation, storage, and disposal through approved and licensed facilities. Universal wastes are collected for recycling and shipped to recycling firms listed on the TVA Environmental Restricted Awards List. These are firms that TVA has determined have the capabilities to properly manage wastes or recycled material.

Low-level radioactive wastes generated at BFN are stored temporarily onsite until they are shipped offsite to NRC-approved disposal facilities. Spent fuel assemblies are stored in the SFP and in large concrete casks in the independent spent fuel storage installation (ISFSI) at BFN. Radiological waste streams generated at BFN are described in the BFN Units 2 and 3 Power Uprate environmental assessment (TVA 2003).

3.2.2 Sequoyah

TVA operates an onsite construction/demolition debris landfill at SQN. This landfill is approximately 18 acres but has not been used recently (TVA 2011). Rather SQN's construction/demolition waste has been sent to state-permitted landfills under a contractual

agreement. Likewise, municipal solid waste is hauled to a local state-permitted landfill under contract agreement.

SQN generates a variety of wastes classified as hazardous under RCRA. These include, but are not limited to, paints, solvents, and universal wastes such as batteries and mercury-containing lighting. SQN is designated as either a small quantity generator or as a conditionally exempt small quantity generator, depending on the amount of waste generated. The majority of the hazardous waste generated at SQN is shipped to TVA's HWSF in Muscle Shoals for disposal thorough approved and licensed facilities. Special wastes (e.g., asbestos containing materials, oily debris, etc.) is either collected in dumpsters and transported to the Rhea County landfill or placed in drums and sent to the HWSF in Muscle Shoals. Universal wastes are collected for recycling and shipped to recycling firms listed on the TVA Environmental Restricted Awards List.

SQN operates a liquid waste processing system and a gaseous waste processing system to collect and consolidate certain radioactive materials. These systems are described in Section 3.8.1 of the SQN license renewal SFEIS (TVA 2011). Specifics for collecting and processing solid radioactive wastes are also described in the SFEIS (TVA 2011). Most of the low level radiological waste is shipped to Oak Ridge, Tennessee, for reduction, packaging, and shipping to an approved disposal facility. However, some radiological wastes are stored in the on-site storage facility at SQN.

Spent nuclear fuel assemblies are stored in the SFP and in cylindrical concrete casks in the ISFSI. The ISFSI is located within the SQN protected area and has an effective capacity of 86 casks.

3.2.3 Watts Bar

Because WBN is similar in design and operation to SQN, the waste streams of both plants are similar in nature. Hazardous and special wastes generated at WBN are shipped to the HWSF in Muscle Shoals. Universal wastes are collected for recycling and shipped to recycling firms listed on the TVA Environmental Restricted Awards List. Some low-level radioactive waste is shipped to Oak Ridge for eventual disposal. There is an onsite landfill at WBN, but it is used infrequently.

WBN operates a liquid waste processing system and a gaseous waste processing system for processing liquid and gaseous radiological wastes. Spent fuel assemblies are stored in the SFP. WBN does not currently have an ISFSI.

3.3 Floodplains and Flood Risk

Floodplains are those low-lying areas along streams and rivers that are subject to periodic flooding. The area subject to a 1 percent chance of flooding in any given year is normally called the 100-year floodplain. Likewise, the 500-year floodplain is that area subject to a 0.2 percent chance of flooding in any given year. As a federal agency, TVA is subject to the requirements of Executive Order 11988 (Floodplain Management).

The Flood Risk Profile (FRP) is a site-specific elevation standard used to control flood damageable development for TVA projects as well as residential and commercial development on TVA-controlled lands. The plant grade is a similar elevation standard used at each nuclear plant site.

The NRC also requires a flood risk evaluation of possible impacts from the Tennessee River PMF and local PMP site drainage. The PMF is defined as the most severe flood that can reasonably be predicted to occur at a site as a result of hydrometeorological conditions. In determining the PMF, the assumption is made that the PMP event is centered on the local watershed, and that a sequence of related meteorological and hydrologic factors typical of extreme storms occur.

3.3.1 Browns Ferry

BFN is located on the north bank of Wheeler Reservoir at Tennessee River Mile (TRM) 294.0 in Limestone County, Alabama. The 100-year floodplain at BFN is that area below elevation 557.3 feet mean sea level (msl). The TVA FRP is also elevation 557.3. At this location, the FRP is also equal to the 500-year flood elevation. The closest upstream dam is Guntersville Dam, which is located at TRM 349.0. The top of the summer operating range for Wheeler Reservoir at BFN is elevation 556.0 feet msl.

The plant grade elevation at BFN is 565 feet msl. The “baseline” (i.e., a flat-surface flood elevation with no waves) Tennessee River PMF elevation at BFN is 572.5. However, the controlling PMF elevation, which includes the influence of wind-driven waves, is calculated to be 578.0 feet msl.

The PMP site drainage system at BFN is broken into three areas: 1) the switchyard, 2) the main plant area, and 3) the cooling tower system. For the switchyard drainage channel, the PMP elevation at the holding pond at the downstream end of the channel is 574.8, and the PMP elevation at the north corner of the switchyard is 577.8. The PMP elevation between the office and service buildings is 566.6. In the vicinity of the radioactive waste, reactor, and diesel generator buildings, PMP elevations for all modes of plant operation would not exceed elevation 564.0. There is sufficient capacity to pass the PMP and condenser water in the cooling tower system of channels.

Calculations indicate that failure of Wheeler Dam would cause the lake elevation to drop to 529.0 feet msl. There is a dredged channel from the Intake Pumping Station to the main river channel to allow continued operation of the Essential Raw Cooling Water intake in the event of an extraordinary loss of reservoir water level.

3.3.2 Sequoyah

SQN is located on a peninsula on the western bank of Chickamauga Reservoir at TRM 484.5 in Hamilton County, Tennessee. At TRM 484.5, the 100-year floodplain is the area below elevation 687 feet msl. The 500-year flood elevation at this location is 688.5 feet msl. The FRP elevation at TRM 484.5 is 689 feet msl. The closest upstream dam to SQN is Watts Bar Dam at TRM 529.9. The top of the summer operating range for Chickamauga Reservoir at SQN is elevation 682.5 feet msl.

The plant grade elevation at SQN is 705.0 feet msl. The baseline PMF elevation at SQN is 722.0 feet msl. The controlling PMF elevation, including wind wave effect, is calculated to be 726.2 feet msl.

The SQN PMP site drainage system was analyzed for a storm producing the PMP on the local area. The site is graded such that runoff would drain away from safety-related structures to drainage channels and subsequently to the Tennessee River. The local area of the SQN plant site would pass the PMP runoff criteria without exceeding elevation of 706 feet msl (TVA 2008).

A minimum water elevation of 639 feet msl is required for the cooling water intake at SQN. In the event of a dam failure at the downstream Chickamauga Dam, a minimum flow of 14,000 cubic feet per second from Watts Bar Dam would be required to maintain adequate cooling water at SQN.

3.3.3 Watts Bar

WBN is located on the western bank of Chickamauga Reservoir between TRM 528.0 and 528.6 in Rhea County, Tennessee. The 100-year floodplain is that area below elevation 697.1 feet above mean seal level (msl) at TRM 528.0 and 697.4 feet msl at TRM 528.6. The TVA FRP is elevation 700.9 feet msl at TRM 528.4 and 701.4 at TRM 528.6. The closest upstream dam is Watts Bar Dam, which is immediately upstream at TRM 529.9. The top of the summer operating range for Chickamauga Reservoir at SQN is elevation 682.5 feet msl.

The plant grade elevation at WBN is 728 feet msl, and the plant is designed to have the capability for safe shutdown for floods exceeding plant grade level. The baseline PMF elevation is calculated to be 739.2 feet msl. Calculations indicate that wind-driven waves would cause the controlling PMF elevation to be 742.3 feet msl.

Previous determinations indicate that the critical elevation for PMP site drainage at WBN would be no higher than elevation 729.0.

The minimum water level necessary to maintain the Essential Raw Cooling Water pump suction is 666 feet msl. In the event of a total failure of Chickamauga Dam downstream, the water level at WBN is expected to fall in about 3 hours after failure, and would drop below elevation 666 after approximately 27 hours, assuming no discharge from Watts Bar Dam. However, if a discharge of at least 3,200 cubic feet per second from Watts Bar Dam were initiated within 12 hours of the failure of Chickamauga Dam, analysis indicates that a water level of 666 feet could be maintained indefinitely.

3.4 Wetlands

Wetlands are areas that are inundated or saturated with surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances, do support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands typically include swamps, marshes, bogs, and similar areas.

Wetlands are regulated under Sections 404 and 401 of the Clean Water Act and are addressed under Executive Order 11990 (Protection of Wetlands). To conduct certain activities in the "Waters of the U.S." that may affect wetlands, authorization under a Section 404 permit from the U.S. Army Corps of Engineers is required. Section 401 gives states the authority to certify whether activities permitted under Section 404 are in accordance with state water quality standards. TDEC is responsible for Section 401 water quality certifications in Tennessee, while the Alabama Department of Environmental Management exercises this jurisdiction in Alabama. EO 11990 requires all federal agencies to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities.

3.4.1 Browns Ferry

The BFN License Renewal Final Supplemental Environmental Impact Statement (FSEIS) (TVA 2002) states that small areas of palustrine emergent wetlands occur within the BFN

plant boundary. However, no wetland areas are located within the BFN environmental impact study area delineated in Figure 3-1.

3.4.2 Sequoyah

A survey conducted during preparation of the Sequoyah FSEIS (TVA 2011) indicated that 1.3 percent of the entire SQN plant area is wetlands, and these are composed of wooded wetlands. No emergent herbaceous wetlands occurred on the site. The channel within the environmental impact study area as shown in Figure 3-2 was identified in the previous review as a wetland (palustrine, unconsolidated bottom, permanently flooded, excavated). This area is a riprapped channel and does not meet the regulatory definition of a wetland.

3.4.3 Watts Bar

The Watts Bar Unit SEIS (TVA 2007) indicates the presence of forested wetlands on the southwest portion of the WBN site, and emergent wetlands have developed in the ash disposal areas and in containment ponds. Several linear forested wetlands have developed along drainage channels in the western and southwestern portions of the plant site. Scattered areas of fringe emergent wetlands occur along the shoreline of the WBN site. Some small areas of forested, scrub-shrub wetlands are associated with onsite streams, particularly in the wooded area north and east of the Unit 2 parking area and in the drain area between the cooling towers and the Watts Bar Steam Plant ash pond. However, no wetlands are present within the environmental impact study area at WBN as delineated in Figure 3-3.

3.5 Endangered and Threatened Species

The Endangered Species Act of 1973 (ESA) is a federal law intended to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved, and provide programs for the conservation of those species, thus preventing extinction of native plants and animals. Regulatory administration of the ESA is the responsibility of the U.S. Fish and Wildlife Service (USFWS). Section 7 of the ESA requires all federal agencies, in consultation with USFWS, to insure that their actions are not likely to jeopardize the continued existence of listed species or result in destruction or adverse modification of critical habitat.

Under the ESA, the term “threatened species” refers to “any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.” Similarly, “endangered” is a classification provided to an animal or plant in danger of extinction within the foreseeable future throughout all or a significant portion of its range.

Those species that are either state-listed or federally listed as endangered or threatened that have been recorded near BFN, SQN or WBN are presented in Table 3-1 below. Five listed mussel species (the birdwing pearlymussel, cracking pearlymussel, dromedary pearlymussel, ring pink, and tuberculed blossom pearlymussel) included in Table 3-1 are considered extirpated and no longer occur within the potentially affected area. No designated critical habitat for plant species are known from within 5 miles of each of these facilities.

Table 3-1. State and Federally Listed Species of Conservation Concern Found Near BFN, SQN or WBN

Common Name	Scientific Name	Status[2]		In Vicinity of
		Federal	State	
Plants				
Appalachian bugbane	*Cimicufuga rubrifolia*	-	THR	WBN
Gibbous panic grass	*Sacciolepsis striata*	-	SPCO	SQN
Large-flower skullcap	*Scutellaria montana*	THR	THR	SQN
Monkey-face orchid[1]	*Platanthera integrilabia*	CAND	END	
Northern bush honeysuckle	*Diervilla lonicera*	-	THR	WBN
Prairie dock	*Silphium pinnatifidum*	-	THR	SQN
Prairie goldenrod	*Solidago ptarmicoides*	-	END	WBN
Slender blazing star	*Liatris cylindracea*	-	THR	WBN
Small whorled pogonia[1]	*Isotria medeoloides*	THR	END	*
Spreading false foxglove	*Aureolaria patula*	-	SPCO	WBN
Virginia spiraea[1]	*Spiraea virginiana*	THR	END	*
Insects				
Cherokee clubtail	*Gomphus consanguis*	-	TRKD	WBN
Fishes				
Bigeye chub	*Hybopsis amblops*	-	TRKD	BFN
Flame chub	*Hemitremia flammea*	-	TRKD	BFN, WBN
Highfin carpsucker	*Carpiodes velifer*	-	NMGT	SQN
Paddlefish	*Polyodon spathula*	-	PROT	BFN
Redline darter	*Etheostoma rufilineatum*	-	TRKD	BFN
Silver redhorse	*Moxostoma anisurum*	-	TRKD	BFN
Snail Darter	*Percina tanasi*	THR	THR	WBN
Spring pygmy sunfish	*Elassoma alabamae*	-	PROT	BFN
Stargazing minnow	*Phenacobius uranops*	-	TRKD	BFN
Tangerine darter	*Percina aurantiaca*	-	NMGT	WBN
Tuscumbia darter	*Etheostoma tuscumbia*	-	PROT	BFN
Mussels				
Birdwing pearlymussel	*Lemiox rimosus*	END	PROT	BFN
Cracking pearlymussel	*Hemistena lata*	END	PROT	BFN
Cumberlandian combshell	*Epioblasma brevidens*	END	PROT	BFN
Dromedary pearlymussel	*Dromus dromas*	END	PROT	BFN, SQN, WBN
Fanshell	*Cyprogenia stegaria*	END	END	WBN
Fluted kidneyshell	*Ptychobranchus subtentum*	PROP END	PROT	BFN
Lilliput	*Toxolasma parvum*	-	TRKD	BFN
Ohio pigtoe	*Pleurobema cordatum*	-	TRKD	BFN
Pink mucket	*Lampsilis abrupta*	END	PROT	BFN, SQN, WBN
Pink papershell	*Potamilus ohiensis*	-	TRKD	BFN
Purple lilliput	*Toxolasma lividus*	-	TRKD	BFN
Pyramid pigtoe	*Pleurobema rubrum*	-	TRKD	WBN
Ring pink	*Obovaria retusa*	END	PROT	BFN
Rough pigtoe	*Pleurobema plenum*	END	END	WBN
Sheepnose	*Plethobasus cyphyus*	END	TRKD	WBN

Common Name	Scientific Name	Status[2]		In Vicinity of
		Federal	State	
Shiny pigtoe pearlymussel	*Fusconaia cor*	END	END	WBN
Tennessee clubshell	*Pleurobema oviforme*	-	TRKD	WBN
Tuberculed blossom pearlymussel	*Epioblasma torulosa torulosa*	END	PROT	BFN
White heelsplitter	*Lasmigona complanata*	-	TRKD	BFN
Snails				
Acornshell	*Epioblasma haysiana*	-	EXTI	BFN
Round-rib elimia	*Elimia nassula*	-	TRKD	BFN
Skirted Hornsnail	*Pleurocera pyrenella*	-	TRKD	BFN
Slender campeloma	*Campeloma decampi*	END	PROT	BFN
Spiral hornsnail	*Pleurocera brumbyi*	-	TRKD	BFN
Warty rocksnail	*Lithasia lima*	-	HIST	BFN
Birds				
Bald eagle	*Haliaeetus leucocephalus*	DM	PROT	BFN, SQN, WBN
Mammals				
Gray bat	*Myotis grisescens*	END	PROT/ NMGT	BFN, WBN
Indiana bat	*Myotis sodalis*	END	END	SQN, WBN
Meadow jumping mouse	*Zapus hudsonius*	-	NMGT	WBN
Amphibians				
Hellbender	*Cryptobranchus alleganiensis*	-	NMGT	WBN

[1]Federally listed species occurring in Hamilton County, but not within 5 miles of SQN.
[2]Status Codes: CAND = candidate for listing; DM = recovered, delisted, and being monitored; END = endangered; EXTI = extirpated from state or region; HIST = historically known from the area, may be extirpated or extinct; NMGT = in need of management; PROP END = proposed endangered; PROT = protected; SPCO = species of special concern; THR = threatened; TRKD = tracked by state (no legal status)

3.5.1 Browns Ferry

A review of the TVA Regional Heritage database indicated that no state or federally listed plants are known to occur within 5 miles of BFN. Likewise, no federal or Alabama state-listed terrestrial animal species have been documented within 3 miles of BFN. However, the federally endangered gray bat and federally protected bald eagle have been documented in Limestone County, Alabama, but not within 3 miles of the BFN project area.

Bald eagles were removed from the endangered species list, but are still protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Both acts prohibit harm to eagles or their nests. Bald eagles nest in forested areas near large bodies of water, such as rivers and reservoirs, where they forage (Bryan et al. 2005; Thompson et al. 2005). The closest documented active bald eagle nest is greater than 6 miles from BFN.

Gray bats roost in caves year-round and typically forage over streams, rivers, and reservoirs (Tuttle 1976). Gray bats have been reported from one cave in Limestone County that is greater than 15 miles from BFN. No caves occur within the environmental impacts study area. The Tennessee River, which is adjacent to BFN provides foraging habitat.

3.5.2 Sequoyah

Three Tennessee state-listed plant species and one federally listed plant species are known from within 5 miles of SQN. There are three federally listed plant species reported from Hamilton County, Tennessee.

Based on review of the TVA Regional Natural Heritage database for records of terrestrial animals, one federally protected species, bald eagle, and no Tennessee state-listed species have been documented within 3 miles of the SQN project area. No additional terrestrial animal species with federal status have been documented in Hamilton County, Tennessee. The federally listed as endangered Indiana bat recently has been listed statewide in Tennessee, although its occurrence has not yet been documented in Hamilton County.

The closest two documented bald eagle nests are 1.3 and 1.7 miles from SQN, along Chickamauga Reservoir. Non-nesting bald eagles have been observed near SQN during January, just outside the eastern boundary of the environmental impacts study area in trees along the Chickamauga Reservoir. The last documented observation was in 2001. These eagles likely migrated south to spend the winter season foraging along the Reservoir.

The Tennessee Ecological Services office of the Fish and Wildlife Service recently listed Indiana bat for every county in Tennessee regardless of whether the species has been documented in the county. The state-wide listing is based on the continued decline of Indiana bat, the determination by the USFWS that past survey efforts have been limited and not comprehensive for the state, and the recent and continued impact of white-nose syndrome on cave-dwelling bat species. Since 2006, when white-nose syndrome was first observed in a cave in New York, the associated fungus, *Geomyces destructans*, has greatly affected cave-dwelling bat species along the eastern seaboard, and impacts are spreading further south and west. Nearly 100 percent mortality has been experienced in affected caves after 2 to 3 years (USFWS 2012).

Indiana bats hibernate in caves during winter, and this bat is one of the species that has succumbed to mortality due to white-nose syndrome. During summer months, this species migrates to roost in trees under exfoliating bark, cracks or crevices (Kurta et al. 2002). The presence of the Indiana bat has not been documented in Hamilton County. No caves have been documented within the environmental impacts study area at SQN, and removal of trees is not within the scope of proposed actions.

3.5.3 Watts Bar

Five state-listed plant species are found within 5 miles of WBN, but no federally listed plants are known to occur within 5 miles of WBN. One federally protected terrestrial animal species, i.e., the bald eagle, and two Tennessee state-listed species (the hellbender and the meadow jumping mouse), have been documented within 3 miles of WBN. The federally listed as endangered gray bat has been documented in Rhea County, Tennessee, but not within 3 miles of WBN. The presence of the federally listed as endangered Indiana bat has not yet been documented in Rhea County.

The closest documented bald eagle nest is approximately 1.7 miles downstream on the opposite side of the river from WBN.

Gray bats have been reported from two caves in Rhea County. Both caves are approximately 9 miles from WBN. No caves occur with the environmental impacts study area at WBN. Nearby Watts Bar Reservoir provides foraging habitat.

Indiana bat has not been documented in Rhea County. No suitable winter (caves) or summer roosting habitat occurs within the environmental impacts study area at WBN.

Meadow jumping mouse inhabits wet meadows, bogs, grassy fields, and forest glades. Natural habitat remaining within the environmental impacts study area is minimal, fragmented, and highly managed (e.g., mowed) and is considered poorly suitable for this species.

The hellbender occurs primarily in medium-sized to large free-flowing streams in the Tennessee and Cumberland River drainages. Inhabited streams possess large rocks or logs that provide shelter and breeding sites. This species usually can be found beneath large rocks in shallow rapids. By day hellbenders stay under rocks or fallen logs, occasionally sticking their heads out (NatureServe 2009). Individuals of this species were likely extirpated as a result of establishment of the dams, which eliminated much of the suitable habitat that was present in the area. Suitable hellbender habitat is not present within the WBN environmental impact study area or in the vicinity of WBN.

3.6 Cultural Resources

Cultural resources include both archaeological resources and historic structures. The National Historic Preservation Act (NHPA) is a federal law intended to preserve historical and archaeological sites in the United States. The NHPA created a State Historic Preservation Office (SHPO) in each state to administer the law and to review actions (i.e., "undertakings") affecting historic resources. Section 106 of the NHPA requires federal agencies to consult with the appropriate SHPO on undertakings that could affect historic resources.

TVA determined the area of potential effects (APE) for historic architectural resources to be the BFN, SQN, and WBN plant reservations. TVA determined the APE for archaeological resources to be the areas in which ground disturbing activities would take place as part of the proposed actions. At each of the three plants, the archaeological APE is equivalent to the environmental impact study area as shown in Figures 3-1, 3-2, and 3-3.

3.6.1 Browns Ferry

A study of three proposed soil disposal areas (Gage 2001) within the northern and eastern sections of the plant reservation identified no historic architectural resources. Based on a recent inventory of TVA-owned historic structures, TVA considers BFN eligible for listing on the National register of Historic Places (NRHP) under criterion A (of 36 CFR Section 60.4) due to its significance as TVA's first nuclear plant and the largest in the world at the time it went online in 1974.

A Phase I cultural resources survey was conducted during the preparation of the BFN Operating License Renewal SEIS on three areas within the BFN site proposed for use as disposal areas for soil removed during plant expansion (Gage 2001). Two historic properties were identified. One was an Early to Middle Woodland (600 B.C. to 1000 A.D.) occupation (site 1Ll535) that is considered eligible for listing on the NRHP. The other was the Cox Cemetery, which was relocated during construction of BFN. An isolated find, considered ineligible for listing on the NRHP, was also identified. None of these resources

are located within the environmental impact study area, including the primary or secondary routes where soil borings are proposed. Native soils and sediments throughout most of the APE were destroyed during plant construction. Photographic documentation of plant construction between 1968 and 1973 indicates that the wooded hill along the southern border of the APE was not disturbed.

3.6.2 Sequoyah

A 2009 Phase I survey (Jones and Karpynec 2009) of portions of the SQN site totaling 6 acres identified no archaeological sites, and no historic architectural properties were identified within a 0.5-mile radius of the archaeological survey area.

A later Phase I cultural resources survey of the entire SQN site (McKee et al. 2010) confirmed earlier findings that two archaeological sites (40HA20 and 40HA22) were destroyed during plant construction. No previously recorded architectural resources were found. Previously identified above ground resources at SQN included the Igou and McGill Cemeteries. Burials at the McGill Cemetery have been disinterred and moved to McGill Cemetery #2, located across the Tennessee River. The 2010 survey identified one archaeological site (40HA549) and three isolated finds. TVA found in consultation with the Tennessee SHPO that the site and isolated finds are all ineligible for inclusion on the NRHP. Two architectural/above ground resources (HS-1 and HS-2) were identified. HS-1 is a 1930s house off the SQN plant site but within the 0.5-mile viewshed. HS-2 is the Igou Cemetery. TVA found in consultation with the Tennessee SHPO that both above ground resources are ineligible for inclusion on the NRHP due to a lack of historic and architectural distinction. However, the Igou Cemetery is protected by state burial laws (Tennessee Code Annotated Title 46-Cemeteries) from destruction and disturbance. No cultural resources were identified within the environmental impact study area. TVA does not consider SQN itself eligible for the NRHP.

3.6.3 Watts Bar

As stated in the Watts Bar SFEIS (TVA 2007), four archaeological sites (40RH1, 40RH6, 40RH7, and 40RH64) are located within the WBN site. All remain eligible for listing on the NRHP. None of these sites is located within the environmental impact study area. TVA does not consider WBN itself eligible for the NRHP.

3.7 Other Environmental Resources

3.7.1 Radiological Concerns

All three of the subject nuclear plants have radioactive materials onsite. All generate nuclear wastes, and these wastes are disposed of in accordance with applicable regulations. The TVA Nuclear Power Group has comprehensive standard procedures for dealing with radioactive materials. Existing regulations and procedures are designed to minimize the potential for inadvertent exposure of TVA personnel or the public to radioactive materials. All such materials are handled and stored in strict accordance with existing regulations, laws, and internal TVA procedures.

3.7.2 Seismic Risk

The NRC requires that nuclear facilities be designed and built to withstand certain events without the loss of systems, structures, and components necessary to ensure public health and safety. Such events include earthquakes, floods, and tornados or hurricanes. This standard is known as the “design basis” (see page 1). In accordance with NRC regulations, TVA’s nuclear plants have been constructed to this design basis. This includes measures

to ensure the integrity of systems, structures, and components following Beyond Design Basis accidents, including seismic events such as earthquakes.

Two metrics with respect to withstanding seismic events are the “safe shutdown earthquake” and the “operating basis earthquake.” The safe shutdown earthquake (also known as the design basis earthquake) is the maximum vibratory ground motion at which certain structures, systems, and components are designed to remain functional. NRC requires nuclear power plant to be designed and built so that, if the safe shutdown earthquake ground motion occurs, certain structures, systems, and components would remain functional and within applicable stress, strain, and deformation limits.

Similarly, the operating basis earthquake is the maximum vibratory ground motion for which a reactor could continue operation without undue risk and safety of the public. NRC regulations require that when subjected to the effects of the operating basis earthquake ground motion in combination with normal operating loads, all structures, systems, and components of the nuclear power plant necessary for continued operation without undue risk to the health and safety of the public must remain functional and within applicable stress, strain, and deformation limits.

3.7.3 Visual and Aesthetic Character

Browns Ferry

Section 3.16 of the BFN FSEIS (TVA 2002) provides a description of the visual resources in the vicinity of BFN, which remains relevant. The predominant visual features are the switchyard, the main plant building, cooling banks, the spill pile, and the stack. BFN does not have the large, tall hyperbolic cooling towers similar to SQN and WBN. Rather, six banks of smaller mechanical draft cooling towers are located along channels on the western side of the plant, and a recently-constructed seventh bank is located northeast of the original six. A border along the upper portion of the main plant building is painted blue. The balance of exteriors of the facilities and buildings on the plant site are an off-white or gray. The discussion of noise in Section 3.19 of the 2002 document adequately describes noise levels and sources of noise emanating from BFN operations.

Sequoyah

The visual setting of SQN is described in Section 3.11 of the SQN license renewal FSEIS (TVA 2011). The outstanding visual features at SQN are the two cooling towers, both of which may have visible steam plumes during operation, the switchyard, and the main plant building. The upper border of the main plant building has a brick-colored trim, which also appears on some other onsite buildings. Otherwise, the majority of the structures and facilities on the site are a concrete gray color.

Section 3.12 of the 2011 document presents the current noise environment at SQN and describes major sources of operational noise (e.g., the cooling towers) from the plant.

Watts Bar

The visual setting at WBN is similar to that of BFN and SQN. The prominent visual features include the two cooling towers, one of which has a plume when the plant is generating, the containment structures, the turbine building, and the training center. With the exception of the turbine building, which has a blue border along its upper half, virtually all the buildings and facilities are a concrete gray color. Ambient noise at WBN is comparable to SQN.

3.7.4 Socioeconomics and Environmental Justice

Browns Ferry

BFN is located in Limestone County in north Alabama. As of 2010, the total county population is 82,782, which has grown 26 percent since 2000. The median household income was $46,682 in 2006-2010 and has grown by 24.8 percent since 2000. Within Limestone County, minorities comprise approximately 21.3 percent of the population. BFN is located in Census Tract 211, which has a minority population share of 33.9 percent. In the 2006 through 2010 period, approximately 13.5 percent of the population of Limestone County had incomes below the poverty level. In Census Tract 211, 17.4 percent of the population was below the poverty level.

Sequoyah

Section 3.13 of the SQN License Renewal FSEIS (TVA 2011) provides a description of socioeconomic conditions in the areas around SQN. That discussion includes descriptions of current and projected population, employment and income, low-income and minority populations, housing, potable water supply sewer service, police and emergency services, schools, local land use, local government revenues, and transportation.

As of 2010, the total Hamilton County population was 336,463 and has grown 9.3 percent since 2000. Median household income was $45,408 in the period from 2006 through 2010 and has grown by 16.6 percent since 2000. The per capita personal income for Hamilton County in 2010 was $38,363, which was higher than the Tennessee average ($34,921) but slightly less than the national average of $39,937. Approximately 14.7 percent of the population of Hamilton County has income considered below the poverty level in 2010. SQN is located in Census Tract 103.04, Block Group 4. Approximately 10.5 percent of the population in the Census Tract has income below the poverty level during the 2006-2010 period.

In 2010, minorities comprised approximately 28 percent of the total population of Hamilton County. Block Group 4 has a minority population share of 2.8 percent, while the entire census tract has a minority population share of 4.3 percent.

Watts Bar

The total population of Rhea County in 2010 was 31,809, which was an increase of 12 percent since 2000. Rhea County median household income was $36,761 in 2006 - 2010 and has grown by 20.9 percent since 2000. In 2010, the per capita personal income of Rhea County was $26,096, which is lower than the state and national averages. Rhea County median household income is $36,761, which has grown by 20.9 percent since 2000.

Minorities comprised 7.9 percent of the Rhea County population in 2010, which is well below both the state and national levels. In the 2006 to 2010 time frame, 19.1 percent of the population had incomes below the poverty level. This rate is slightly higher than the state and national levels.

3.7.5 Groundwater

Browns Ferry

The BFN relicensing FSEIS (TVA 2002) provides a description of groundwater resources and characteristics in the vicinity of BFN. Groundwater is relatively shallow at the plant site, and recharge is derived primarily from precipitation. Groundwater movement at the site is typically toward the Tennessee River.

Sequoyah
Section 3.2 of the SQN Unit 1 and 2 License renewal FSEIS provides a detailed description of groundwater conditions in the vicinity of SQN. The main source of groundwater below SQN is infiltration of precipitation. Groundwater movement under SQN is typically downward and towards the Tennessee River. TVA has detected minor groundwater contamination from past inadvertent releases of liquids containing radioisotopes. Tritium concentrations in groundwater meet the EPA drinking water standard and are below standards for radiation exposure. TVA identified the source of two diesel fuel spills, removed and replaced faulty transfer lines and underground storage tanks, and has removed the contaminated soil to eliminate any additional groundwater contamination (TVA 2011).

Watts Bar
As documented in the WBN FSEIS (TVA 2007), TVA determined that the descriptive information concerning groundwater resources in the vicinity of WBN presented in the WBN Final Supplemental Environmental Review (TVA 1995) remains accurate. As stated in the 2007 WBN SFEIS, low levels of tritium were detected in groundwater at an on-site monitoring location. The source of this contamination was located, and the leak was repaired. Some residual tritium will likely remain in the local groundwater until it decays or is diluted. Eventually, this groundwater will migrate to the Tennessee River, where dilution will further reduce levels of tritium.

3.7.6 Surface Water and Aquatic Life

Because they require adequate cooling water, all three nuclear plants considered in this environmental review are located along the Tennessee River. The Tennessee River provides the necessary cooling water at all three facilities and is the UHS for each site.

WBN and SQN are located on Chickamauga Reservoir, near TRM 528 and TRM 484, respectively. Chickamauga Dam impounds the Tennessee River between river miles 471 and 530 and houses four hydro-electric generating units. Water elevations in the reservoir vary between approximately 675.0 feet msl in winter and 682.0 feet msl in the summer. WBN is located adjacent the tailwater of Watts Bar Dam, which is located near TRM 530.

Benthic macroinvertebrates (i.e., larger bottom-dwelling animals without backbones, such as worms and insects) are sampled in TVA's aquatic monitoring programs. Benthic community scores for the past 5 years for Chickamauga and Wheeler reservoirs have been "fair" to "good" with the exception of the forebay in Wheeler (TRM 277.0), which has had a consistently poor rating.

The native mussel fauna of the Tennessee River basin is one of the richest in the world, supporting 102 species within Tennessee (Parmalee and Bogan 1998) and 93 species in the reach within Alabama (Williams et al 2008). This group of animals has changed dramatically in much of the Tennessee River over the last century due to loss of habitat (primarily from impoundment by dams), commercial mussel harvesting, water quality problems, and introduction of non-native species like the zebra mussel. While many species have been decimated or lost, some species that are tolerant of low-flow habitats and finer substrates have increased or invaded the Tennessee River reservoirs. Riverine habitat is now primarily found only in tailwaters downstream of dams, which have provided refuge habitat for many of the mussels historically found here.

TVA monitors community structure and function of fish populations and has developed a metric known as the Reservoir Fish Assemblage Index (RFAI). Chickamauga and Wheeler Reservoirs rated "Good or "Fair" for the past 7 years sampled.

Browns Ferry
BFN is located on Wheeler Reservoir at TRM 294. Wheeler Dam, located near TRM 275, was completed in 1936, operates 11 hydro-electric generating units, and maintains an operating water level between about 550.5 feet msl in the winter and 556.0 feet msl in the summer. No recent mollusk surveys have been conducted on Wheeler Reservoir near BFN. A description of surface water resources, particularly the quality of Wheeler Reservoir, is provided in Section 3.6 of the 2002 BFN SFEIS.

There are three areas of onsite surface water within the BFN environmental impact study area shown in Figure 3-1. The switchyard ditch is located immediately east of the switchyard and drains surface runoff from the switchyard and other portions of the site. Two lined ponds located southwest of the proposed FLEX equipment storage building site (see Figure 3-1) are used to treat water prior to discharge to the river.

Sequoyah
SQN is situated at TRM 484 on the right descending (west) bank of Chickamauga Reservoir. Chickamauga has been monitored in alternate years since 1994 under the Ecological Health Monitoring Program. The reservoir has rated "fair" to "good" consistently. A description of surface water quality and flows is provided in Section 3.1 of the 2011 SQN SFEIS.

A recent mollusk study near SQN (Third Rock Consultants 2010a) indicated that local mussel and snail communities were very low in species richness and abundance. Overall, 11 mussel species were collected and four snail species were found; no federally listed species of either fauna were collected. Mean density of mussels ranged from 0.0 to 0.7 mussels/m^2, and that of snails per site ranged from less than 0.1 to 1.0 snails/m^2 (Third Rock Consultants 2010b). Mussel and snail densities at the survey sites were relatively low compared to more productive reaches of the Tennessee River. Zebra mussels were abundant in the area and infested the majority of mussels. TVA's reservoir benthic monitoring efforts near SQN between 2001 and 2009 indicated that aquatic snail densities ranged from 0.0 to 106.7 snails/m^2 and averaged 27.7 snails/m^2.

One onsite body of surface water, the cooling tower discharge channel, occurs within the environmental impact study area.

Watts Bar
WBN is located at TRM 528, immediately downstream of Watts Bar Lock and Dam, on the right descending (west) bank of Chickamauga Reservoir. A mollusk survey was conducted recently near the WBN site (Third Rock Consultants 2010b). That survey evaluated sites near river miles 528, 526, and 520, which corresponded to locations surveyed previously by TVA (Ahlstedt and McDonough 1997; Fraley et al 2002). Among the three sampling locations, a total of 17 mussel species were collected, including one individual each of the federally listed as endangered pink mucket (*Lampsilis abrupta*) and proposed endangered sheepnose (*Plethobasus cyphyus*), which were found at river mile 526 (Third Rock Consultants 2010b). Mussel densities at each of the sites were relatively low compared to more productive reaches of the Tennessee River. Overall mussel density was 0.71 mussels/m^2 in riverbed surface samples and 1.7 mussels/m^2 in excavated quadrat samples.

Snails were also relatively low in density among all the sites (mean = 0.26 snails/m^2 in surface samples and 6.3 snails/m^2 in excavated quadrat samples), and were comprised of only two common species (Third Rock Consultants 2010b).

There are no onsite areas of surface water within the environmental impact study area delineated in Figure 3-3. Section 3.1 of the 2007 WBN SFEIS provides a description of the current surface water conditions, primarily within the Tennessee River, at WBN and the potential effects to receiving waters from the operation of WBN with respect to hydrothermal effects and effects from chemical additives in discharges.

3.7.7 Vegetation and Wildlife

Scant woody or native vegetation remains within the footprints of the project areas at BFN, SQN, or WBN. Consequently, invasive plant species either already occur on site, or they have the potential to spread onto the sites. Executive Order 13112 (Invasive Species) defines an invasive species as any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem; and whose introduction does or is likely to cause economic or environmental harm or harm to human health. Invasive plants can infest small forest openings, interfere with forest productivity and management, and degrade wildlife habitat. Common invasive plant species likely within the project areas include: bush honeysuckle, Chinese privet, Japanese honeysuckle, Japanese stilt grass, Johnson grass, mimosa, multiflora rose, Russian olive, and sericea lespedeza. All of these species have the potential to adversely impact the native plant communities because of their potential to spread rapidly and displace native vegetation. In addition, according to EddMaps (2012), the federal noxious weed cogongrass, is known to occur in all counties adjacent to Limestone County, Alabama.

Browns Ferry

BFN is located within the Eastern Highland Rim, a subdivision of the Interior Plateau Ecoregion (Griffith et al. 2001). Natural habitat within the environmental impacts study area includes isolated patches of herbaceous vegetation (i.e., mowed lawns adjacent to infrastructure), a linear row of scrub-shrub, deciduous forest along the southeastern edge, and two small ponds. Given the fragmented nature and small scale of these habitats, presence of wildlife is limited. Birds found in early successional habitats with a dominant grass component include dickcissel, grasshopper sparrow, savannah sparrow, northern bobwhite, eastern meadowlark and white-throated sparrow. Small mammals such as eastern mole, white-footed mouse, and prairie vole, and larger mammals such as eastern cottontail, woodchuck, common raccoon and white-tailed deer can be abundant in early successional habitats. Predators that hunt small mammals in these areas include red fox, coyote, snakes, and raptors such as American kestrel and red-tailed hawk. Reptiles often found in early successional habitats include black racer, black rat snake, milk snake, and common garter snake. Ponds dominated by herbaceous vegetation provide habitat for wading birds such as great blue heron and great egret, and amphibians including American and Fowler's toads, green frog, northern cricket frog, southeastern chorus frog, and red-spotted newts.

Deciduous forests provide habitat for downy woodpecker, pileated woodpecker, white-breasted nuthatch, and American crow, as well as numerous Neotropical migrant birds such as wood thrush, red-eyed vireo, ovenbird, hooded warbler, black-and-white warbler, and yellow-rumped warbler. White-tailed deer and eastern gray squirrel are mammals frequently found in deciduous forests. Eastern zigzag salamanders may be present and

common reptiles include eastern box turtle, ring-necked snake, black rat snake, and copperhead.

No caves or wading bird colonies have been documented within 3 miles of the BFN project area.

Sequoyah
Natural habitat within the SQN environmental impacts study area includes isolated patches of herbaceous vegetation (i.e., mowed lawns adjacent to infrastructure), a linear row of scrub-shrub on either side of a channelized stream, and fragmented deciduous forest in the eastern section near Chickamauga Reservoir.

Areas composed primarily of herbaceous vegetation provide habitat for early successional bird species such as Carolina wren, eastern bluebird, American robin, brown thrasher, eastern kingbird, yellow-breasted chat, prairie warbler, indigo bunting, northern cardinal, blue grosbeak, field sparrow, and song sparrow. Birds found in early successional habitats with a dominant grass component include dickcissel, grasshopper sparrow, savannah sparrow, northern bobwhite, eastern meadowlark and white-throated sparrow. Small mammals such as eastern mole, white-footed mouse, and prairie vole, and larger mammals such as eastern cottontail, woodchuck, common raccoon and white-tailed deer can be abundant in early successional habitats. Predators that hunt small mammals in these areas include red fox, coyote, snakes, and raptors such as American kestrel and red-tailed hawk. Reptiles often found in early successional habitats include black racer, black rat snake, milk snake, and common garter snake.

Forested areas provide habitat for wild turkey, downy woodpecker, pileated woodpecker, white-breasted nuthatch, and American crow, as well as numerous Neotropical migrant birds such as wood thrush, red-eyed vireo, ovenbird, hooded warbler, black-and-white warbler, and yellow-rumped warbler. White-tailed deer and eastern gray squirrel are mammals frequently found in deciduous forests, and scattered rock outcrops within these forests provide habitat for woodrats and other small mammals. Common reptiles include eastern box turtle, ring-necked snake, black rat snake, and copperhead.

One wading bird colony and one cave have been documented within 3 miles of the project area. The wading bird colony is approximately 2.4 miles from the project area, on the opposite side of the reservoir and along a cove. The cave is located approximately 1.6 miles from the project area, also on the opposite side of the Reservoir, and inland.

Watts Bar
Natural habitat within the environmental impacts study area includes isolated patches of herbaceous vegetation (i.e., mowed lawns adjacent to infrastructure) in an otherwise heavily developed setting. Given the fragmented and highly maintained nature of this habitat, presence of wildlife likely is limited. Such areas may provide habitat for eastern bluebird, American robin, brown thrasher, eastern kingbird, field sparrow, and song sparrow. Small mammals such as eastern mole, white-footed mouse, and prairie vole, and larger mammals such as eastern cottontail, woodchuck, common raccoon and white-tailed deer may be present on occasion is not deterred by human presence and activity. Predators that hunt small mammals in these areas include red fox, coyote, snakes, and raptors such as American kestrel and red-tailed hawk. Reptiles often found in early successional habitats include black racer, black rat snake, milk snake, and common garter snake.

Three wading bird colonies and no caves have been documented within 3 miles of the project area. The closest colony is approximately 0.6 miles away, along Yellow Creek. The other two colonies are along the reservoir.

3.7.8 Transportation

Browns Ferry

U.S. Highway 72 (US 72), which runs east-west approximately 6 miles north of the BFN site is the nearest four-lane highway. US 31, another four-lane road, runs north-south approximately 9 miles from BFN. Primary access to BFN from US 72 is via two-lane County Road 20, also known as Shaw Road. Access to the site from Athens is from Browns Ferry Road and Nuclear Plant Road. Nuclear Plant Road (County Road 20) intersects with US 31 approximately 9 miles from BFN.

BFN is located on the north bank of Wheeler Reservoir adjacent to the main navigation channel. Currently, BFN has no formal barge terminal facilities. However, there are two locations along the plant waterfront that are suitable for offloading barges.

Sequoyah

U.S. Highway 27 (US 27) is the major arterial highway in the vicinity of SQN. SQN personnel access the site from US 27 or from State Road 319 (SR 319) – also known as Hixson Pike, via the Sequoyah Access Road. The Sequoyah Access Road runs eastward from US 27 and intersects with SR 319 near SQN.

SQN maintains a single-barge slip at TRM 485, immediately upstream of the plant water intake. There are no fixed crane facilities at the barge facility.

Watts Bar

Road access to WBN is from SR 68, a two-lane highway. Approximately 6 miles west of WBN, US 68 intersects with the four-lane US 27. Approximately 4 miles eastward, SR 68 intersects SR 58, a two lane road that connects Kingston and Chattanooga. SR 68 continues eastward and intersects Interstate 75 approximately 15 miles from WBN.

WBN is located approximately 2 miles downstream of Watts Bar Dam Lock and Dam. A series of mooring cells associated with the now-demolished Watts Bar Fossil Plant are located at TRM 529. There are no fixed crane facilities at this site. WBN is located on the north side of the Tennessee River (i.e., the upper reaches of Chickamauga Reservoir). The main navigation channel and sailing line leading to the lock are near the east bank. A series of federal mooring cells are located on the downstream side of the Watts Bar Lock.

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CHAPTER 4 – ENVIRONMENTAL CONSEQUENCES

This chapter contains a discussion of the anticipated potential effects of implementing the two alternatives considered. As described in Section 2.1.1, TVA would not implement the actions required under NRC Order NRC-12-049 under the No Action Alternative. Conversely, under the Action Alternative, TVA would implement these required actions (see Section 2.1.2).

Actions Not Considered in Detail

The following specific actions proposed under the Action Alternative either do not have the potential to cause effects to the environment or such environmental effects would be *de minimis*. Therefore, the potential effects of the following actions were not analyzed in detail in this environmental review. In those cases where inspections or evaluations indicate the need for remedial actions, those specific actions would be subjected, as appropriate, to additional environmental review under NEPA at the point that the recommended action is clearly defined and proposed for implementation. Those actions that were not analyzed in detail are listed below under their corresponding NTTF recommendation.

***Seismic and Flood Hazard Re-evaluations* (NTTF Recommendation 2.1)**

- Inspect the BFN, SQN, and WBN plant sites and prepare a Hazard Assessment Report to re-evaluate flooding hazards.
- Use Seismic Probabilistic Risk Assessment methods at BFN, SQN, and WBN to evaluate probabilities and consequences of various scenarios associated with seismic risks.
- Resolve Individual Plant Examination of External Events outliers under NTTF Recommendation 2.3.
- Work with the Electric Power Research Institute to determine the need for better definition of onsite geotechnical properties at BFN, SQN, and WBN.
- Continue working with the Nuclear Energy Institute and the Electric Power Research Institute to better understand the risk assessment process and develop effective plans.

***Seismic and Flood Walkdowns* (NTTF Recommendation 2.3)**

- Conduct flood walkdowns of all systems, structures, and components at WBN, SQN, and BFN designed to withstand a design basis flood.
- Evaluate the procedural effectiveness for monitoring, maintenance, and responding to a flood within the current design basis.
- Implement NRC guidance to inspect equipment necessary to achieve safe shutdown of the plant, SFP, and the UHS equipment.
- Evaluate procedural effectiveness for responding to design basis earthquakes.

***SBO Regulatory Actions and Equipment Covered under 10 CFR 50(hh)(2)* (NTTF Recommendation 4.1 and 4.2)**

- Develop a strategy for deploying and operating FLEX pumps at BFN, SQN, and WBN.

- Develop a Control Room lighting strategy for BFN, SQN, and WBN.
- Develop a strategy for coping with the loss of pneumatic supply to the Main Steam Relief Valves/Containment Atmospheric Dilution tank upgrade.
- Develop a strategy for extended battery coping capability at all three plant sites.
- Develop upgraded procedures for coping with an ESBO at all three sites.
- Develop procedures for direct current-backed instrumentation for dry well temperature and suppression pool levels at all three sites.
- Develop strategies for re-powering the integrated computer system to mitigate SBO (use 225-kVA diesel generators or 3-MW diesel generators) at BFN, SQN, and WBN.
- Develop a strategy for Reactor Core Isolation Cooling/High Pressure Coolant Injection and evaluate equipment reliability and strategies for enduring extended loss of AC power.
- Provide UPSs for radio repeater systems.
- Develop a strategy for maintaining business systems and computer access.

Reliable Hardened Vent Systems Mark I Containment Systems for BWRs (NTTF Recommendation 5.1)

- Work with the Boiling Water reactor Operators Group to develop modifications to prevent cross-flow between units and to provide for the simultaneous venting of all units at BFN.

Spent Fuel Cooling (NTTF Recommendation 7.1)

- Install instrumentation in the SFP to allow remote indication of pool levels at BFN, SQN, and WBN.

Strengthening and Integration of EOPs, SAMGs, and EDMGs (NTTF Recommendation 8.0)

- Develop and implement plant-specific emergency procedures, to be implemented by 2016.

Emergency Preparedness Regulatory Acton (NTTF Recommendation 9.3)

- Assess current communications and equipment used during an emergency to ensure power is maintained during a large-scale natural event.

Actions Considered in Detail

Unlike those actions mentioned above, several of the actions described in Section 2.1.2 have the potential to affect the environment because they involve ground-disturbing activities (e.g., construction of new buildings and facilities) or have the potential to produce waste streams during their construction or operation. These actions are listed below under their respective NTTF recommendations.

Seismic and Flood Hazard Walkdowns (NTTF recommendation 2.3)

- Implement DCN T40717A to replace the diesel generator shutdown board PCB-containing transformers at BFN

SBO Regulatory Actions and Equipment covered Under 10 CFR 50.54(hh)(2) (NTTF Recommendations 4.1 and 4.2)

- Construct a FLEX equipment storage building with associated equipment at BFN, SQN, and WBN (see Section 2.1.2).
- Install as many as three 225-kVA diesel generators on the roofs of existing buildings at BFN, SQN, and WBN.
- Harden the CSTs and piping at BFN, SQN, and WBN. Options being considered include constructing concrete or metal enclosures for the existing CSTs or constructing replacement CSTs having more robust designs. Other options for mitigating damage to the CSTs, such as constructing moats or dikes around the CSTs are also being considered.
- Conduct general construction-type activities associated with minor upgrades to existing systems. These could include excavation for building foundations or piping/conduit, soil borings, installation of buried pipes, wires or other structures, installation of concrete or metal foundations/footings, covering of bare ground with pavement or gravel, and the temporary installation of work trailers.

Reliable Hardened Vent Systems Mark I Containment Systems for BWRs (NTTF Recommendation 5.1)

- At BFN, either discard or resize the current common vent configuration or separate the vent system into vent headers that discharge to the plant stack or other elevated plant structure. Remove the existing common vent pipe and construct three new pipes (one for each unit) between the wet well and the stack. Add associated components and other minor equipment to existing buildings.
- Provide a remote station to house a pneumatic supply to allow manual operation from a safe location at BFN.
- Modify the BFN effluent radiation monitor to maintain operation during ESBO or install a new monitoring system with UPS.
- Install one or more roughing filters to remove contaminants from the vent gases at BFN. The location of the filters will be selected to minimize any radiological impacts to site personnel.

4.1 Air Quality and Greenhouse Gases

4.1.1 No Action Alternative

Under the assumption that current operations would continue indefinitely under the No Action Alternative, there would be no additional direct consequences with respect to air quality or the production of greenhouse gasses.

However, if NRC were to revoke TVA's operating licenses for BFN, SQN, and WBN, additional sources of the baseload power produced by these facilities would be required. Because of the speculative nature of the fuel source for producing this power, any changes in air quality and the production of greenhouse gasses cannot be determined accurately. However, use of nuclear fuels has virtually no effect on air quality and does not produce greenhouse gasses. Because generation using conventional fuels (e.g., fossil fuels such as coal, oil, and natural gas) would likely be used to offset most of the loss in generation

capacity, adverse effects to air quality and the production of GHGs would be more likely following the implementation of the No Action Alternative if TVA were to lose its ability to operate BFN, SQN or WBN.

4.1.2 Action Alternative

Transient air pollutant emissions would occur during construction activities. Construction-related air quality impacts are primarily related to site preparation and the operation of internal combustion engines.

Site preparation and vehicular traffic over paved and unpaved roads at construction sites would result in the emission of fugitive dust particulate matter during active construction periods. The largest fraction (greater than 95 percent by weight) of fugitive dust emissions would be deposited within the immediate area of construction (Buonicore and Davis 1992). If necessary, dust emissions from open construction areas and paved/unpaved roads would be mitigated by spraying water on the roadways (see Section 2.3).

Combustion of gasoline and diesel fuels by internal combustion engines in vehicles, construction equipment, etc. would generate local emissions of particulate matter, nitrogen oxides, carbon monoxide, volatile organic compounds, sulfur dioxide, and GHGs during the site preparation and construction period. The total amount of these emissions would be small and would result in minimal off-site effects to air quality.

Air quality effects from construction activities would be temporary, and they depend on both man-made factors (intensity of activity, control measures, etc.) and natural factors such as wind speed and direction, soil moisture, etc.). However, even under unusually adverse conditions, these emissions would have, at most, a minor transient impact on off-site air quality and would be well below the applicable ambient air quality standard. Overall, the air quality impact of construction-related activities for the project would be minor.

The proposed emergency generators would be started and run a short time periodically to ensure their availability for service. The contribution of air pollutants and GHGs from this periodic testing would be minor. Similarly, the additional amount of GHGs produced from periodic testing and from construction is expected to be minor and under the 25,000 tons per year major source threshold.

4.2 Solid, Hazardous, and Radiological Waste

4.2.1 No Action Alternative

Under the No Action Alternative, TVA would continue to operate BFN, SQN, and WBN in accordance with existing regulatory requirements and according to current operating procedures. Thus, no changes in the amounts of waste generated or the types of waste are anticipated under the No Action Alternative.

4.2.2 Action Alternative

Under the Action Alternative, TVA would continue to handle all wastes generated at BFN, SQN, and WBN in accordance with currently applicable regulations and TVA environmental procedures. Construction of the FLEX equipment storage buildings and the vent upgrades would generate some construction debris. However, this volume of solid waste is not expected to change TVA's waste generation status at any of the three sites. Some low-level radioactive waste could be produced from the vent upgrades at BFN. This waste would be handled in accordance with existing procedures.

4.3 Floodplains and Flood Risk

The floodplains and flood risk assessment involves ensuring that facilities would be sited to provide a reasonable level of protection from flooding. In doing this, the requirements of Executive Order 11988 (Floodplain Management) would be fulfilled. Due to the fact that buildings and facilities associated with the proposed actions would be located at nuclear generating facilities, the NRC requires a flood risk evaluation of possible impacts from the Tennessee River PMF and PMP site drainage for all alternatives.

4.3.1 No Action Alternative

Under the No Action Alternative, modifications to existing facilities and the proposed new construction would not occur. Therefore, there would be no direct, indirect, or cumulative impacts to floodplains because there would be no physical changes to the current conditions found within the local floodplains. Any future projects or actions would be reviewed when they are proposed.

4.3.2 Action Alternative

None of the activities listed under this alternative would be located within the 100-year floodplain or below the TVA Flood Risk Profile elevation. Thus, these actions would be consistent with Executive Order 11988.

None of the actions proposed under the Action Alternative would have any direct effect on the ability to access the UHS at any of the three plants. In the event of a drastic reduction in reservoir level, flow and water levels would afford adequate supplies of cooling water at each of the plants.

The Tennessee River baseline PMF elevation at WBN is 739.2 feet msl. Wind-driven wave action could increase the controlling PMF elevation to 742.3. At WBN, fill material would be placed in the area such that the FLEX equipment storage building floor elevation would be at least 742.3 feet msl. Site drainage at the location of the WBN FLEX equipment storage building is to the northeast. Thus, the placement of fill would not adversely affect PMP site drainage with respect to the plant.

The FLEX equipment storage buildings at BFN and SQN would be located on positions of high ground at each site. Additional site fill would be placed such that the floor elevation of the storage building at BFN would be 583.5 feet msl and the SQN FLEX equipment storage building floor elevation would be 733 feet msl. These elevations are above the Tennessee River baseline PMF elevation (i.e., 572.5 feet msl at BFN and 722.0 feet msl at SQN) and the controlling PMF elevations (578.0 feet msl for BFN and 726.2 feet msl for SQN). Placement of fill at BFN and SQN would not adversely affect PMP drainage patterns.

The 225-kVA diesel generators would be located on the roofs of existing buildings at BFN, SQN, and WBN which would be well above the PMF elevation. The FLEX equipment storage buildings and the diesel generators would not be located within the PMP site drainage areas and would therefore not adversely impact PMP elevations.

Hardening the CSTs, which are located in the plant yard, would prevent their being damaged by the PMF and allow them to function during and after a flood or other Beyond Design Basis event. At this time, several alternatives are being considered for hardening the existing CSTs as well as constructing new, more robust CSTs. Plans could also include a retention basin to contain the water from the tanks in the event of a tank failure. The existing CSTs and the new CSTs may be located within the PMP site drainage areas at

each plant. Once the decision is made regarding the preferred CST alternative, the specific projects would be evaluated to ensure that the CSTs would not be adversely impacted by a PMF event and that they do not adversely affect the PMP site drainage elevations.

Some of the general construction activities associated with NTTF Recommendation 4.2 (see Section 2.1.2) could have the potential to affect site PMP drainage. Examples of such activities include excavation for building foundations where the footprint of the existing building or structure is enlarged, installation of footings or foundations, placement of gravel, and the installation of trailers. Therefore, general construction activities at all sites would be evaluated as they are identified to ensure that the proposed structures would not be adversely impacted by a PMF event or result in unacceptable increases to the PMP site drainage elevations at that site.

At BFN, the Mark I vent systems would be modified and one or more filter buildings would be constructed. The vent pipes would be located underground and would not be adversely impacted by a PMF. Although the site i.e., the "footprint," of the filter building would be below the PMF elevation, the building would be elevated above the PMF elevation or sited at a location above the PMF elevation (578.0 feet msl).

4.4 Wetlands

4.4.1 No Action Alternative

Under the No Action Alternative, existing conditions at the three nuclear plants would not change with respect to wetland resources. There would be no effects to wetlands associated with implementing this alternative.

4.4.2 Action Alternative

The programmatic actions that would be undertaken under this alternative would have no impacts to wetlands. Construction activities associated with FLEX equipment storage buildings and upgrades of existing equipment would have no impacts on wetlands, as there are no wetlands located within the proposed project areas on each plant site.

4.5 Threatened and Endangered Species

4.5.1 No Action Alternative

Under the No Action Alternative, operations at BFN, SQN, and WBN would continue, at least in the near term, under current conditions, guidelines and procedures. Because no known occurrences of sensitive plant species occur within the footprint of the three nuclear facilities, no impacts to threatened and endangered plant species are expected as a result of implementing the No Action Alternative.

Likewise, impacts to endangered and threatened terrestrial or aquatic animal species are not expected. The status and conservation of the potentially affected listed species would continue to be determined by the actions of others. Therefore, there would be no direct, indirect, or cumulative impacts to endangered and threatened terrestrial animal species and their critical habitats under the No Action Alternative.

4.5.2 Action Alternative

With the exception of building concrete FLEX equipment storage buildings at each nuclear facility, the hardening of the CSTs, and vent pipe work at BFN, all the other actions within this alternative would not require soil disturbance that could impact any threatened or endangered plant species. Because no known occurrences of federally or state-listed plant

species or habitat to support these species are known on or immediately adjacent to the action areas at BFN, SQN, and WBN, implementing the proposed actions that would require soil disturbance would also have no impacts to such plant species. No indirect or cumulative impacts are anticipated to these botanical resources as a result of adopting the Action Alternative.

No bald eagle nests have been documented in any of the study areas. Although suitable nesting habitat within the environmental impact study areas at each site is minimal and limited to the edge of the study areas at BFN and SQN, adjacent to the reservoirs, such habitat would not be impacted by the proposed actions. No suitable nesting habitat for bald eagle is present within the environmental impact study area at WBN. Because of the intervening distance to known eagle nest sites, disturbance from the proposed actions is not expected to affect documented eagle nesting (USFWS 2007). Suitable cave habitat for gray or Indiana bat does not exist within any of the study areas, and any potentially suitable summer roosting habitat for Indiana bat would not be impacted by proposed actions. Suitable habitat for hellbender or meadow jumping mouse does not exist within any of the environmental impact study areas. Therefore, these species and their habitats would not be affected by implementation of the proposed Action Alternative.

Because all actions would occur on land and because appropriate best management practices would be followed, no direct or indirect impacts to threatened and endangered aquatic species within the vicinity of BFN, SQN or WBN would occur.

4.6 Cultural Resources

4.6.1 No Action Alternative

Implementation of The No Action Alternative would have no effects to historic properties at the BFN, SQN, or WBN environmental impact study areas because no ground-disturbing activities are associated with this alternative.

4.6.2 Action Alternative

The construction or installation of the necessary onsite equipment to cope with ESBO events would have no effects on historic properties at BFN, SQN, or WBN. Although the construction of an onsite FLEX equipment storage building and installation of diesel generators may produce visual changes within the viewshed of the NRHP-eligible BFN plant, these changes would not cause effects to the plant because the characteristics from which the plant derives its eligibility for listing on the NRHP do not include architectural qualities. Because the viewshed of the proposed actions has been impacted previously by major industrial development, TVA determined that the proposed actions do not have the potential for visual impacts to any architectural resources within the environmental impact study area or in a direct line of sight to the environmental impact study area at BFN. There are no historic architectural properties at SQN or WBN. In addition, the proposed actions would cause no disturbances to the Cox Cemetery at BFN or the Igou Cemetery at SQN.

The proposed drilling of boreholes or other proposed soil-disturbing activities would occur at the location of the proposed FLEX equipment storage buildings, CSTs, and along existing roadways with the plant sites. No intact archaeological resources or historic properties have been identified at those locations in any of the three study areas. Therefore, the proposed activities under the Action Alternative would have no effects on historic properties.

4.7 Other Environmental Resources

4.7.1 Radiological Concerns

Under the No Action Alternative, TVA would continue to operate BFN, SQN, and WBN in strict accordance with applicable NRC regulations, laws, and internal TVA procedures.

TVA would continue to operate BFN, SQN, and WBN in strict accordance with applicable regulations and internal procedures under the Action Alternative. Because certain measures were included in the basic design of each plant, and because specific operating procedures are implemented, the probability of accidental releases of radioactive materials has been minimized to the extent feasible.

Although the likelihood of accidents or natural disasters is remote, the probability of such an event cannot be reduced to zero. One of the lessons learned from the Fukushima event was that post-event situations can exacerbate or confound the ability to perform a safe shutdown or return a nuclear plant to normal operations.

The proposed work on the existing vent system at BFN could generate some low-level radioactive waste. However, appropriate internal procedures would be following in handling and disposal of this material. Implementing the proposed actions under the Action Alternative would provide an extra margin of operational flexibility in coping with an emergency situation. Thus, implementing the Action Alternative would reduce the likelihood of a release of radioactive materials following a Beyond Design Basis event.

4.7.2 Seismic Risk

Under The No Action Alternative, TVA would continue to operate BFN, SQN and WBN under current procedures. The current design basis with respect to seismic stability would not be changed under either alternative. Thus, measures would not be taken at this time to strengthen existing structures to better allow them to withstand a seismic event. The existing facilities have been constructed to design basis, including withstanding seismic events such as the operating basis earthquake and the safe shutdown earthquake.

Under the Action Alternative, TVA would take measures that would facilitate the continued operation of the three nuclear plants, primarily by mitigating circumstances or conditions that could exacerbate conditions following a Beyond Design Basis event. These measures would improve TVA's ability to cope with seismic events at BFN, SQN, and WBN.

4.7.3 Visual and Aesthetic Character

Under the No Action Alternative, no new structures or buildings would be constructed, and no changes in current operations are anticipated. Therefore, no changes in the visual character or in ambient noise levels are anticipated under this alternative.

Under the Action Alternative, a FLEX equipment storage building would be constructed at each nuclear site along with the placement of emergency diesel generator on the roofs of existing onsite structures. The addition of these structures would result in minor changes in the existing industrial setting. The diesel generators would be enclosed and would resemble commercial roof-mounted heating ventilation and air conditioning units. Therefore, they are not expected to cause a noticeable contrast to the present visual character of the site.

Construction activities associated with building the FLEX equipment storage buildings, installing the roof-mounted emergency diesel generators, hardening the CSTs, and the changes to the vent system at BFN would pose temporary changes in visual character. However, these changes would be limited to the duration of the construction. Although there would be some changes in the existing visual character of each site, these changes would be minor.

Construction activities would generate noise, but this noise would be temporary. Noise levels generated under the Action Alternative are not expected to exceed the ambient onsite noise levels by any noticeable amount at any of the three sites.

4.7.4 Socioeconomics and Environmental Justice

Under the No action Alternative, all three plants would continue normal operations, at least for the near term. Assuming indefinite continued operation of all three plants, no effects to local socioeconomic conditions are likely. However, if NRC were to revoke operating licenses for the plants based on non-compliance, direct, long-term effects to the local economy are likely, as most of the workers currently employed at the plants would be displaced.

Any noticeable adverse social or economic impacts resulting from implementing the Action Alternative would occur on or near the sites. The immediate area around all the sites is sparsely populated, with a small minority population. Noticeable impacts to road traffic are unlikely. Any such impacts would occur only for a short time (see Section 4.9.6) and would have no disproportionate impacts to disadvantaged populations. A small positive effect to some local businesses, such as restaurants, could occur due to the presence of additional construction workers on site. Overall, these impacts would be small and temporary. In addition, there would be some permanent increase in the safety level for plant personnel and the surrounding community under the Action Alternative.

4.7.5 Groundwater

Implementation of the No Action Alternative is not expected to cause any additional effects to groundwater resources at any of the three plant sites.

Implementation of the Action Alternative would not involve activities that could typically adversely affect groundwater. However, diesel generators would be installed at each site, and fuel spills have the potential to affect groundwater. Appropriate spill control measures, such as using double-walled pipes for buried fuel lines, would be implemented to reduce the likelihood of spills and groundwater contamination. Additionally, the integral fuel tanks used for the generators would be double-walled, which would reduce the likelihood of spills. With these protective measures in place, any potential effects to groundwater resources under the Action Alternative would be minor.

4.7.6 Surface Water and Aquatic Life

Under the No Action Alternative, no changes to current environmental conditions at BFN, SQN, and WBN are likely. Thus, there would be no change in the current status of surface waters, aquatic life, and conditions near the project areas.

Under the Action Alternative, TVA would implement the actions described in Section 2.1.2. Because all of the proposed actions would occur on land and appropriate best management practices would be implemented during construction, no direct or indirect

impacts to the surrounding aquatic life at each site are likely to occur from implementation of the proposed action.

Soil disturbances associated with construction activities, including the drilling of bore holes for seismic testing, can potentially result in adverse water quality effects. Soil erosion and sedimentation can clog small streams and threaten aquatic life. Removal of the tree canopy near water bodies can increase water temperatures, algal growth, dissolved oxygen depletion, and adverse impacts to aquatic biota. Improper use of herbicides to control vegetation could result in runoff to streams and subsequent effects to aquatic life.

TVA routinely includes precautions in the design, construction, and maintenance of facilities to minimize these potential impacts. Construction and maintenance activities would comply with applicable state permit requirements and TVA requirements as described in Muncy (2012). With the proper implementation of these measures, implementation of the proposed actions is expected to result in only minor temporary impacts to surface waters. No cumulative impacts to surface water quality are anticipated.

4.7.7 Vegetation and Wildlife

Under the No Action Alternative, operations at BFN, SQN, and WBN would continue, at least in the near term, under current conditions, guidelines, and procedures. No impacts to local terrestrial plant communities are expected as a result of implementing the No Action Alternative. For similar reasons, there would be no direct, indirect, or cumulative impacts to local wildlife or wildlife habitats under the No Action Alternative. However, the potential for the continued spread of exotic invasive plants in areas of disturbance around BFN, SQN, and WBN facilities would likely persist.

Under the Action Alternative, TVA would implement actions at BFN, SQN, and WBN to avoid or mitigate the effects of a severe accident. Given the limited availability and quality of natural habitat present within the environmental impacts study areas at each of the three sites, potential impacts to wildlife resulting from proposed activities (e.g., noise, surface water runoff, groundwater runoff, and ground disturbance) are expected to be minimal and temporary. The overall nature of habitat currently present would not change, in that herbaceous vegetation present would still be present, and forest vegetation, where present, also would remain. The proposed actions are expected to result in minor direct, indirect, or cumulative impacts to terrestrial wildlife or their habitats.

Because of the intervening distance, the proposed construction activities are not expected to affect the cave or wading bird colony near SQN.

Because virtually the entire project footprint at BFN, SQN, and WBN occurs on lands with previous disturbances to the native plant communities due to facility operations, potential effects to these areas as a result of implementing the Action Alternative are expected to be minor. Because no uncommon terrestrial communities or otherwise unusual vegetation occurs on the lands to be disturbed under the Action Alternative, no adverse effects to the wildlife and vegetation of the region are anticipated. However, the proposed construction activities would result in soil disturbances that could potentially be a vector for the introduction and spread of invasive species. In order to comply with Executive Order 13112, disturbed areas requiring revegetation would be revegetated as appropriate with native or non-native, non-invasive species to prevent the introduction or spread of invasive plant species.

4.7.8 Transportation

Under the No Action Alternative, the three nuclear plants would continue current operations. No changes in current transportation patterns or traffic loads are anticipated under this alternative.

Under the Action Alternative, various construction materials and equipment would be delivered to the three plant sites. Surface delivery by truck is the most likely means of transporting these materials. The largest pieces of equipment would be the 3-MW diesel generators, which would be delivered by flatbed truck. No special arrangements requiring detours or road closures are anticipated. No deliveries of materials or equipment by barge are anticipated; thus, there would be no effects to navigation.

Construction of structures and facilities under the Action Alternative could involve additional onsite workers. The number of onsite workers at each of these plants tends to fluctuate by several hundred, depending on site-specific activities. The number of workers associated with the proposed construction would be well within these normal work force fluctuations. Therefore, no major changes to local traffic loads in the vicinity of BFN, SQN or WBN are anticipated. Soil borings along existing plant roadways are not expected to pose any major traffic problems due to the temporary nature of this action and because onsite traffic could be re-routed temporarily, as necessary. Therefore, any potential effects to local transportation resources are expected to be temporary and minor under the Action Alternative.

4.8 Cumulative Impacts

Cumulative effects are those that tend to accumulate, sometimes over time. Because of the nature of the proposed actions, few cumulative impacts are likely. Construction of new structures and facilities on the three sites would cause a minor cumulative effect to the current visual character of the sites.

4.9 Unavoidable Adverse Environmental Impacts

Construction activities associated with the Action Alternative would cause minor, temporary adverse effects to air quality in the form of fugitive dust and exhaust emissions from construction equipment. Similarly, removal and hauling of construction debris off site would produce vehicular exhaust emissions and contribute a minor amount of additional truck traffic on local roadways. However, these cumulative effects are expected to be minor.

4.10 Relationship of Short-Term Uses and Long-Term Productivity

The plant sites at BFN, SQN, and WBN will be used exclusively for the purpose of generating electric power for the foreseeable future. Much of these plant sites, including the protected areas at each site, is occupied by generating equipment and associated facilities. However, some portions of the sites outside the protected areas are vacant, undeveloped areas. Activities proposed under the Action Alternative would occur within the more developed areas on the respective plant sites.

Thus, no loss of productivity of natural resources such as timber, minerals, or other extractable resources is anticipated. Likewise, use of a portion of the BFN, SQN, and WBN plant sites for the proposed facilities is not expected to result in any short-term or long-term loss of productivity of these sites.

4.11 Irreversible and Irretrievable Commitments of Resources

As used here, irreversible commitments of resources include the use or consumption of non-renewable resources as a result of a decision or implementing a proposed action. For example, extraction of ore is an irreversible commitment. Irretrievable commitments involve the use or commitment of resources for a period of time, even a long period. An example of an irretrievable resource commitment is the loss of timber production on a newly-cleared transmission line right-of-way through a previously forested area. In that case, removal of the transmission line and the right-of-way would eventually result in the restoration of forest land and timber productivity.

Certain activities associated with the Action Alternative, especially those involving construction of facilities and the operation of heavy equipment would result in the irreversible commitment of certain fuels, energy, building materials, and process materials. TVA's use of portions of the BFN, SQN and WBN sites for new facilities and equipment would constitute a cumulative irretrievable commitment of land resources and land use for the life of the respective nuclear plants.

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