CHAPTER 9 ALTERNATIVES

Chapter 9 identifies and describes alternatives for siting, constructing and operating two or more Small Modular Reactors (SMRs) at the Clinch River Nuclear (CRN) Site as a demonstration of this new technology. The proposed federal action is the issuance, under the provision of Title 10 of the Code of Federal Regulations Part 52, of an Early Site Permit (ESP) to the Tennessee Valley Authority (TVA) approving the CRN Site as a suitable site for future demonstration of the construction and operation of two or more SMRs. TVA's goal in preparing the ESP application (ESPA) is to obtain U.S. Nuclear Regulatory Commission (NRC) approval of the CRN Site and to minimize the amount of additional environmental review needed for a combined license application (COLA). In addition, the submittal of an ESPA will allow TVA and NRC to address any unique issues that may be associated with the COLA for the Clinch River (CR) SMR Project, thereby establishing that an SMR demonstration project is a viable option. The alternatives described in Chapter 9 are shaped by TVA's unique objective, which is to demonstrate and deploy first-of-its-kind SMR technology within its power service area.

The descriptions in this chapter provide sufficient detail to facilitate the evaluation of the impacts of the various alternatives. Chapter 9 is divided into four sections:

- No-Action Alternative (Section 9.1)

  Section 9.1 describes the environmental impact if an ESP is not issued and the SMRs are not constructed or operated.

- Energy Alternatives (Section 9.2)

  Section 9.2 is not included as part of the ESPA. The Energy Alternatives discussion is provided at COLA.

- Alternative Sites (Section 9.3)

  Section 9.3 describes and evaluates the alternative sites considered for the CR SMR Project.

- Alternative Plant Systems (Section 9.4)

  Section 9.4 describes and evaluates plant and transmission system alternatives for the SMRs.

9.1 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, the U.S. Nuclear Regulatory Commission (NRC) would not issue an Early Site Permit (ESP) for two or more small modular reactors (SMRs) at the Clinch River Nuclear (CRN) Site and Tennessee Valley Authority (TVA) would not pursue a demonstration of SMR technology as a viable option for electric power production at the CRN Site. In accordance with NUREG-1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plans*, the No-Action Alternative presupposes that no other similar facility would be built by TVA and no other similar strategy would be implemented by TVA to take its place. The environmental impacts associated with the CR SMR Project would not occur since the SMRs would not be constructed and operated at the CRN Site. Under the No-Action Alternative, the CRN Site would remain relatively unused and TVA would continue to manage the CRN Site for the specified land uses (Sensitive Resources Management and Project Operations). TVA would continue routine maintenance and clearing associated with the transmission lines that traverse the CRN Site. In addition, the Tennessee Wildlife Resource Agency's permit for use of TVA land for controlled hunting could be reinstated.

Under the No-Action Alternative, TVA would not have access to the energy-generating capacity of the CR SMR Project and would not be able to meet the objectives of the CR SMR Project:

- Power generated by SMRs could be used for addressing critical energy security issues. *TVA would not demonstrate that the use of SMR technology on or immediately adjacent to U.S. Department of Defense (DoD) or U.S. Department of Energy (DOE) facilities could provide secure electric power in the event of a national emergency without relying on a regional grid system. In addition, TVA would not demonstrate that SMR technology could potentially provide long-term, sustainable energy solutions to the DoD and DOE under Executive Order (EO) 13636 and Presidential Policy Directive 21, which were designed to strengthen the security and resilience of critical infrastructure against evolving threats and hazards (Reference 9.1-1)*.

- SMR technology can assist federal facilities with meeting carbon reduction objectives. *TVA would not demonstrate the ability of SMR technology to meet greenhouse gas emission reduction goals for federal agencies established by EO 13514 and EO 13693*. (Reference 9.1-2; Reference 9.1-3)

- SMR design features include underground containment and inherent safe-shutdown features, longer station blackout coping time without external intervention, and core and spent fuel pool cooling without the need for active heat removal. *TVA would not demonstrate SMR advancements in safety by eliminating design basis accident scenarios based on the incorporation of these key features. TVA would not demonstrate SMR advancements in security by development of a security–informed design which would provide the same or better protection against the threats large reactors must consider.*

- SMR power generating facilities are designed to be deployed in an incremental fashion to meet the power generation needs of a service area. *TVA would not demonstrate the incremental deployment of SMR technology to match load growth projections.*

Additionally, the No-Action Alternative would not result in the creation of new jobs, whereas construction and operation of SMRs at the CRN Site could result in hundreds of temporary and permanent new jobs, both direct and indirect. This increase in employment and procurement of needed goods and services associated with operation of SMRs at the CRN Site could inject millions of dollars into the regional economy. Although the No-Action Alternative would not result in the environmental effects that the proposed CR SMR Project would cause, the substantial technological and financial benefits to the local community, Tennessee Valley, and the nation that would result from the construction and operation of first-of-its-kind SMRs would not be realized under the No-Action Alternative. Therefore, construction and operation of the CR SMR Project is preferable to the No-Action Alternative.

9.1.1 References

Reference 9.1-1. The White House, "Executive Order 13636 - Improving Critical Infrastructure Cybersecurity," EO 13636, February 19, 2013.

Reference 9.1-2. The White House, "Executive Order 13514: Federal Leadership in Environmental, Energy, and Economic Performance," The White House, Office of the Press Secretary, EO 13514, October 5, 2009.

Reference 9.1-3. The White House Council on Environmental Quality, "Implementing Instructions for Executive Order 13693 Planning for Federal Sustainability in the Next Decade," June 10, 2015.

9.2 ENERGY ALTERNATIVES

This section is not required for an Early Site Permit Application.

9.3 ALTERNATIVE SITES

The Tennessee Valley Authority (TVA) is a corporate agency of the United States that provides electricity for business customers and local power distributors serving nine million people in parts of seven southeastern states. As authorized by the Tennessee Valley Authority Act, TVA is committed to maintaining a national leadership role in technological innovation (Reference 9.3-1). As part of this mission, TVA is working to meet future demand for cleaner power by developing technologies that will generate electricity in ways that are renewable and efficient.

In 2013, Executive Order (EO) 13636 was issued on *Improving Critical Infrastructure Cybersecurity* and *Presidential Policy Directive (PPD) 21 on Critical Infrastructure Security and Resilience* (Reference 9.3-2). EO 13636 and PPD-21 are designed to strengthen the security and resilience of critical infrastructure against evolving threats and hazards. More recently, EO 13693 was issued on *Planning for Federal Sustainability in the Next Decade* (Reference 9.3-3). EO 13693 specifically addresses the reduction of greenhouse gas (GHG) emissions and alternative energy sources such as small modular reactors (SMRs) (Reference 9.3-4). In response to EOs 13636 and 13693 and PPD-21, TVA is proposing to demonstrate and evaluate SMR technology as a way to supply federal mission-critical loads with reliable power from generation and transmission that is less vulnerable to supply disruption from intentional destructive acts and natural phenomenon than typical commercial power generation facilities and transmission systems.

This section identifies and evaluates a set of alternatives to the TVA Clinch River Nuclear (CRN) Site. The purpose of this evaluation is to verify that a reasonable suite of candidate sites has been considered, and that there is no “obviously superior” site for the eventual construction and operation of two or more SMRs.

The objectives of the Clinch River (CR) SMR Project served as an initial basis for the alternative site selection process. As stated in Section 1.1, these objectives are to demonstrate that:

- Power generated by SMRs could be used for addressing critical energy security issues. Their use on or immediately adjacent to U.S. Department of Defense (DoD) or U.S. Department of Energy (DOE) facilities, using robust transmission (e.g., armored transformers, underground transmission), could address national security needs by providing reliable electric power in the event of a major grid disruption. A more reliable electric power supply could be accomplished by the SMR operation in “power island” mode with robust transmission to critical facilities. In addition, intentional destructive acts (e.g., terrorist attacks) and natural phenomena (e.g., tornadoes, floods, etc.) could disrupt the grid and the ability to restore most generation sources. SMRs can provide reliable energy for extended operation. Because nuclear reactors require fuel replenishment less frequently than other power generation sources (coal, gas, wind and solar), SMRs are less vulnerable to interruptions of fuel supply and delivery systems. TVA could demonstrate this “power islanding” and secure supply concept as part of the CR SMR Project by utilizing controls, switching, and transmission capabilities to disconnect the SMR power plant from the

electrical grid while maintaining power from the SMR power plant to a specified DOE power need. Such a demonstration would show that SMR technology is capable of supplying reliable power that is less vulnerable to disruption from intentional destructive acts and natural phenomena.

- SMR technology can assist federal facilities with meeting carbon reduction objectives. Energy-related carbon dioxide (CO_2) emissions account for more than 80 percent of GHG emissions in the United States. Studies show that on average coal combustion generates approximately 894 to 975 grams of CO_2 per kilowatt-hour (g/kWh) of electricity generated. Natural gas generates an estimated 450 to 519 g/kWh. Nuclear power emission rates have been calculated to range from 6 to 26 g/kWh.
- SMR design features include underground containment and inherent safe-shutdown features, longer station blackout coping time without external intervention, and core and spent fuel pool cooling without the need for active heat removal. These key features advance safety by eliminating several design basis accident scenarios. Development of a security-informed design efficiently provides the same or better protection against the threats large reactors must consider. Physical security is designed into the SMR plant architecture, incorporating lessons learned from significant shifts in security posture since 2001, and the opportunity to build more inherently secure features into the initial design.
- SMR power generating facilities are designed to be deployed in an incremental fashion to meet the power generation needs of a service area. Generating capacity can be added in increments to match load growth projections. For the CR SMR Project, two or more SMRs would be constructed and brought into operation incrementally to achieve up to 800 megawatt electric (MWe).

A significant implication of these objectives is that TVA or its customer must be able to control physical access to both the plant site, including critical infrastructure to operate the plant such as cooling water supply systems, and the transmission facilities linking SMR-generated power to federal customer loads.

Direct-served customers are those customers that purchase their power directly from TVA instead of through a third party power distributor. The six customer locations identified for consideration are:

- Arnold Air Force Base
- Columbus Air Force Base
- Fort Campbell
- Naval Support Activity Mid-South
- Oak Ridge Reservation
- Redstone Arsenal

An overview of TVA's site selection process is depicted in Figure 9.3-1. The process was executed in accordance with guidance provided in the Electric Power Research Institute (EPRI) Siting Guide: Site Selection and Evaluation Criteria for New Nuclear Power Generation Facilities. Subsections 9.3.1 through 9.3.3 provide a summary of the steps in TVA's evaluation of alternative sites; a detailed description of process steps and technical evaluations is provided in the TVA Site Selection Report (Siting Report), November 2016. (Reference 9.3-5)

9.3.1 Identification of Candidate Areas

The TVA Power Service Area was identified as the Region of Interest (ROI) for the SMR Project (Figure 9.3-2). The ROI was screened using exclusionary criteria to eliminate those areas that are either unsuitable or are significantly less suitable than other potential siting areas. These exclusionary criteria were:

- Proximity to Customers (Security Requirements)
- Seismology
- Population Density
- Cooling Water Availability

Details of the application of these criteria in screening the ROI are provided in the Siting Report, Section 3.1.

Results of regional screening are discussed in Section 3.2 and Appendix A of the Siting Report. The outcome of screening was that Arnold Air Force Base, Columbus Air Force Base, Fort Campbell, and Naval Support Activity Mid-South were deferred from further consideration. Thus, regional screening yielded two candidate areas (CA), as follows:

- CA-1 Oak Ridge Reservation (ORR)
- CA-2 Redstone Arsenal

Each candidate area consists of the customer property plus those areas within a 0.5 mile (mi) distance around the property boundary that also met regional screening criteria.

9.3.2 Identification of Potential Sites

As described in Section 4.1 of the Siting Report, TVA applied two independent processes for potential site identification tailored to address federally-owned versus privately-owned components of the candidate areas.

For the federally-owned facilities (ORR and Redstone Arsenal), TVA consulted with the Federal customers to identify sites that:

- Have a contiguous area of 120 acres (ac) for SMR siting, preferably in a square configuration. Site must be able to accommodate a reactor block with sides of 0.4 mi in length.
- Are consistent with TVA's objectives for the project.
- Are consistent with land use plans and other requirements associated with existing missions and activities.

TVA also identified sites that are TVA owned and adjacent to the candidate areas.

To identify potential sites on privately-owned land, TVA canvassed areas within a 0.5-mi buffer around the ORR and Redstone Arsenal boundaries that remained after regional screening for sites that met the 120-ac area requirement and appeared to be suitable for an SMR.

As a result of the potential site identification processes described above, 15 potential sites (8 sites within the ORR Candidate Area 1 and 7 sites within the Redstone Arsenal Candidate Area 2) were identified for further consideration (Reference 9.3-5).

9.3.3 Evaluation of Potential Sites and Identification of Candidate Sites

General siting criteria used to evaluate the Potential Sites were derived from those presented in Chapter 3.0 of the EPRI Siting Guide. The overall process for evaluation of the 15 potential sites, which is detailed in Section 5.1 of the Siting Report, was composed of the following elements.

- Develop criterion ratings for each site.
- Develop weight factors reflecting the relative importance of each criterion.
- Develop composite site-suitability ratings. (Reference 9.3-5)

Composite ratings for the potential site evaluations are shown in Figure 9.3-3.

Based on the results illustrated in Figure 9.3-3, Sites 2, 3, and 8 (Oak Ridge Reservation) and Site 12 (Redstone Arsenal) were selected as candidate sites. These ORR sites ranked highest in the overall composite suitability ratings; the next three ORR sites (10, O1, and 5) were rated similar to one another, but marginally lower than ORR Site 2 (Reference 9.3-5). In addition, ORR Site 8 was ranked highest for wetlands considerations and ranked highest when considering only environmental criteria (i.e., excluding cost and geology/seismology). The environmental criteria evaluated demonstrate that the ORR sites, identified as candidate sites, include those among the best environmental sites that can reasonably be found in the region of interest and those that are favorable from a wetlands impact-avoidance perspective. (Reference 9.3-5)

Redstone Arsenal Site 12 – the top-ranked Redstone Arsenal site – was included to provide geographical and environmental diversity in the detailed environmental comparison of candidate sites. (Reference 9.3-5)

Thus the candidate sites identified were:

- ORR Site 2
- ORR Site 3
- ORR Site 8
- Redstone Arsenal Site 12 (Reference 9.3-5)

The four candidate sites (ORR Sites 2, 3, and 8 and Redstone Arsenal Site 12) are shown on Figures 9.3-4 and 9.3-5.

Although the proposed CRN Site (ORR Site 3) is not on the ORR, it is immediately adjacent to the ORR; therefore, the CRN Site (ORR Site 3), ORR Site 2, and ORR Site 8 are collectively referred to as the ORR Sites throughout Section 9.3. Figures 3.7-1, 9.3-6, 9.3-7, and 9.3-8 show the proposed SMR project facilities, transmission lines, intake, and discharge locations for the CRN Site and each of the alternative sites.

9.3.4 Alternative Site Review

The four Alternative Sites were compared based on site-specific differentiating criteria. This comparison was performed to determine whether any one of the Alternative Sites is obviously superior to the proposed CRN Site. The CRN Site and three Alternative Sites were evaluated in each area (Safety, Environment, and Socioeconomic). In the area of Safety, the four Alternative Sites were evaluated to establish that no known limiting conditions exist at the Alternative Sites. In the areas of Environment and Socioeconomics, impacts were analyzed, and a single significance level of potential impact to each resource (i.e., SMALL, MODERATE, or LARGE) was assigned consistent with the criteria that the U.S. Nuclear Regulatory Commission (NRC) established in 10 Code of Federal Regulations (CFR) Part 51, Appendix B, Table B-1, Footnote 3.

The proposed CRN Site is discussed as needed in this section to allow for comparison. Proposed generic site layouts for the alternative sites are provided in Figures 3.7-1, 9.3-6 through 9.3-8.

A summary of the Preconstruction, Construction, and Operation impact evaluations for the Alternative Sites for Environmental and Socioeconomic criteria is provided in Table 9.3-1.

9.3.4.1 Environmental Criteria

The proposed SMR project facilities, transmission lines, and intake and discharge locations are provided for the CRN Site (Figure 3.7-1), ORR Site 2 (Figure 9.3-6), ORR Site 8 (Figure 9.3-7), and Redstone Arsenal Site 12 (Figure 9.3-8). Based on the large amount of available acreage at the CRN Site, the proposed site layout as described in Chapter 3 and also in Subsection 4.1.1.1 encompasses more than the minimum 120 ac. For the purposes of alternatives analysis, the minimum acreage of 120 contiguous ac was assumed to be required for the reactor block and ancillary support facilities at each of the three Alternative Sites.

For the evaluation, key differentiators between the Alternative Sites include the location of the SMR project facilities within each Alternative Site, and associated lengths of potential rights-of-way for access roads, transmission lines and cooling water intake and discharge pipelines that would need to be installed in cleared corridors on or off the site. It should be noted that for Redstone Arsenal Site 12, no new roads would be required for access; an existing roadway (Anderson Road; see Figure 9.3-8) currently traverses the site; therefore, adequate access to the site already exists. To minimize impacts, the proposed transmission line was located parallel to Anderson Road.

The following subsections address the impacts of preconstruction, construction, and operation of the SMR facility, as well as offsite facilities (e.g., roads, rail lines, transmission lines, pipelines, and barge facilities) required for full project implementation. For most resources, impacts are evaluated based on the complete project consisting of two of more SMR units, and the evaluations are not dependent on the overlap of construction and operations of multiple SMR units. For specific socioeconomic resources, impacts associated with the overlap of construction and operations of multiple SMR units are also addressed, as appropriate.

9.3.4.1.1 Land Use

Current land use at and around the CRN Site and three Alternative Sites was evaluated to assess compatibility of the SMR Project with existing conditions, future plans and areas requiring special consideration. The geographic area of interest for this evaluation was the project site and any offsite areas that would be required for additional facilities (e.g., roads, rail lines, transmission lines, pipelines, and barge facilities) associated with full project implementation.

CRN Site and ORR Sites 2 and 8

The CRN Site consists of approximately 935 ac of primarily undeveloped land located on the Clinch River arm of the Watts Bar Reservoir, adjacent to the ORR. Subsection 2.2.1.1 and Table 2.2-1 present the existing land use/land cover on the CRN Site based on the 2011 U.S. Geological Survey (USGS) National Land Cover Database classifications. The site is owned by the federal government and managed by TVA. Limited infrastructure development and structures are present on the site. TVA's Watts Bar Reservoir Land Management Plan specifies

two different land uses on this site. The majority of the site is designated as Zone 2 – Project Operations, and a strip along the reservoir shoreline is designated Zone 3 – Sensitive Resource Management. (Reference 9.3-6) There is sufficient area in Zone 2 for siting two or more SMRs. The use of the CRN Site for an energy demonstration project is consistent with the TVA-designated land use for the site and with land use on adjacent areas of the ORR; therefore, the impacts associated with the approximate 328-ac land usage would be SMALL.

ORR Site 2 consists of approximately 547 ac of primarily undeveloped land located north and west of Bear Creek Road adjacent to the Clinch River arm of the Watts Bar Reservoir. Table 9.3-2 shows the 2011 USGS National Land Cover Database categorizations for ORR Site 2, their acreages on the site, and the percentage of the site covered by each land cover category. ORR Site 2 is owned by the federal government and managed by the DOE. Limited infrastructure development and structures are present on ORR Site 2 (Reference 9.3-5). Use of ORR Site 2 for an energy production and demonstration project is consistent with DOE-designated land use for the site and with land use on adjacent areas of the ORR. There is sufficient total area for siting two or more SMRs. Table 9.3-2 details the quantities of each land cover type at ORR Site 2 that would be potentially impacted by construction of the power block area and various linear facilities located on and off the site, including access roads, transmission lines, and cooling water intake and discharge pipelines. The power block, turbine building, switchyard, cooling towers, offices, and other facilities of the SMR Project would cover approximately 120 ac within this 547-ac site. In addition, linear corridors for an access road and cooling water intake and discharge pipelines within the site would cover approximately 8.5 ac. Of this total corridor acreage, the majority would be within the site boundary, and approximately 2 ac would be within the portion of the intake and discharge pipeline corridors that would extend from the site boundary to the shoreline of the reservoir.

Two ORR Site 2 features include the East Tennessee Technology Park (ETTP) Overlook and the Wheat Community African Burial Ground, both of which are adjacent to and publicly accessible from TN 58 (Reference 9.3-5). Consideration would have to be made for maintaining public access to the ETTP Overlook and the Wheat Community African Burial Ground. Because these two areas are located immediately adjacent to TN 58, maintaining access would not be anticipated to significantly impact the space availability for two or more SMRs. Although there are minor concerns associated with maintaining public access to the ETTP Overlook and the Wheat Community African Burial Ground, the impacts associated with the approximate 128.5-ac land usage at ORR Site 2 would be SMALL.

ORR Site 8 consists of approximately 424 ac on the Melton Hill Reservoir and the Clinch River arm of the Watts Bar Reservoir on the ORR. Table 9.3-3 shows the 2011 USGS National Land Cover Database categorizations, acreages, and percentages for ORR Site 8, which is owned by the federal government and managed by DOE. ORR Site 8 is located on a peninsula, bounded on the south and east by the Melton Hill Reservoir. (Reference 9.3-5) A portion of the site is a narrow access corridor that extends from the area of Melton Hill Dam along the Clinch River arm of the Watts Bar Reservoir. Table 9.3-3 details the quantities of each land cover type at ORR Site 8 that would be potentially impacted by construction of the power block and various

linear facilities located on and off the site, including access roads, and cooling water intake and discharge pipelines. The power block, turbine building, switchyard, cooling towers, offices, and other facilities of the SMR Project would cover approximately 120 ac within this 424-ac site. In addition, linear corridors for an access road and cooling water intake and discharge pipelines within the site would cover approximately 25 ac. The land cover on these impacted areas is predominantly deciduous forest. There is sufficient total area for siting two or more SMRs. ORR Site 8 is currently designated in the ORR 10-Year Site Plan for future aquatic-terrestrial interface studies (Reference 9.3-7). At ORR Site 8, potential conflicts with the ORR's 10-year (yr) plan for the site indicate that impacts associated with the approximate 145-ac land usage would be SMALL to MODERATE.

Redstone Arsenal Site 12

Redstone Arsenal Site 12 consists of approximately 130 ac of undeveloped forest and grassland located in the western part of Redstone Arsenal adjacent to the arsenal boundary. Table 9.3-4 shows the 2011 USGS National Land Cover Database categorizations, acreages, and percentages for Redstone Arsenal Site 12. The surrounding area within the arsenal is also undeveloped, with a missile test range located to the southeast. Use of Redstone Arsenal Site 12 for an energy production and demonstration project would be inconsistent with weapons system testing, which is the designated land use for the site and adjacent areas. However, Redstone Arsenal has provided a letter to TVA stating that the Arsenal mission would be modified to meet the land use requirements in the event that Redstone Arsenal Site 12 was selected as the preferred location for the SMR Project (Reference 9.3-5). Table 9.3-4 details the quantities of each land cover type that would be potentially impacted by construction of the power block and various linear facilities located on and off the site, including access roads, transmission lines, and cooling water intake and discharge pipelines. The power block, turbine building, switchyard, cooling towers, offices, and other facilities of the SMR Project would cover approximately 120 ac within this 130-ac site. In addition, linear corridors for a transmission line and cooling water intake and discharge pipelines off the site would cover approximately 96.3 ac. The land cover on the impacted areas of the site is predominantly pine forest. Land cover on the offsite corridors includes mainly pine and deciduous forest as well as open space with herbaceous vegetation. Additionally, a residential area is located adjacent to the western boundary of Redstone Arsenal in close proximity to Redstone Arsenal Site 12. If Redstone Arsenal Site 12 were selected as the preferred location for the SMR Project, radiation dosage calculations would be performed at the site boundary and taken into consideration in the development of the site layout and facility design.

At Redstone Arsenal Site 12, there are moderate concerns because of the land use designated for the site in the Arsenal's current Master Plan and the proximity of a residential community adjacent to the western boundary of Redstone Arsenal Site 12. Concerns regarding the Master Plan are partially mitigated by the installation's commitment to modifying the land use requirements for this area of the installation. Potential conflicts associated with the plan and the proximity of the site to residential areas indicates that the impacts associated with the approximate 216.3-ac land usage would be SMALL to MODERATE.

9.3.4.1.2 Water Use and Quality

Current water supply and use at and around the CRN Site and three Alternative Sites was evaluated to assess compatibility of the SMR Project with existing conditions, future plans and areas requiring special consideration. Water-related impacts associated with the construction and operation of the SMR Project at the CRN Site are discussed in Sections 4.2, 5.2, and 5.3. The geographic area of interest for water use and quality impacts is the drainage basin of the receiving reservoir, noting that the potential for the SMR Project to contribute to impacts is expected to be highest in close proximity to the site and to decrease with distance away from the site.

CRN Site and ORR Sites 2 and 8

Surface Water Use

The analysis of surface water use impacts is based on evaluation of the Tennessee River watershed water balance, consumptive water use during low flow periods, impacts to specific water users on the affected reservoirs, and the impact of consumptive water use on pool level (impacts to recreation and navigation). These impacts are evaluated for operation of two or more SMR units, which would be the scenario with the largest surface water use. As discussed in Subsection 4.2.2.1, withdrawal and consumption of surface water for dust suppression during construction of the SMRs at the CRN Site is SMALL.

The impacts of consumptive surface water use within the Tennessee River watershed are evaluated in Subsection 5.2.2.1.1. The proposed SMR withdraws an average of 26 million gallons per day (mgd; 40 cubic feet per second [cfs]) (44 mgd [68 cfs] maximum), which would increase the current projected total withdrawal within the Tennessee River Watershed to 9475 mgd (14,661 cfs) (9493 mgd [14,698 cfs] maximum). The proposed SMR withdrawal represents approximately 0.27 percent (0.46 percent maximum) of the current projected total withdrawal within the Tennessee River Watershed. The projected maximum consumptive water use from the CRN Site is 18 mgd (28 cfs). This increases the estimated projected net water demand to 730 mgd (1130 cfs) within the watershed and to 44 mgd (68 cfs) for the Clinch River arm of the Watts Bar Reservoir upstream of the CRN Site. This proposed increase of net water demand represents approximately 2.5 percent of the current projected net water demand in the Tennessee River watershed. These projections are within the initial projection estimates that were used in the development of TVA's reservoir operation system policy. Based on the above, the potential impacts of operation on other surface water users regionally in the Tennessee River watershed would be minimal. Because the consumptive water use would be the same at any of the ORR Sites, this impact conclusion also applies to SMR operations at the CRN Site and two Alternative ORR Sites.

The reservoir low-flow statistic used to evaluate the impact of consumptive water use during low flow periods is the lowest 7 day average flow that occurs on average once every 10 years (7Q10) flow rate, which is 390 cfs (175,045 gallons per minute [gpm]) for the reach of the Clinch

River arm of the Watts Bar Reservoir near the CRN Site (Reference 9.3-8). Because Melton Hill Reservoir is a run-of-river system, it generally releases the same amount of water that flows into it (Reference 9.3-9). Because the average flow rate in the Clinch River arm of the Watts Bar Reservoir is based on releases from Melton Hill Dam, the flow rate within Melton Hill Reservoir is the same as that in the Clinch River arm of the Watts Bar Reservoir.

The expected maximum consumptive use of water at the CRN Site is 12,808 gpm (28.5 cfs, or 18 mgd). For the CRN Site, as well as ORR Sites 2 and 8, the 7Q10 flow rate is 390 cfs (175,045 gpm). For any of the three ORR sites, the consumptive surface water use is approximately 7.3 percent of the 7Q10 flow in the reservoir (12,808 gpm/175,045 gpm = 0.073 or 7.3 percent). These estimates are conservative, because TVA's management of the dam and reservoir system counteracts this adverse effect by beneficially storing excess surface water for use during periods of low precipitation, ensuring availability of water for all uses in all but the worst droughts.

Surface water use by the SMRs at any of the ORR sites is also minimal compared to the withdrawals by other surface water users. Surface water users from Watts Bar, Melton Hill, Chickamauga, and Fort Loudoun Reservoirs are listed among the surface water withdrawals presented in Table 2.3.2-3. Total withdrawal in the seven county area surrounding the CRN Site in 2010 was 1479 mgd. Thermoelectric water use (1366.17 mgd) was by far the highest usage due to withdrawals for Bull Run, Kingston, and Watts Bar Nuclear power plants. Public supply was the second highest water use (102.62 mgd) (Reference 9.3-10). Consumptive surface water use by the SMRs at any of the ORR sites would be approximately 1.2 percent of the total withdrawals in the seven county area (18 mgd/1479 mgd = 0.012, or 1.2 percent). Therefore, the impact of consumptive surface water use at the CRN Site, and at ORR Sites 2 and 8, on other surface water users would be SMALL.

All nine mainstream and 16 tributary reservoirs in the TVA system, including Watts Bar and Melton Hill, are managed for multiple purposes, including recreational boating and fishing, wildlife management, and economic development as well as navigation, flood control and power production. Each of the reservoirs also supports numerous surface water intakes and discharge structures. Intake structures generally occupy a small segment of the shoreline, and must be designed to avoid specific recreational or navigational infrastructure. Discharge structures are generally installed on the reservoir bottom, and/or have a limited radius of influence which does not interfere with recreation or navigation within the reservoir.

Recreation and navigation may be impacted by consumptive water uses, if those uses result in a lowering of pool level within the reservoir. As discussed in Subsection 5.2.1.2.1, the water level within Watts Bar Reservoir is primarily supported by flow within the Tennessee River, released from Fort Loudoun Dam. For 2004 through 2013, the overall average release from Fort Loudoun Dam was about 18,310 cfs (compared to 4670 cfs for Melton Hill Dam). By comparison, the expected maximum consumptive use of water at the CRN Site, about 12,808 gpm (28.5 cfs), is essentially inconsequential compared to the combined average conveyances from Melton Hill Dam and Fort Loudoun Dam (28.5 cfs/18,310 cfs + 4670 cfs = 0.0012 or 0.1

percent). As such, hydrologic impacts of water consumption at either the CRN Site or ORR Site 2 on the overall flow and pool levels, and therefore on recreation and navigation, in Watts Bar Reservoir would be SMALL.

For ORR Site 8, the impact of surface water use on flow and pool levels would be on Melton Hill Reservoir, with no contribution of flow from Fort Loudoun Dam. The expected maximum consumptive use of water at ORR Site 8 would be minimal compared to the average flow rate in Melton Hill Reservoir (28.5 cfs/4670 cfs = 0.006 or 0.6 percent). As such, hydrologic impacts of water consumption at ORR Site 8 on the overall flow and pool levels, and therefore on recreation and navigation, in Melton Hill Reservoir would be SMALL.

Surface Water Hydrology

The analysis of the impact of the discharge on surface water use hydrology is evaluated in Subsection 5.2.1.2.1. The diffuser for the discharge is described in Subsection 3.4.2.3. Cursory designs were developed and analyzed to quantify their impact on the receiving water body, with results reported in the Hydrothermal Task Force Report. The criteria used for the selection of the design for the diffuser included providing a velocity head at the entrance to the diffusers not exceeding about 0.8 feet (ft), and providing an average velocity for the flow exiting the diffuser ports of between 8 and 10 ft per second. The former is related to limiting energy losses in the diffuser and approach conduits, whereas the latter is related to providing effective mixing of the diffuser effluent with ambient water in the river. Assessment of the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) at the proposed CRN Site and three Alternative Sites did not indicate any limiting conditions based on flooding potential (Figures 9.3-9 through 9.3-11).

The proposed design is a submerged, bottom-mounted multiport diffuser similar to that used at TVA's other operating nuclear power plants, and which is the best technology available for mixing the thermal discharge. As discussed in Subsection 5.2.1.2.1, the diffuser design meets objectives of maximizing thermal and chemical mixing while limiting local scour and the possible formation of problematic water velocities and flow patterns in the reservoir.

As shown in Figure 3.3-1, the average flow rate of the discharge is 5615 gpm. This is the same for all three ORR Sites. Also, as discussed in the analysis of surface water use impacts, the 7Q10 flow rate is the same for all three ORR Sites. Therefore, for all three ORR Sites, the discharge rate is approximately 3.2 percent of the 7Q10 flow in the reservoir (5615 gpm/175,045 gpm = 0.032 or 3.2 percent). Subsection 5.2.1.2.1 states that the diffuser design limits local scour and the possible formation of problematic water velocities and flow patterns in the reservoir. Based on these analyses, it is concluded that the impact of the discharge on surface water hydrology at the CRN Site is SMALL.

Minor differences in bathymetry could result in higher or lower impacts associated with the discharge at ORR Sites 2 or 8, but these differences would be addressed through siting of the discharge structure and/or modification of continuous by-pass flow rates at Melton Hill Dam, as

was proposed in the hydrothermal analysis for the CRN Site. Therefore, the impact of the discharge on surface water hydrology at ORR Sites 2 and 8 is SMALL.

Onsite Surface Water and Wetlands

Wetlands (emergent herbaceous and woody wetlands) occupy approximately 82.8 ac, or 8.85 percent of the CRN Site. Open water occupies approximately 16.8 ac, or 1.8 percent of the CRN Site. The CRN Site is much larger than required for the SMR Project, and the project facilities could be located on a portion of the site that does not affect onsite streams except for one small perennial stream. Given the proposed location of the project facilities and linear corridors, approximately 8 percent of the CRN Site wetlands, or about 7 ac of wetlands, would be impacted by site construction. The analyses of the CRN Site described in Sections 4.2 and 5.2 concluded that impacts to onsite water bodies and wetlands from construction and operations would be SMALL.

As presented in Table 9.3-2, wetlands occupy approximately 21.8 ac, or 4 percent of ORR Site 2. Open water occupies approximately 4.0 ac, or 0.7 percent of ORR Site 2. The wetlands located on ORR Site 2 cannot be completely avoided. However, indirect or direct impacts to less than 10 percent of the wetland acreage, or less than 3 ac of wetlands, are anticipated. Therefore, construction and operational-related impacts to wetlands and onsite water bodies would be SMALL at ORR Site 2.

As presented in Table 9.3-3, wetlands occupy approximately 0.6 ac, or 0.1 percent of ORR Site 8. Open water occupies approximately 5.1 ac, or 1.2 percent of ORR Site 8. The wetlands located on ORR Site 8 cannot be completely avoided. However, indirect or direct impacts to less than 10 percent of the wetland acreage or less than 0.1 ac of wetlands, of the sites are anticipated. Therefore, construction and operational-related impacts to wetlands and onsite water bodies would be SMALL at ORR Site 8.

Surface Water Quality

TVA operates a multipurpose water control system comprised of dams and reservoirs for the purposes of navigation, flood control, power production, and a wide range of other public benefits. Under TVA's 2004 Reservoir Operation Plan, system-wide flow requirements were established to ensure that downstream needs are met, including the need to provide recreational opportunities, protect water quality for the public and for aquatic biological resources, provide year-round navigation, and provide water for power production and municipal and industrial use. (Reference 9.3-11)

As part of TVA's river operations program, TVA has monitored the ecological health of the Watts Bar and Melton Hill Reservoirs. Based on dissolved oxygen, chlorophyll, fish, bottom life, and sediment data from 1994 to 2012, Watts Bar Reservoir rated either good or fair every year with the exception of 2002 and 2010, when it rated poor. Lower ecological health scores generally occur during low flow conditions (Reference 9.3-12). Melton Hill Reservoir rated either good or

fair every year from 1994 to 2012. The higher ecological health scores were due to chlorophyll and bottom life rating near the upper ends of their historic ranges during this timeframe (Reference 9.3-13).

Surface water on the ORR drains into the Watts Bar Reservoir. Several facilities on the ORR conduct their own water quality programs. These water quality programs were established to monitor numerous environmental parameters in surface water and groundwater. Surface water samples are collected quarterly from five locations along the Clinch River (Watts Bar Reservoir), including public water intakes, as part of the ORR Water Resources Restoration Program, developed in 1996. (Reference 9.3-14) The State of Tennessee has classified these locations for recreation and domestic use. Samples are screened for radioactivity and are analyzed for general water quality parameters, mercury, and specific radionuclides. Based on the 2011 results, there is no statistically significant difference for radionuclides in samples collected upstream of the ORR versus downstream. No radionuclides were detected above the reference criterion dose limit of 4 millirem (mrem). Mercury was not detected above its maximum contaminant level. (Reference 9.3-15)

Table 2.3.3-1 summarizes the streams and water bodies near the CRN Site, which are designated by the U.S. Environmental Protection Agency (EPA) as impaired. These water bodies include the Clinch River arm of Watts Bar Reservoir (polychlorinated biphenyls [PCBs] in sediment), Whiteoak Creek (cesium, strontium, and loss of biological integrity), and Melton Hill Reservoir (PCBs and chlordane in contaminated sediment.

As discussed in Subsection 4.2.1.1.2, TVA is party to an Interagency Agreement, along with the U.S. Army Corps of Engineers (USACE), DOE, Tennessee Department of Environment and Conservation (TDEC), and the EPA, to coordinate review of permitting and other use authorization activities which could result in the disturbance, re-suspension, removal, and/or disposal of contaminated sediments in the Clinch River arm of the Watts Bar Reservoir. Sections 4.2 and 5.2 concluded that impacts to water quality from construction and operations at the CRN Site are SMALL. Land-based construction is performed in accordance with a Stormwater Pollution Prevention Plan (SWPPP) approved by the TDEC. Water-based construction is performed using the coordination process required under the Interagency Agreement. Operations are conducted under the terms and conditions of the National Pollution Discharge Elimination System (NPDES) permit. Based on the similarity of the environmental setting of ORR Sites 2 and 8 to the CRN Site and the fact that the same regulatory requirements apply, impacts to water quality from construction and operations at these sites are also SMALL.

Groundwater

The primary source for many streams within the ORR is groundwater from the Knox Aquifer, and most of the larger springs receive a portion of the discharge from the aquifer. Depths for the Knox Aquifer can be as much as 300 ft to 400 ft below ground surface and the aquifer is used locally for domestic water supplies (Reference 9.3-15). Groundwater depths in the ORR often

mimic the surface water tributaries it eventually enters. Since groundwater flow primarily occurs in the fractures and solution cavities, groundwater depth, pathway, and availability varies significantly across the installation.

Local groundwater use for the CRN Site was summarized in Subsection 2.3.2.2.2 and is applicable to ORR sites 2 and 8 as well due to their close proximity. Present and known future offsite groundwater users are sufficiently distant from each of the three sites and none of the sites would use groundwater for plant operations. Therefore, there would be no withdrawals that would affect or be adversely affected by local groundwater users. Groundwater flow is expected to discharge to the reservoir. Because the CRN Site and ORR Site 8 are located directly on the reservoir and ORR Site 2 is situated so that the downgradient groundwater flow pathway between the site and the reservoir is on ORR property, there would be no groundwater users situated between the plant and the groundwater discharge location. With respect to groundwater quality, construction is performed in accordance with the Construction SWPPP and TVA Best Management Practice (BMP) procedures. Based on the similarity of the environmental setting of ORR Sites 2 and 8 to the CRN Site, and the fact that none of the sites would use groundwater for operations, impacts to groundwater from construction and operations at these sites are also SMALL.

Redstone Arsenal Site 12

Surface Water Use

The impacts of consumptive surface water use within the Tennessee River watershed are evaluated in Subsection 5.2.2.1.1. The proposed SMR withdraws an average of 26 mgd (40 cfs) (44 mgd [68 cfs] maximum), which would increase the current projected total withdrawal within the Tennessee River Watershed to 9475 mgd (14,661 cfs) (9493 mgd [14,698 cfs] maximum). The proposed SMR withdrawal represents approximately 0.27 percent (0.46 percent maximum) of the current projected total withdrawal within the Tennessee River Watershed. This proposed increase of net water demand represents approximately 2.5 percent of the current projected net water demand in the Tennessee River watershed. These projections are within the initial projection estimates that were used in the development of TVA's reservoir operation system policy. Based on the above, the potential impacts of operation on other surface water users regionally in the Tennessee River watershed would be minimal. As indicated in the alternative discussion for the ORR Site, because the consumptive water use would be the same at any of the Alternative Sites, this impact conclusion also applies to SMR operations at Redstone Arsenal Site 12.

For Redstone Arsenal Site 12, the consumptive surface water use is approximately 0.5 percent of the 7Q10 flow in the reservoir (12,808 gpm/2,823,590 gpm = 0.005 or 0.5 percent). Again these estimates are conservative, because TVA's management of the dam and reservoir system counteracts this adverse effect by beneficially storing excess surface water for use during periods of low precipitation, ensuring availability of water for all uses in all but the worst droughts.

Also, surface water use by the SMRs at the Redstone Arsenal Site 12 is minimal compared to the withdrawals by other surface water users. Surface water withdrawals in the Wheeler Lake watershed totaled 2959 mgd in 2010. Of this, the vast majority (2731 mgd) was withdrawn to support thermoelectric power production, and an additional 139 mgd was withdrawn for other industrial uses. Public water supply was the third highest use. Public water supply systems within the seven counties surrounding Redstone Arsenal are listed in Table 9.3-8. Table 9.3-9 shows the water consumption by county for the 15 counties in the Tennessee River Watershed in Alabama. Table 9.3-10 provides additional information on surface water consumption by county and category of use. Surface water users who contribute to cumulative water use, and who could be impacted by cumulative water use impacts, include Decatur Utilities (33.38 mgd in 2010), Huntsville Utilities Water Department (38.08 mgd), Redstone Arsenal (1.69 mgd), and the West Morgan East Lawrence Water and Sewer Authority (5.47 mgd) (Reference 9.3-16). Consumptive surface water use by the SMRs at the Redstone Arsenal Site 12 would be approximately 0.6 percent of the total withdrawals in the Wheeler Lake watershed (18 mgd/2959 mgd = 0.006, or 0.6 percent). Therefore, the impact of consumptive surface water use at the Redstone Arsenal Site 12 on other surface water users would be SMALL.

All nine mainstream and 16 tributary reservoirs in the TVA system, including Wheeler, are managed for multiple purposes, including recreational boating and fishing, wildlife management, and economic development as well as navigation, flood control and power production. Each of the reservoirs also supports numerous surface water intakes and discharge structures. Intake structures generally occupy a small segment of the shoreline, and must be designed to avoid specific recreational or navigational infrastructure. Discharge structures are generally installed on the reservoir bottom, and/or have a limited radius of influence which does not interfere with recreation or navigation within the reservoir.

For Redstone Arsenal Site 12, the expected maximum consumptive use of water would be minimal compared to the average flow rate in Wheeler Reservoir (28.5 cfs/26,511 cfs = 0.0010 or 0.1 percent). As such, hydrologic impacts of water consumption at Redstone Arsenal Site 12 on the overall flow and pool levels, and therefore on recreation and navigation, in Wheeler Reservoir would be SMALL.

Surface Water Hydrology

The discharge rate at Redstone Arsenal Site 12 is the same as that at the CRN Site, or 5615 gpm. For Redstone Arsenal Site 12, the discharge rate is approximately 0.2 percent of the 7Q10 flow in the reservoir (5615 gpm/2,823,590 gpm = 0.0020 or 0.2 percent). Similar to the analysis of ORR Sites 2 and 8, minor differences in bathymetry could result in higher or lower impacts to hydrology at the Redstone Arsenal Site 12, but these differences would be addressed through siting of the discharge structure and/or modification of continuous by-pass flow rates. Therefore, the impact of the discharge on surface water hydrology at Redstone Arsenal Site 12 is SMALL. Assessment of the FEMA FIRMs at the proposed CRN Site and three Alternative Sites did not indicate any limiting conditions based on flooding potential (Figures 9.3-12).

Onsite Surface Water and Wetlands

Indian Creek, Huntsville Spring Branch, and McDonald Creek, all of which empty into the Wheeler Reservoir, are the major systems flowing through the Redstone Arsenal property. Swan Pond is located to the south and Indian Creek to the east of the site. As presented in Table 9.3-4, wetlands occupy approximately 2.1 ac or 1.6 percent of Redstone Arsenal Site 12. In addition, there is no open water on the Redstone Arsenal Site 12. Therefore, construction and operational-related impacts to wetlands and onsite water bodies would be SMALL at Redstone Arsenal Site 12.

Surface Water Quality

As indicated previously, TVA operates a multipurpose water control system comprised of dams and reservoirs for the purposes of navigation, flood control, power production, and a wide range of other public benefits. Under TVA's 2004 Reservoir Operation Plan, system-wide flow requirements were established to ensure that downstream needs are met, including the need to provide recreational opportunities, protect water quality for the public and for aquatic biological resources, provide year-round navigation, and provide water for power production and municipal and industrial use. (Reference 9.3-11)

TVA has monitored the ecological health of the Wheeler Reservoir as part of its river operations program (Reference 9.3-17). Based on dissolved oxygen, chlorophyll, fish, bottom life, and sediment data from 1994 to 2011, Wheeler Reservoir rated either good or fair every year with the exception of 2007 and 2011, when it rated poor. Lower ecological health scores occur during years with lower flow because of higher chlorophyll concentrations and lower dissolved oxygen levels (Reference 9.3-17).

Two streams within Redstone Arsenal property have been designated by the EPA as impaired: Huntsville Spring Branch and Indian Creek. The pesticide dichlorodiphenyltrichloroethane (DDT) was the primary cause of impairment for these two streams. No impaired water bodies have been identified within the property boundaries (Reference 9.3-18). Although two streams in the area have been identified as impaired by the EPA, these designations should not prohibit further industrial development in the area; however, these issues may be reflected in the site-specific NPDES permit.

Construction and operations at Redstone Arsenal Site 12 are subject to similar regulatory controls as at the ORR sites. Land-based construction is performed in accordance with a SWPPP approved by the Alabama Department of Environmental Management (ADEM). Operations are conducted under the terms and conditions of the NPDES permit. Therefore, impacts to water quality from construction and operations at the Redstone Arsenal Site 12 are SMALL.

Groundwater

Redstone Arsenal is characterized by karst terrain with ready groundwater movement along fractures and solution channels between the surface and subsurface. Aquifers in Redstone Arsenal are semi-confined to unconfined with no confining geologic layers; allowing groundwater to generally mimic the land surface topography and to discharge at surface springs and water bodies (Reference 9.3-19). Depth to groundwater varies widely from a few feet to greater depths at the high elevations (Reference 9.3-20). While the groundwater flow mimics the surface topography and discharges into nearby streams, sometimes flowing northward to discharge into surface streams, these streams discharge southward into the Tennessee River (Wheeler Reservoir). Fractures and karst features allow the ready exchange of water between groundwater and surface water bodies; thus making depth to groundwater highly variable across the installation. Groundwater enters the Redstone Arsenal property along the northern boundary and flows south toward the Tennessee River (Wheeler Reservoir), where it discharges along the southern boundary of Redstone Arsenal (Reference 9.3-19). This entire flow pathway is located on Redstone Arsenal property, so is unlikely to affect any groundwater users off of the property to the west.

Table 9.3-9 shows water consumption by county within the 15 counties in the Tennessee River Watershed in Alabama. Table 9.3-11 provides additional information on groundwater consumption by county and category of use.

As with the ORR Sites, there is no groundwater use for operations, and there are no groundwater users situated between the plant site and its discharge location on Wheeler Reservoir. In addition, the Construction SWPPP and TVA BMP procedures which protect groundwater quality are followed. Therefore, impacts to groundwater from construction and operations at the Redstone Arsenal Site 12 are SMALL.

9.3.4.1.3 Terrestrial Ecology

The geographic area of interest for this evaluation for each site is the project site and any offsite areas that would be required for additional facilities (e.g., roads, rail lines, transmission lines, pipelines, and barge facilities) associated with the SMR Project.

CRN Site and ORR Sites 2 and 8

Terrestrial ecological resources at the proposed CRN Site are described in Subsection 2.4.1, and potential impacts are described in Subsections 4.3.1 and 5.6.1. The analyses provided in these sections determined that direct and indirect impacts to terrestrial resources from preconstruction, construction and operation of the SMR Project at the CRN Site, as well as associated offsite facilities such as roads, transmission lines, and barge facilities, would be SMALL.

ORR Site 2 is adjacent to the CRN Site and would occupy approximately 547 ac within the Southern Dissected Ridges and Knobs subdivision of the Ridge and Valley Ecoregion of eastern Tennessee. ORR Site 8 is approximately 3 mi east of the CRN Site and would occupy approximately 424 ac mainly within the Southern Limestone/Dolomite Valleys and Rolling Hills subdivision of the Ridge and Valley (Reference 9.3-21). The CRN Site is also within these subdivisions of this ecoregion, and the ecological communities native to each of the ORR sites are similar. A dominant ecological feature of the ORR is its large areas of mature eastern deciduous hardwood forest. Approximately 70 percent of the ORR is forested. In addition to the oak-hickory hardwood forest, other natural forest types within the ORR include floodplain forests and small stands of hemlock and white pine. Undeveloped areas of the ORR also contain grassland, old fields at various stages of succession, unique or important vegetation communities, planted pines and hardwoods, wetlands, beaver ponds, and caves. This diversity of habitats supports a wide variety of wildlife species in the area, as described in Subsection 2.4.1. (Reference 9.3-22)

ORR Sites 2 and 8 each overlap at least one designated natural area that includes terrestrial biological resources. ORR Site 2 encompasses the 20-ac Northwest Pine Ridge Natural Area, a Potential Habitat Area (a designation which indicates it may support a commercially exploited, state-listed species), and a small portion of a Cooperative Management Area (the Grassy Creek Powerline Area, which is a 51-ac linear area managed cooperatively among agencies for special purposes such as wildlife management) (Reference 9.3-23). The Potential Habitat Area occupies much of the interior of ORR Site 2, and it could not be avoided when siting the SMR Project on this hilly site. Approximately half of ORR Site 8 includes the 293-ac Tower Shielding Bluffs Natural Area, which includes oak-hickory forest, steep slopes, and a rare species. Most of the remainder of Site 8 is within the Melton Dam Bluffs Natural Area, which supports diverse forest communities that contain limestone outcrops and two rare species (Reference 9.3-23). These two natural areas cover almost all of ORR Site 8 and could not be avoided when siting the SMR Project. Wetlands occupy approximately 4 percent of ORR Site 2 and 0.1 percent of ORR Site 8. The small wetland areas within these upland sites are located near the site boundaries (Figures 9.3-6 and 9.3-7). Most wetlands could be avoided when the SMR Project is sited, and any unavoidable effects on wetlands would be limited in extent and could be mitigated in accordance with USACE guidelines.

Numerous terrestrial or wetland species that are federally or state-listed as endangered or threatened are known or reported to occur on the ORR. These include 22 state-listed species, of which eight also are federally listed (Reference 9.3-23). As noted above, rare species with a state status occur within ORR Sites 2 and 8. Information from the TVA Natural Heritage database indicates there are recorded occurrences of state-listed terrestrial species on ORR Sites 2 and 8. On ORR Site 2, there is a plant that is state-listed as threatened, shining ladies'-tresses (*Spiranthes lucida*), and a plant that is a state species of special concern, spreading false-foxglove (*Aureolaria patula*). On ORR Site 8, occurrences of the butternut, (*Juglans cinerea*), which is state-listed as threatened, and spreading false-foxglove have been recorded.

The principal area to be cleared of habitat for preconstruction, construction and operation of the SMR Project is assumed to cover approximately 120 ac within each of the Alternative Sites. In addition to this area, the corridors to be cleared for the installation of linear facilities at ORR Sites 2 and 8 would be located almost entirely within the site boundaries. At ORR Site 2, the clearing of access road, transmission line, and pipeline corridors would remove a total of approximately 8.5 ac of predominantly deciduous forest. Of this total corridor acreage, the majority would be within the site boundary, and approximately 2 ac would be within the portion of the intake and discharge pipeline corridors that would extend from the site boundary to the shoreline of the reservoir. No wetlands would be crossed. At ORR Site 8, the clearing of access road, transmission line, and pipeline corridors would remove a total of approximately 25 ac of predominantly forest habitat, all of which would be within the site boundary. Approximately 0.3 ac of woody wetlands would be crossed.

The analyses of the CRN Site in Subsections 2.4.1, 4.3.1, and 5.6.1 concluded that impacts to terrestrial resources from preconstruction, construction, and operations of the SMR Project at that site would be SMALL. ORR Site 2 is adjacent to the CRN Site and covered by similar forest communities. However, ORR Site 2 is largely designated as a Potential Habitat Area and a Natural Area that includes terrestrial biological resources. Its hilly topography would limit opportunities to site the SMR Project so that these areas could be avoided; consequently, impacts to terrestrial biological resources at ORR Site 2 would be MODERATE. ORR Site 8 is covered by forest and is almost completely covered by two large natural areas that include diverse communities and several rare species. Thus, installation of the SMR Project on ORR Site 8 would have a potential to adversely affect terrestrial biological resources within major portions of these natural areas, and its impacts to terrestrial ecology would be MODERATE.

Redstone Arsenal Site 12

Natural vegetation in the Redstone Arsenal ecoregion is transitional between oak-hickory forest and mixed mesophytic forests. (Reference 9.3-24) In northern Alabama and at Redstone Arsenal, pines are also present in association with the hardwoods and in isolated stands (Reference 9.3-25). Forested habitats on Redstone Arsenal cover approximately 15,700 ac and include hardwood, mixed hardwood and pine, pine, and riparian and bottomland hardwoods. Approximately 50 percent of the pine area is pine plantations. The most extensive forest type is hardwood, which covers over 8500 ac. Hardwoods occur mainly in bottomland areas and in a few large stands on rocky slopes. (Reference 9.3-26) Wetlands cover over 20 percent of Redstone Arsenal (Reference 9.3-27).

Springs, sinks, and caves formed by dissolution of the limestone common in the Eastern Highland Rim provide habitats for unique cave-dwelling fauna, including fish, amphibians, and invertebrates (Reference 9.3-24). Caves also contribute to the richness of the bat fauna in the region. The community of other wildlife inhabiting the area consists of a diversity of species characteristic of the forest habitats of the region. (Reference 9.3-25) Wheeler National Wildlife Refuge (NWR) encompasses 37,000 ac of Wheeler Reservoir and surrounding shoreline from Decatur to Redstone Arsenal (Reference 9.3-28). Within the Arsenal, the refuge extends to

encompass Indian Creek and Huntsville Spring Branch within the central portion of the Arsenal and includes 4085 ac within the Redstone Arsenal boundary (Reference 9.3-29). A principal focus of Wheeler NWR is providing habitat and protection for migratory birds, particularly waterfowl. It also provides fish and wildlife-oriented recreation and conservation of rare species. In addition to its extensive open water areas, Wheeler NWR has approximately 2000 ac of swamps and 14,000 ac of forested wetlands. (Reference 9.3-28)

Redstone Arsenal Site 12 is in an upland area on Redstone Arsenal adjacent to the boundary of Wheeler NWR. The site is mainly covered by pine forest, with smaller components of deciduous and mixed forest. Woody wetlands in the northeast corner occupy approximately 2 ac or 1.6 percent of Redstone Arsenal Site 12. It is unlikely that this wetland area can be entirely avoided when locating approximately 120 ac of facilities on this 130-ac site (Figure 9.3-8). Other wetlands would be crossed by the cooling water intake and discharge pipelines extending south from the site and a new transmission line that would extend north from the site. Wetlands would be avoided to the extent practicable when installing these linear facilities and any unavoidable effects on wetlands could be mitigated in accordance with USACE guidelines. Many of the wetlands likely to be crossed by the transmission line and the discharge pipeline are within the Wheeler NWR, and mitigation of wetland impacts and any loss of waterfowl habitat is expected to be a focus of the USACE.

Redstone Arsenal Site 12 could potentially provide habitat for some terrestrial species that are federally listed, state-protected, or have other special status designations in Alabama. Five terrestrial or wetland species that are federally listed have the potential to occur in Madison County. Alabama does not designate species for protection by listing them as state endangered or threatened; instead, species are designated as protected under several regulations. In Madison County, 14 terrestrial or wetland species are state-designated as protected. (Reference 9.3-30) Information from the TVA Natural Heritage database indicates there are no recorded occurrences of federally or state-protected terrestrial species on or near Redstone Arsenal Site 12.

Installation of the SMR Project on Redstone Arsenal Site 12 would have wetland impacts that would occur in conjunction with the installation of linear facilities and maintenance of their corridors within the Wheeler NWR. These impacts would require mitigation. Thus, the impacts on terrestrial ecology from installation of the SMR facility on Redstone Arsenal Site 12 would be MODERATE.

9.3.4.1.4 Aquatic Ecology

CRN Site and ORR Sites 2 and 8

For the purpose of this analysis, the geographic area of interest is defined as the drainages associated with the project site and associated offsite areas where ecological effects from the operation of the SMR Project would occur. It also includes the limited area within the Clinch River arm of the Watts Bar Reservoir that may be affected by operation of the SMR Project.

Aquatic resources on and in the vicinity of the proposed CRN Site and potential impacts to those resources are described in detail in Subsections 2.4.2, 4.3.2, 5.3.1, 5.3.2, and 5.6.2. Based on the analysis provided in these subsections, potential impacts to aquatic resources from preconstruction, construction, and operation of the SMR facility at the CRN Site were concluded to be SMALL.

Impacts on aquatic ecology from preconstruction and construction would result primarily from activities such as in-water construction of intake and discharge structures, dredging, filling or diversion of small streams within the footprint of facilities on each site, crossing of streams by facilities such as pipelines and roads, and erosion and sedimentation associated with these activities. Construction of facilities on each site potentially would impact four small streams on ORR Site 2 and seven small streams on ORR Site 8. Installation of linear facilities such as access roads, transmission lines, and cooling water intake and discharge pipelines is described in Subsection 9.3.4.1.3, Terrestrial Ecology. The same barge facility evaluated for the CRN Site is adjacent to ORR Site 2, and essentially no dredging or other in-water work is expected to occur at this facility. If a barge facility is required at ORR Site 8, it would need to be constructed on either Melton Hill Reservoir or the Clinch River arm of the Watts Bar Reservoir below Melton Hill Dam. Construction of such a facility likely would require localized dredging in the reservoir and excavation for and construction of the facility along the shoreline.

BMPs would be employed to minimize the potential for adverse effects from erosion and sedimentation due to the clearing of corridors and the installation of facilities in the vicinity of streams or reservoirs. As discussed for the CRN Site in Subsection 4.3.2.3, the installation of structures such as the intake, discharge, and barge facility may involve excavation near the shoreline and in the water. BMPs likely to be employed to minimize sediment transport associated with these activities in the reservoir include silt curtains and cofferdams. The aquatic and benthic habitats within the footprints of such structures would be lost; however, these areas would be very small in comparison to the extensive area of such habitats present within the reservoir in the vicinity of each site.

Operations-related effects on aquatic ecology are primarily related to the operation of condenser cooling water systems. These typically include impacts on aquatic organisms from entrainment, impingement, and thermal effects. An important consideration in evaluating the suitability of the Alternate Sites is the proposed design of the condenser cooling water system. The heat rejection rate and make up water requirements of the auxiliary cooling systems of the surrogate SMR plant design are not dependent on site-specific characteristics. The use of closed-cycle cooling with mechanical draft cooling towers by the SMR Project is a best available technology for minimizing the required amount of cooling water withdrawal and thermal effluent discharge. The thermal effects of cooling tower blowdown to the receiving water body would be primarily a function of 1) the percentage of total flow in the source water body and receiving water body in comparison to average and low flow in the water body, and 2) the size and characteristics of the water body, including whether it is a reservoir, regulated river, or free-flowing river. The source and receiving water bodies for each of the three ORR Sites are reservoirs.

For ORR Site 2, as for the adjacent CRN Site, cooling water would be withdrawn from and cooling tower blowdown would be returned to the Clinch River arm of the Watts Bar Reservoir. For ORR Site 8, cooling water would be withdrawn from Melton Hill Reservoir and blowdown would be returned to the Clinch River arm of the Watts Bar Reservoir downstream of Melton Hill Dam. As discussed in Subsection 2.3.1.1.2.4, the flow of the Clinch River arm of Watts Bar Reservoir in the vicinity of ORR Sites 2 and 8 is approximately 4670 cfs (Reference 9.3-31). For each Alternative Site, thermal limits would be imposed by a site-specific NPDES permit for the protection of aquatic life. Figures 3.7-1, 9.3-6, and 9.3-7 show the proposed intake and discharge locations for the CRN Site and each of the Alternative ORR Sites.

Because the SMR Project is a new facility, it will be required to meet Clean Water Act (CWA) Section 316(b) Phase I requirements for its cooling water intake at any of the Alternative Sites. Section 316(b) regulates cooling water intakes to minimize impacts from entrainment and impingement on populations of aquatic organisms. As discussed in Subsection 5.3.1.2, the NRC has determined that entrainment and impingement of fish and shellfish has not been a problem at operating nuclear facilities with cooling towers and a closed-cycle cooling system, which is the type of system planned for the SMR facility, due to the relatively low rates of water withdrawal required by such facilities. NRC did not identify any operating nuclear power plants with cooling towers operated in closed-cycle mode that reported reduced populations of aquatic organisms due to entrainment and impingement. Thus, operation of the cooling water intake at any of the ORR Sites would have minimal effects on populations of aquatic organisms in either the Clinch River arm of the Watts Bar Reservoir or Melton Hill Reservoir.

Several aquatic species that are federally or state-listed as endangered or threatened are known or reported to occur on the ORR. These include seven species that are federally and state-listed (Reference 9.3-23). The evaluation of aquatic natural areas on the ORR by Baranski indicated that ORR Sites 2 and 8 are not known to support listed aquatic species (Reference 9.3-32). Information from the TVA Natural Heritage database indicates no recorded occurrences of federally or state-listed aquatic species in the Clinch River arm of the Watts Bar Reservoir adjacent to ORR Sites 2 and 8 or in the Melton Hill Reservoir adjacent to ORR Site 8.

The Clinch River arm of the Watts Bar Reservoir is the source of cooling water for the CRN Site and ORR Site 2, and Melton Hill Reservoir is the source of cooling water for ORR Site 8. The physical/chemical characteristics and ecology of Melton Hill Reservoir are described in Subsection 2.4.2.1.2 As discussed in Subsection 2.3.1.1.2.4, the flow of the Clinch River arm of Watts Bar Reservoir in the vicinity of ORR Sites 2 and 8 is approximately 4670 cfs (Reference 9.3-31).

A detailed discussion of the impacts from the thermal discharge to the Clinch River arm of the Watts Bar Reservoir from SMR operations at the CRN Site is provided in Subsection 5.3.2. The ORR Site 2 discharge (which would be located at approximately Clinch River mile [CRM] 14.2) and the ORR Site 8 discharge (which would be located at approximately CRM 22.7, 8.5 mi upstream) are each situated in a similar hydrologic setting on the Clinch River arm of the Watts Bar Reservoir. Because there are no major tributaries entering the reservoir in this area, the

flow rate and bathymetry and, therefore, the ability of the reservoir to absorb the thermal impact, should be similar for these three sites. Minor differences in bathymetry could result in higher or lower impacts at any of the sites, but these differences would likely be addressed through siting of the discharge structure and/or modification of continuous by-pass flow rates at Melton Hill Dam, as was proposed in the hydrothermal analysis for the CRN Site. Therefore, it is assumed that the thermal impacts associated with the operations of two or more SMRs at the ORR Alternative Sites would be similar to those discussed for the CRN Site in Subsection 5.3.2.

The analyses in Subsections 4.3.2, 5.3.1, 5.3.2, and 5.6.2 of potential impacts to aquatic resources from installation of an SMR facility at the CRN Site concluded that impacts associated with preconstruction, construction, and operation of the SMR facility and associated offsite facilities would be SMALL. Preconstruction, construction, and operation of the SMR facility and associated offsite facilities are likely to have similar effects on the Clinch River arm of the Watts Bar Reservoir or Melton Hill Reservoir if located at ORR Sites 2 or 8. Impacts on aquatic resources would result from operation of the cooling water intake and discharge in the reservoir as well as activities such as in-water construction of intake or discharge structures, dredging in conjunction with the installation of these structures, or sedimentation from stormwater runoff or sediment disturbance and transport within water bodies as a result of such activities. The potential for occurrence of listed or other special status aquatic species on ORR Site 2 or 8, in water bodies near each site, or in the reservoir in the vicinity of the potential intake or discharge structure locations is minimal. BMPs would be employed throughout preconstruction and construction activities, and TVA would comply with associated permits. Therefore, the aquatic impacts associated with preconstruction and construction are likely to be minimal and similar to those described for the CRN Site. The use of closed-cycle cooling and mechanical draft cooling towers, the small proportion of water that would be withdrawn, the expected design and location of the intake, and the composition of the aquatic community indicate that the impacts from entrainment, impingement, or other effects on fish and other aquatic organisms due to the operation of the cooling water intake system would be minor. Thus, the results of this assessment indicate that impacts on aquatic ecology at each of the Alternative Sites from the combined impacts of preconstruction, construction, and operation of an SMR facility and associated offsite facilities would also be SMALL.

Redstone Arsenal Site 12

For the purpose of this analysis, the geographic area of interest is defined as the area of Redstone Arsenal Site 12 and associated linear facilities extending off the site, as well as the middle portion of Wheeler Reservoir. This geographic area of interest is expected to encompass drainages associated with area of Redstone Arsenal Site 12 and associated offsite areas where effects on aquatic ecology from the operation of the SMR facility could occur.

At Redstone Arsenal, the principal aquatic resource is Wheeler Reservoir, an impoundment of the Tennessee River that forms the southern boundary of the installation. Approximately one-third of the installation lies within the 100-yr floodplain (Reference 9.3-27). Other aquatic habitats on the installation include manmade ponds (excavations for gravel and quarrying),

streams, and springs (Reference 9.3-33). The largest streams within the installation are Indian Creek, McDonald Creek, and Huntsville Spring Branch (Reference 9.3-27). For Redstone Arsenal Site 12, cooling water would be withdrawn from and cooling tower blowdown would be returned to Wheeler Reservoir. As described previously, the Tennessee River (Wheeler Reservoir) at the Whitesburg, Alabama gaging station, located approximately 10 mi upstream of the potential intake location for Redstone Arsenal Site 12, had an average monthly flow of approximately 42,230 cfs from 1924 to 1960 (Reference 9.3-34). Redstone Arsenal currently operates two intakes along Wheeler Reservoir for separate domestic and industrial water systems on the Arsenal (Reference 9.3-35). Figure 9.3-8 shows the proposed intake and discharge locations for Redstone Arsenal Site 12.

Indian Creek is located east and south of Redstone Arsenal Site 12. As a result, it likely would need to be crossed by the cooling water intake and discharge pipelines near the reservoir south of the site, and possibly by the transmission line northeast of the site. Indian Creek is within Wheeler NWR, so installation of the pipelines and transmission line would impact NWR resources. In addition, Indian Creek has been identified by EPA as being impaired due to historical contamination by the pesticide DDT. Thus, in-water work may have the potential to mobilize DDT and other contaminants that may be bound to stream sediment, and the implementation of BMPs to effectively control sediment transport could be particularly important for the protection of wildlife in Wheeler NWR.

BMPs would be employed to minimize the potential for adverse effects from erosion and sedimentation due to the clearing of offsite corridors and the installation of facilities in the vicinity of streams or reservoirs. As discussed for the CRN Site in Subsection 4.3.2.3, the installation of structures such as the intake, discharge, and barge facility may involve excavation near the shoreline and in the water of Wheeler Reservoir. BMPs likely to be employed to minimize sediment transport associated with these activities in the reservoir include silt curtains and cofferdams. The aquatic and benthic habitats within the footprints of such structures would be lost; however, these areas would be very small in comparison to the extensive area of such habitats present within Wheeler Reservoir in the vicinity of the site.

Redstone Arsenal Site 12 does not contain streams that would be affected by onsite preconstruction or construction. A barge dock facility constructed and used by the National Aeronautics and Space Administration (NASA) is present in the vicinity of Redstone Arsenal Site 12. It was assumed that this barge facility could be used for the SMR project and that essentially no dredging or other in-water work would occur at the barge facility for this site.

Wheeler Reservoir supports a fish community that includes largemouth bass, black crappie, bluegill, channel catfish, and other common species. The invertebrate community includes many species of native freshwater mussels and snails. (Reference 9.3-28)

As discussed above, the potential for impacts to the aquatic community of Wheeler Reservoir from operation of the cooling water intake is minimal due to CWA Section 316(b) requirements that limit entrainment and impingement of aquatic organisms at the intake. Similarly, the

discharge structure within Wheeler Reservoir would be designed to comply with thermal limits imposed by a site-specific NPDES permit for the protection of aquatic life, and the flow rate in Wheeler Reservoir is more than 40 times that in the Clinch River arm of the Watts Bar Reservoir. The SMR facility would use a closed-cycle cooling system with mechanical draft cooling towers in order to minimize the rate of cooling water withdrawal and reduce the temperature of the discharge. For the discharge, thermal limits would be imposed by a site-specific NPDES permit for the protection of aquatic life. Thus, the numbers of organisms in the reservoir that potentially would be impacted by operation of the SMR cooling water system would be limited, requirements of CWA Section 316(a) and (b) would be met, and impacts to the aquatic community of Wheeler Reservoir would be small.

The Brown's Ferry Nuclear (BFN) Plant provides an example of the limited impacts on the aquatic community produced by the operation of an existing nuclear facility on Wheeler Reservoir. The BFN Plant is located on Wheeler Reservoir approximately 27 Tennessee River miles (TRM) downstream of the potential discharge location for the SMR Project. The BFN facility includes three large nuclear units that normally operate in open mode using once-through cooling. As a result, the BFN facility withdraws and discharges substantially greater amounts of cooling water than would the closed-cycle SMR facility (an average intake flow of approximately 2.2 million gpm for the BFN facility versus 18,423 gpm for the SMR facility). The NRC concluded in the EIS for relicensing of the BFN facility (NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, Supplement 21, 2005) that its operation has small impacts on fish and shellfish in Wheeler Reservoir from entrainment, impingement, and thermal effects (heat shock). The BFN facility withdraws cooling water from Wheeler Reservoir at a rate more than 100 times that of the SMR facility, yet it has only small impacts on aquatic ecology. Therefore, such impacts from the operation of the SMR cooling system are predicted to be small.

Among the aquatic species potentially affected by SMR operation are several rare species. Multiple aquatic species that are federally listed as endangered or threatened have the potential to occur in Madison County. In this county, 24 aquatic species are federally listed or proposed for federal listing, and 58 aquatic species are state-listed as protected (Reference 9.3-30). The potential for occurrence of listed or other special status aquatic species on Redstone Arsenal Site 12 is minimal due to the absence of significant aquatic habitats on the site. Information from the TVA Natural Heritage database indicates no recorded occurrences of federally or state-listed aquatic species on or adjacent to Redstone Arsenal Site 12.

Listed aquatic species in Wheeler Reservoir potentially could be impacted if they occur in the vicinity of the intake or discharge structures, which would be located on the north shore of Wheeler Reservoir at the southwest corner of Redstone Arsenal near TRM 321 to 322 (more than 2 mi south of Redstone Arsenal Site 12). Of the three federally or state-listed fish species in Madison County, only the snail darter (*Percina tanasi*), which is federally listed as threatened and is state protected, may be likely to occur in Wheeler Reservoir. The closest occurrence of the snail darter to Redstone Arsenal is a population in the Paint Rock River, a tributary to the upper reach of Wheeler Reservoir, and this species appears to be somewhat tolerant of

reservoir conditions. The snail darter inhabits mainly larger creeks and the deeper portions of rivers and reservoirs where current is present. It has not been determined if the snail darter occupies impounded reaches of mainstem Tennessee River reservoirs, but it has been found in greatest numbers in flowing reaches of tributaries to the Tennessee River, upstream of impoundments. (Reference 9.3-36) Accordingly, the snail darter would not be expected to occur in the downstream reach of Wheeler Reservoir where the intake and discharge would be located for Redstone Arsenal Site 12.

Similarly, the hellbender (*Cryptobranchus alleganiensis*) is the only state protected amphibian potentially occurring in Wheeler Reservoir, and its preferred habitat of medium to large streams and rivers with fast-flowing water and rocky substrates (Subsection 2.4.2.3.2) is not present in the reach of the reservoir where the intake and discharge would be located.

Freshwater mussels constitute the largest group of listed aquatic species in Madison County: 25 species have a state protected status, and 19 of these also have a federal listing status of endangered or threatened or have been proposed for federal listing (Reference 9.3-30). The state also has designated additional mussel species with a state partial status if they are protected by other regulations. In Wheeler Reservoir, this includes 24 mussel species that have a partial status for their protection within two separate reaches located in the upper portion of the reservoir between approximately TRM 333 (which is approximately 12 river miles upstream of the Redstone Arsenal Site 12 intake) and Guntersville Dam. Critical habitat has not been designated in the vicinity of Redstone Arsenal for the federally listed mussels. The listed mussel species predominantly require habitats with currents and substrates that are unlikely to occur in the portion of Wheeler Reservoir adjacent to Redstone Arsenal. Therefore, these mussels are unlikely to occur in the area of the SMR intake or discharge and are unlikely to be affected by operation of the cooling water system or in-water work such as facility construction or associated dredging. In order to confirm this assessment, mussel surveys would be required in the potentially affected areas.

Preconstruction, construction, and operation of the SMR facility at Redstone Arsenal Site 12 and associated offsite facilities are likely to have similar effects on Wheeler Reservoir. Impacts on aquatic resources at Redstone Arsenal Site 12 would result from operation of the cooling water intake and discharge in the reservoir as well as activities such as in-water construction of intake or discharge structures, dredging in conjunction with the installation of these structures, or sedimentation from stormwater runoff or sediment disturbance and transport within water bodies as a result of such activities. The potential for occurrence of listed or other special status aquatic species on Redstone Arsenal Site 12, in water bodies near the site, or in Wheeler Reservoir in the vicinity of the potential intake or discharge structure locations is minimal. BMPs would be employed throughout preconstruction and construction activities, and TVA would comply with associated permits. Therefore, the aquatic impacts associated with preconstruction and construction are likely to be minimal and similar to those described for the CRN Site. The use of closed-cycle cooling and mechanical draft cooling towers, the small proportion of water that would be withdrawn, the expected design and location of the intake, and the composition of the aquatic community indicate that the impacts from entrainment, impingement, or other effects

on fish and other aquatic organisms due to the operation of the cooling water intake system would be minor. Thus, the results of this assessment indicate that impacts on aquatic ecology in the area of Redstone Arsenal Site 12 from the combined impacts of preconstruction, construction, and operation of an SMR facility and associated offsite facilities would also be SMALL.

9.3.4.1.5 Socioeconomics

CRN Site and ORR Sites 2 and 8

Air Quality

The geographic area of interest for air quality is a 5-mi radius during preconstruction and construction and a 10-mi radius during operations for each site. For the CRN Site the potential air quality impacts are described in Subsections 4.4.1.2 and 5.8.1.2. Supporting equipment associated with the operation of the SMR facility (but not production of electricity) would generate minor levels of criteria pollutants or air toxics emissions. Motor vehicle emissions are not expected to create significant impacts. The conclusion in these subsections is that preconstruction, construction and operation would not destabilize or noticeably alter air quality and the impacts would be SMALL.

Air quality impacts of construction and operation of the SMR Project ORR Sites 2 and 8 would be similar to the impacts for the CRN Site. The CRN Site and ORR Sites 2 and 8 are each in locations regulated as attainment areas for all criteria pollutants. Thus existing air quality in the vicinity of each of these sites is similar. Preconstruction- and construction-related air emissions would be similar for each of the ORR Sites. Also during operation of the SMR Project, there would be no appreciable differences in air emissions expected for the CRN Site or ORR Sites 2 or 8. The impacts to air quality from preconstruction, construction, and operation of the SMR Project at the CRN Site and at ORR Sites 2 and 8 would not destabilize or noticeably alter air quality in the area and would therefore be SMALL.

Noise

Potential noise impacts from preconstruction, construction, and operation of the SMR Project at the CRN Site are presented in Subsections 4.4.1.1 and 5.8.1.1. The geographic area of interest for noise is within 5 mi of the site. The indirect noise and vibration impacts to the public from construction-related traffic on local roads associated with preconstruction and construction activities at the CRN Site would be small to moderate. Direct noise and vibration impacts from CRN Site preconstruction and construction would be small for the surrounding communities and the nearest residents. During operation, noise impact from the mechanical draft cooling towers, the main source of continuous onsite noise, would be small. There are no anticipated increases to the current ambient noise levels associated with the operation of the transmission system, and the effect of the SMR Project on transmission line noise would be small. The sources and levels of onsite and offsite noise would be the same for ORR Sites 2 and 8 and sensitive

receptors would be similar. Therefore, the impacts to noise from preconstruction, construction, and operation of the SMR Project at the CRN Site and at ORR Sites 2 and 8 would be SMALL.

Human Health

The geographic area of interest for human health is a radius of 50 mi around the site. Potential human health impacts from radiological exposures for the CRN Site are described in Subsections 4.5.6 and 5.4.3. These sections concluded that the preconstruction, construction, and operational-related impacts to human health are within regulatory limits for the protection of human health and thus impacts would be SMALL. As described in Sections 4.2, 5.3, and 5.6, the non-radiological impacts on the surrounding public from any public health impacts as a result of SMR Project operation at the CRN Site would be small. Public health impacts were evaluated for cooling system effects on surface water and the atmosphere and transmission line effects on members of the public.

Because the ORR Sites 2 and 8 are within the same geographic region as the CRN Site, site-specific meteorological data, water and other exposure pathways, and potential exposed populations are similar for the ORR Sites 2 and 8. Therefore the human health impacts from radiological and non-radiological emissions at ORR Sites 2 and 8 would be similar to the impacts from the CRN Site.

Radiological emissions and dose impacts would comply with regulatory dose limits (e.g., offsite dose less than 100 mrem/yr) for ORR Sites 2 and 8 as they would for the CRN Site. Compliance at ORR Sites 2 and 8 would not require mitigation above what would be required at the CRN Site. Therefore, human health impacts would be comparable and the impacts from preconstruction, construction, operations for ORR Sites 2 and 8 would be SMALL.

Population

The number of in-migrant workers is dependent on labor availability within commuting distance of the plant site. If an adequate supply of workers is available within reasonable commuting distance, few workers would choose to relocate to the site. Potential socioeconomic effects are associated with any temporary influx of construction workers who live too far away to commute daily from their residence. The geographic area of interest for population is Anderson, Knox, Loudon, and Roane Counties, Tennessee, the four counties where the majority of the employees at the DOE Oak Ridge facility reside (as described in Subsection 2.5.2.6).

The capacity of communities to absorb an increase in population depends on the availability of sufficient resources such as adequate housing and community services (e.g., schools, hospitals, police, transportation systems, and fire protection) to support the influx without straining existing services. The factors considered in evaluating sites from the perspective of preconstruction and construction effects include labor requirements, location of labor pool, number of in-migrants, and the economic structure of affected communities. Construction employment would be the same for the CRN Site and ORR Sites 2 and 8, with an estimated

peak overlap workforce of approximately 3666 workers onsite during any 24-hr period associated with the construction of the SMR Project.

In Subsection 3.10.2, several assumptions were used to bound the construction workforce composition with respect to workforce commuting and relocation. It was assumed that construction workers typically commute up to a maximum of 50 mi to the jobsite. It was assumed that 80 percent of the field craft labor workforce (2033 personnel) would be available to the project from within a 50-mi radius (based on a peak construction workforce of 3300 x 77 percent field craft labor = 2541 craft workers x 80 percent from within 50 mi = 2033 local craft personnel). The balance of the construction craft workforce (2541 x 20 percent = 508 personnel) would come from outside the 50-mi radius. These personnel are assumed to relocate within the geographic area of interest to minimize their commute distance and seek temporary housing. It was also assumed that 20 percent of the field non-manual labor workforce (152 personnel) would come from the local labor market within the 50-mi area, and commute (based on a peak construction workforce of 3300 x 23 percent field non-manual labor = 759 workers x 20 percent from within 50 mi = 152 local non-manual personnel). The balance of the field non-manual labor staff, or 607 personnel (759 x 80 percent), would relocate from outside the 50-mi radius and seek permanent housing. Therefore, the total in-migrating construction workforce would be 1115 workers (508 craft labor + 607 non-manual).

The socioeconomic effects of operations are measured by the demands placed by the operations workforce on the surrounding region and the benefits afforded to local communities as a result of wages earned by the workforce and expenditures made to support operations at the facility. The factors considered in evaluating Alternative Sites from the perspective of operations effects are the same as those considered for preconstruction- and construction-related effects. They include labor requirements, location of labor pool, number of in-migrants, and the economic structure of affected communities. The capacity of communities to absorb an increase in population depends on the availability of sufficient resources such as adequate housing and community services (e.g., schools, hospitals, police, transportation systems, and fire protection) to support the influx without straining existing services. Operations employment will be the same for the CRN Site and ORR Sites 2 and 8, with an estimated 500 workers onsite for full plant operation, as indicated in Table 3.1-2, Item 16.3.1.

It is assumed that 50 percent of the total operations workers (500 x 50 percent = 250) would be recruited and trained from within a 50-mi radius, based on the information presented in Section 3.10 and the size of the population and workforce in the counties surrounding the ORR. The remaining 50 percent, or 250 workers, would relocate from outside of the 50-mi radius. It is conservatively assumed that 100 percent of these in-migrating workers would relocate within the geographic area of interest.

The proposed SMR Project includes construction of multiple SMRs that would be brought into operation sequentially; therefore, there would be a period of time when one or more SMR(s) is operating while other SMR(s) are being constructed. The duration of this overlap between construction and operation would be expected to take between three and five years. During that

overlap period, the combined project workforce, independent of the site location, would include the peak construction workforce (3300 workers) plus the operation workforce present at the same time (approximately 366) for an estimated peak overlap workforce of 3666 workers.

The ORR is located within the city limits of Oak Ridge, Tennessee, which has a population of 29,330 (Reference 9.3-37). The closest metropolitan area is Knoxville, Tennessee, located approximately 25 mi east of the CRN Site and ORR Sites 2 and 8. The Knoxville, Tennessee city population is 178,874 (Reference 9.3-38). The data used is based on the U.S Census Bureau population by zip code. The total area and population of every zip code that is located entirely or partially within the 20-mi radius was included in the calculation. A total of approximately 837,570 people reside within this area of 3470.3 square miles. Therefore, the population density is 241 persons per square mi. Approximately 9600 people are employed at Oak Ridge National Laboratory (ORNL) and Y-12 Complex, the major employers at ORR, and spend a portion of each workday within ORR and nearby areas.

The total 2010 population of the geographic area of interest (the four counties surrounding the ORR) was 610,092 (Reference 9.3-39). As projected by the State of Tennessee, the total population of these counties would be about 807,594 by the year 2040 (Reference 9.3-40). It is assumed that each construction and operations worker that relocates into the geographic area of interest would bring a family. As presented in Subsection 4.4.2.1, an in-migrating construction workforce of 1115 would increase the population in the geographic area of interest by 2765 people, or 0.5 percent of the geographic area of interest population in 2010. Subsection 5.8.2.1.1 identifies a total population increase of 620 associated with an in-migrating operations workforce of 250, with the total increase constituting 0.1 percent of the 2010 population of the geographic area of interest. During the overlap period between construction and operation, the population in the geographic area of interest would increase by 3385 people (2765 associated with construction and 620 associated with operation). This combined population increase constitutes 0.6 percent of the 2010 population of the geographic area of interest.

Because the CRN Site and ORR Sites 2 and 8 would be drawing the workforce from the same communities, it was assumed that the increased demands on housing and community services, such as utilities, schools, hospitals, and police and fire protection would be the same. The in-migrating construction workers and their families would represent a small increase to the total population within the geographic area of interest for the ORR sites (0.5 percent). The in-migrating operations workers would represent an even smaller increase to the population in the geographic area of interest for the ORR sites (0.1 percent). The combined population increase associated with in-migrating workers during the overlap period between construction and operation represents a small increase to the total population within the geographic area of interest for the ORR sites (0.6 percent). Therefore, for both preconstruction/construction and operations and for the overlap period when both preconstruction/construction activities and operation occur, the in-migrating construction and operations workers along with their families would represent less than 1.0 percent of the population in the geographic area of interest and population impacts would be SMALL for the CRN Site and ORR Sites 2 and 8.

Housing

Definitions of significance levels of impacts that result from increased housing demand, as per NUREG-1437, Revision 1, are provided in Subsection 4.4.2.1. In summary, SMALL impacts result when no easily discernible change in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and no extraordinary housing construction or conversion occurs. MODERATE impacts result when there is a discernible reduction in housing availability, rise in rental rates or housing values exceed the inflation rate elsewhere in the state, and minor housing conversions or temporary additions occur. LARGE impacts occur when project-related demand results in very limited housing availability, considerable increases in rental rates and housing values, and substantial conversion of housing units as well as overbuilding of new units. The geographic area of interest for housing is Anderson, Knox, Loudon, and Roane Counties, Tennessee.

As presented in Subsections 4.4.2.1 and 5.8.2.1.2 for the CRN Site, there is currently enough housing to accommodate all the expected in-migrating families associated with preconstruction, construction, and operations, as well as during the overlap period between preconstruction/construction and operations, in Knox County alone. Knox County, with the greatest number of housing units in the four-county geographic area of interest, had 17,700 vacant units in 2010, with 6777 for rent and 3747 for sale. This conclusion is also applicable to the ORR Sites 2 and 8.

Due to the large number (17,700) of available vacant housing units in the geographic area of interest and the relatively small requirements for the in-migrating preconstruction and construction workforce (1115 workers) operations workforce (250 workers), and overlap period in-migrating workforce (1365 workers), there would be no easily discernable change in housing availability, prices, and the rate of housing construction or conversions for the geographic area of interest. Therefore, the impacts on housing would be SMALL for the CRN Site and ORR Sites 2 and 8.

Economy and Tax Revenues

Per NUREG-1437, Revision 1, economic impacts are considered SMALL if project-related employment accounts for less than 5 percent of total employment in the geographic area of interest, MODERATE if it represents 5 to 10 percent, and LARGE if it represents more than 10 percent. The geographic area of interest for economy and tax revenues is Anderson, Knox, Loudon, and Roane Counties, Tennessee.

Anderson, Knox, Loudon, and Roane Counties had a total 2011 employment of 393,763 jobs. Government and government enterprises provide 12.6 percent of the jobs. Retail trade is the next largest employment sector, providing 11.2 percent of the jobs. Health care and social assistance is the third largest sector, with 11.0 percent of employment. The construction sector employs 21,524 persons, representing 5.5 percent of employment in the four counties. (Reference 9.3-41; Reference 9.3-42; Reference 9.3-43; Reference 9.3-44) A total of 24,003

people were unemployed in the four counties in 2011, which represents an unemployment rate of 7.4 percent (Reference 9.3-45).

The preconstruction and construction workforce of 3300 assumed for the SMR Project accounts for less than 1 percent of the total workforce (based on 2011 employment levels) within the four counties in the geographic area of interest. Based on existing construction employment of 21,254 persons in the geographic area of interest, the estimated plant preconstruction and construction workforce represents an increase of approximately 15 percent in the construction workforce.

For the ORR Sites, the 500 operations workers assumed for the SMR Project account for 0.1 percent of the total workforce (based on 2011 employment levels) within the four counties in the geographic area of interest, and the 1000 temporary refueling outage workers represent 0.2 percent of the total workforce. During the overlap period between preconstruction/construction and operation, the total workforce of 3666 represents less than 1 percent of the total workforce.

The employment of the preconstruction, construction, and operations workforce and temporary refueling outage workers, and expenditures for goods and services associated with activities at the SMR Project, would have positive economic effects on the geographic area of interest. The analysis of economic impacts associated with preconstruction, construction, and operation of the SMR Project at the CRN Site is presented in Subsections 4.4.2 and 5.8.2. Preconstruction and construction employment, operations employment, and the total employment during the overlap period between construction and operations each account for less than 5 percent of employment within the four counties in the geographic area of interest. Therefore, the impact of preconstruction, construction, and operation employment (an increase of employment of up to 1 percent including the total employment during the overlap period) on the economy of the geographic area of interest for the ORR Sites would be SMALL and beneficial.

Per NUREG-1437, Revision 1, tax impacts are considered SMALL if potential new tax payments, or tax equivalent payments, constitute less than 10 percent of total revenues for local taxing jurisdictions, MODERATE if they represent 10 to 20 percent, and LARGE if they represent more than 20 percent.

As discussed in Subsection 2.5.2.3, TVA makes tax equivalent payments to eight states under Section 13 of the TVA Act of 1933, including the State of Tennessee. TVA pays 5 percent of its gross proceeds from the sale of power (with certain exclusions) to states where its power operations are carried out. Payments to each state are determined based upon the proportion of TVA power property and power sales, in each state, compared to TVA's total power property and power sales, respectively.

The amount of the funding provided to the counties and municipalities is determined by the individual state. TVA's tax equivalent payments to the State of Tennessee and the state's allocation of those payments to local governments are presented in Subsection 2.5.2.3. The State of Tennessee allocation paid by TVA during FY 2013-2014 was $331.6 million. From that,

Tennessee paid $96.1 million to counties, including $1.1 million to Anderson County, $3.4 million to Knox County, $1.1 million to Loudon County, and $1.6 million to Roane County. Total annual tax revenues collected in fiscal year (FY) 2013-2014 were $109.6 million for Anderson County, $846.9 million for Knox County, $67.3 million for Loudon County, and $91.3 million for Roane County (Reference 9.3-46). Therefore, the percentage of total county revenues represented by the TVA tax equivalent payment (i.e., TVA payment divided by total county revenues) for FY 2013-2014 ranged from 0.4 percent for Knox County to 1.8 percent for Roane County.

Several types of taxes would be generated by the preconstruction, construction, and operation of the SMR facility at the CRN Site, ORR Site 2, or ORR Site 8. Sales and use taxes would be generated through retail expenditures of the construction and operations workforce, and through purchase of construction materials and supplies. Property tax revenues would be generated by the increased economic activity involving the construction and operations workforce.

Quantitative estimates of the impact payments associated with the SMR Project at the ORR Sites are not available at this time. The TVA tax equivalent payments compared to the total amount of taxes collected would be more than the current 0.4 percent for Knox County and more than 1.8 percent for Roane County. Given the structure by which the TVA makes tax equivalent payments, the general distribution structure of funding by the State of Tennessee, as well as the increase in sales and property taxes, the potential impact of taxes for CRN Site, ORR Site 2, or ORR Site 8 would be considered SMALL and beneficial.

Transportation

NUREG-1437, Revision 1 presents criteria for the assessment of transportation impacts based on the effect of project-related traffic on the level of service (LOS) for roadways within the relevant study area. In summary, LOS A and B are associated with SMALL impacts because the operation of individual users is not substantially affected by the presence of other users; no delays occur and no improvements are needed. LOS C and D are associated with MODERATE impacts because the operation of individual users begins to be severely restricted by other users; upgrading of roads or additional control systems may be required. LOS E and F are associated with LARGE impacts because the use of the roadway is at or above capacity level, causing traffic delays and a potential increase in accident rates; major renovations of existing roads or additional roads may be needed. The geographic area of interest for transportation is Anderson, Knox, Loudon, and Roane Counties, Tennessee.

Construction of the SMR Project requires dependable transportation alternatives for large vehicles and adequate road capacity to accommodate the preconstruction and construction workforce. The Alternative Sites were evaluated on the capacity of the surrounding transportation system to accommodate construction and worker vehicles required for preconstruction and construction of the SMR Project.

A rural principal arterial, Interstate (I-) 40, is located south of the CRN Site and ORR Sites 2 and 8 and the Clinch River arm of the Watts Bar Reservoir. Two rural principal arterials traverse the installation providing access to the center of the ORR from I-40. The northwestern portion of the ORR is traversed by TN 58 and the northeastern portion of the ORR is traversed by TN 95. TN 58 and TN 95 intersect near the center of the ORR. No major roadway improvements are planned for the area. The City of Oak Ridge and the Tennessee Department of Transportation (TDOT) are planning a General Aviation Airport in the area to potentially support regional growth, job creation, and economic and community development (Reference 9.3-47). The construction date for this airport has not been established.

Southern Freight Logistics, specializing in warehousing, trucking, air, and rail transportation, is headquartered in Oak Ridge, Tennessee. This company has earned permits to transport hazardous waste or materials by the State of Tennessee, the U.S. Department of Transportation, and by the Interstate Commerce Commission. The company is located in the Heritage Center, which is in close proximity to I-40 and I-75 and within one day's drive of more than 65 percent of major United States metropolitan areas. Southern Freight Railroad is a "handling line" for Norfolk Southern Railroad. (Reference 9.3-48)

There is an inactive barge terminal once used by the DOE located at CRM 13.1. This inactive barge terminal has access to TN 58 via Bear Creek Road. There is currently no truck or rail access to or from this terminal. (Reference 9.3-49) This is the only known barge terminal in the vicinity of the ORR Sites. The ORR Sites are immediately adjacent to the Clinch River (Clinch River arm of the Watts Bar Reservoir). The Clinch River is a major tributary of the Tennessee River. The Tennessee River has a main navigable channel 652 mi long beginning at Knoxville and merging with the Ohio River in Paducah, Kentucky. This channel is controlled by a series of nine mainstream dams and locks which are part of TVA's integrated river control system consisting of a total of 49 dams and 15 navigation locks (Reference 9.3-50). Commercial navigation occurs on the Clinch River for 61 mi (Reference 9.3-51). The commercially navigable portion of the Clinch River extends from its mouth near Kingston, Tennessee upstream to Clinton, Tennessee. The navigable portion of the Clinch River includes a navigation lock at the Melton Hill Dam. The lock is 75 ft by 400 ft and has a maximum lift of 60 ft. (Reference 9.3-9) Therefore, barge access from all ORR Sites is feasible.

In the City of Oak Ridge, Energy Solutions, LLC operates the 11.5-mi Heritage Railroad shortline serving the ETTP (Reference 9.3-52). A second shortline, operated by Knoxville and Holston River Railroad, extends 18 mi from Knoxville through Knox County (Reference 9.3-53). Both of these lines connect with rail lines operated by Norfolk Southern Railway Company. Norfolk Southern rail lines are located approximately 7.5 mi northwest and 9 mi southeast of the CRN Site. The line to the southeast runs through Knoxville, Tennessee, connecting Chattanooga, Tennessee with Johnson City and Kingsport, Tennessee. (Reference 9.3-54) There are currently no rail spurs to any of the ORR Sites. However, Heritage Railroad is located approximately 2.5 mi north-northwest of the center point of the CRN Site, northwest of TN 58 (Reference 9.3-55).

The same primary roads would be used to access the CRN Site and ORR Sites 2 and 8. The construction and operations workforce is anticipated to access ORR Site 2 and the CRN Site via Bear Creek Road from TN 58 and ORR Site 8 via TN 95 (Figure 9.3-4). Vehicle volumes on roads in the vicinity of the ORR Sites are provided by the TDOT in the form of estimated annual average daily traffic (AADT) counts. The AADT counts for the primary access roads to the CRN Site were last updated in 2012. The AADT counts for TN 58 (Gallaher Road / Oak Ridge Turnpike), TN 95 (White Wing Road / Oak Ridge Turnpike), TN 327 (Blair Road), and Bear Creek Road as described in Subsection 2.5.2.2.3 Traffic Conditions would be applicable for each of the ORR Sites.

Subsection 2.5.2.2.3 also describes the capacity analyses that were performed for the four intersections most likely to be affected by the preconstruction, construction, and operation of the SMR Project at the CRN Site. Figure 2.5.2-1 shows the locations of the intersections investigated during the traffic study. These intersections are TN 58 at Bear Creek Road Ramp (Location 1), TN 58 at TN 327 (Location 2), TN 95 at Bear Creek Road (Location 3), and Bear Creek Road at Bear Creek Road Ramp (Location 4). Capacity analyses were performed for 2013 AM and PM peak hours for all the intersections analyzed. The capacity analysis for the CRN Site is addressed in Subsection 4.4.2.3. The results of the traffic assessment, including LOS and delay for each study intersection, are summarized in Table 4.4-4 for all periods analyzed. The same capacity analysis can be applied to ORR Site 2. Preconstruction and construction traffic would typically access ORR Site 2 via Oak Ridge Turnpike (TN 58) and/or Bear Creek Road. Similar roadway modifications would be required for ORR Site 2 as for the CRN Site. The modifications required for preconstruction and construction (based on 3300 workers) would then accommodate the anticipated operation traffic (based on 366 workers) and traffic during the overlap period between preconstruction/construction and operation (based on 3666 workers).

Subsection 2.5.2.2.4 describes the traffic accident analysis conducted on segments of the three primary roadways used to access the CRN Site (ORR Site 3) and ORR Site 2. Subsection 4.4.2.3 describes the potential increase in traffic accidents and related injuries and fatalities associated with construction at the CRN Site. Since the same roads are used to access the CRN Site and ORR Site 2, the traffic analysis for the CRN Site is applicable to ORR Site 2. As shown in Table 4.4-8, the number of traffic accidents would noticeably increase on TN 58 by approximately 43 percent during peak overlap workforce period occurring during the construction and operations overlap period. Those increases would not destabilize traffic flow or safety along these roadways, thus having a moderate impact. The approximate 9 percent and 10 percent increases in number of traffic accidents on TN 95 and TN 327, respectively, during the peak overlap workforce period would be minor and would neither destabilize nor noticeably alter traffic flow and/or safety on these roadways, thus having a small impact.

These impacts for the CRN Site and ORR Site 2 would be minimized through implementation of roadway modifications discussed in Subsection 4.4.2.3, and through the use of best management practices (BMPs), such as posting signs near construction entrances and exits to make the public aware of areas with high construction traffic, development of a traffic control

mitigation plan, use of staggered shift start and end times, use of carpooling, and scheduling of deliveries to avoid peak traffic periods.

Based on the traffic study conducted in association with the CRN Site (which would also apply to ORR Site 2), recommended modifications would be implemented and the resulting direct and indirect impacts to traffic during preconstruction and construction would be MODERATE (individual drivers would begin to be severely restricted by the presence of other drivers) and temporary, and impacts to traffic during operations would be SMALL (individual users are not substantially affected) for the CRN Site and ORR Site 2. Therefore, traffic impacts associated with the total employment during preconstruction/construction and operations would be SMALL to MODERATE for the CRN Site and ORR Site 2.

Construction traffic would typically access ORR Site 8 directly from TN 95 and not use TN 58 or TN 327. The projected workforce is expected to nearly double the traffic on TN 95 and this additional traffic would noticeably increase yearly accidents (by approximately 81 percent), injuries (by approximately 86 percent), and fatalities (by approximately 87 percent) along TN 95 during the period of peak overlap workforce. The increase in accidents would be noticeable, but would not likely destabilize traffic flow and/or safety along TN 95, thus having a moderate impact.

The ORR Site 8 traffic analysis included an assessment of traffic capacity on TN 95 for the anticipated 2024 peak year of construction traffic. The ORR Site 8 traffic capacity assessment evaluated the conditions for all construction traffic utilizing TN 95 alone, as compared to the three roadways traffic would disperse across the ORR Sites 2 and 3. The traffic analysis determined that there would be large impacts to traffic flow on TN 95 during construction. To minimize these large impacts, roadway modifications would be required potentially including:

- Installation of a traffic signal at the intersection of TN 95 and the entrance to ORR Site 8 (Greenway Road).
- Construction of a free flow northbound right-turn lane on TN 95 with 400 feet (ft) of storage.
- Construction of a southbound left-turn lane on TN 95 with 500 ft of storage and protected permissive phasing.
- Development of two separate lanes entering the site on Greenway Road (one for the northbound free flow right-turn lane and one for the southbound left-turn lane from TN 95).
- Construction of dual westbound left-turn lanes on Greenway Road and an exclusive right-turn lane. The left and right-turn lane should have at least 300 ft of storage. One of the left-turn lanes should extend all the way into ORR Site 8.

- Widening of TN 95 south of Greenway Road to two lanes southbound to receive the dual westbound left-turn lanes. The two southbound lanes should merge back into one lane southbound just prior to TN 95 bridge over the Watts Bar Reservoir.

Using the above recommended improvements, the intersection of TN 95 at Greenway Road is expected to operate at an overall LOS C in both the AM (29.5 seconds delay) and PM (29.8 seconds delay) peak hours. Turn lanes entering and exiting the site have been recommended to minimize queuing. After completion of construction, the need for a signal would be reevaluated to determine if it needs to remain permanently. A separate traffic analysis would be required to examine operation at the I-40 interchange with respect to construction and operations at ORR Site 8. (Reference 9.3-123)

The resulting direct and indirect impacts to traffic during the peak overlap workforce period at ORR Site 8 would be MODERATE and temporary, and impacts to traffic during operations would be SMALL. Therefore, traffic impacts associated with the total employment during preconstruction/construction and operations would be SMALL to MODERATE for ORR Site 8.

Visual Intrusions

Definitions of significance levels of impacts that result from visual intrusions, as per NUREG-1437, Revision 1, are provided in Subsection 4.4.2.6. The criteria address a changed sense of place or a diminution in the enjoyment of the physical environment, and impacts to socioeconomic institutions and processes. In summary, SMALL impacts result when there are no complaints from the affected public and no measurable socioeconomic impacts. MODERATE impacts result when there are some complaints and measurable impacts that do not alter socioeconomic functioning. LARGE impacts occur when there is widely shared opposition based on reduced sense of place or enjoyment and measurable social impacts that disturb the functioning of the community. The geographic area of interest for visual intrusions includes the 2-mi radius surrounding each site.

For the proposed CRN Site the potential visual intrusion impacts associated with preconstruction and construction are described in Subsection 4.4.2.6. Although most of the preconstruction and construction activities are not expected to be visible to the general public, construction of the facility would entail the use of large cranes, which would be visible from local public roads. Additional activities such as use of large earth-moving equipment, relocation of a portion of the Kingston FP – Fort Loudon HP 161-kilovolt transmission line on the CRN Site, the transportation of large materials onto the CRN Site, and use of night time lighting would be visible to members of the public from the surrounding area. The locations of offsite activities (including road, rail, and barge area improvements) required for project implementation also would likely be more visible to observers. The conclusion in Subsection 4.4.2.6 is that preconstruction and construction-related impacts to visual intrusions would be SMALL for the general public and MODERATE for nearby residents and recreational users of the Clinch River arm of the Watts Bar Reservoir based on the anticipated likelihood of complaints from those groups about the SMR Project. ORR Site 2 has more hilly topography than the CRN Site and

preconstruction and construction activities would be more visible. Therefore, the visual impacts associated with ORR Site 2 would be MODERATE for the general public and nearby residents. Based on its location on a peninsula in the Melton Hill Reservoir, the visual impacts associated with ORR Site 8 would be similar to those identified for the CRN Site. In summary, visual intrusion impacts in the geographic area of interest from construction and preconstruction would be SMALL to MODERATE for the CRN Site and Site 8, and MODERATE for Site 2.

The potential visual intrusion impacts associated with operations at the CRN Site are described in Subsection 5.8.1.4. Most of the structures associated with the SMR Project are not expected to be visible to the general public. From a distance of approximately 2 mi, the SMR Project on the CRN Site would not be visible from most viewpoints. However, the average annual plume and the winter plume would draw the observer's attention to the facility, inserting an industrial aspect to a mostly natural landscape. The plume impacts would be greater on a clear, cloudless day than on an overcast day. Therefore, due to the plume, the visual intrusion impacts due to operation of the SMR Project at the CRN Site and at ORR Sites 2 and 8 would range from SMALL (no complaints) to MODERATE (some complaints), depending on the location of the observer and the atmospheric conditions.

Infrastructure

Demand from onsite construction activities as well as population increases in the geographic area of interest associated with preconstruction, construction, and operation were considered when evaluating the effects of the SMR Project on infrastructure. The geographic area of interest for infrastructure includes Anderson, Knox, Loudon, and Roane Counties, Tennessee. The primary community infrastructure components evaluated for the Alternative Sites are water supply facilities and wastewater treatment facilities.

Water Supply Facilities

As presented in Subsection 4.4.2.7, during preconstruction and construction at the CRN Site, the onsite potable water usage and the demand from the in-migrating construction workforce and their families would have small impacts on the local utilities' capacity to supply potable water to their customers within the geographic area of interest. As presented in Subsection 5.8.2.7, during operation at the CRN Site, the onsite potable water usage for operations workers and outage workers would have a small impact on water supply facilities. Impacts from potable water demand in the geographic area of interest from the in-migrating operation workers and their families also would be SMALL. Accordingly, impacts to water supply facilities from preconstruction, construction, and operation of the SMR Project at the CRN Site were determined to be SMALL. Because the CRN Site and ORR Sites 2 and 8 would generate the same demand for potable water and obtain it from the same water supply facilities, impacts for ORR Sites 2 and 8 also would be SMALL.

Wastewater Treatment Facilities

As presented in Subsection 4.4.2.7, during preconstruction and construction at the CRN Site, the wastewater produced onsite would have a moderate impact to wastewater treatment facilities. The demand from the in-migrating construction workforce and their families would have small impacts on the local utilities' capacity to supply wastewater treatment to their customers within the geographic area of interest. As presented in Subsection 5.8.2.7, during operation at the CRN Site, the wastewater produced onsite by operations workers and outage workers would have a small impact on wastewater treatment facilities. Impacts from wastewater treatment demand in the geographic area of interest from the in-migrating operation workers and their families also would be SMALL. Because the CRN Site and ORR Sites 2 and 8 would generate the same demand for wastewater treatment and obtain it from the same treatment facilities, impacts for ORR Sites 2 and 8 also would be SMALL.

Education

Potential impacts to education were evaluated based on the estimated number of school-aged children that would relocate to the geographic area of interest as a result of the SMR Project. The geographic area of interest for education includes Anderson, Knox, Loudon, and Roane Counties, Tennessee. As described in Subsection 4.4.2.8, an estimated 1365 workers (based on the peak overlap workforce) are assumed to come from outside the 50-mi region for the SMR Project at the CRN Site. This would result in a population increase of 3385 based on an average household size in Tennessee of 2.48 persons. In the 2010 U.S. Census Bureau estimates, 17.1 percent of the population of Tennessee was 5 to 17 years old (i.e., school age) and students account for 15.1 to 16.3 percent of total county populations in the four counties within the geographic area of interest. Using the highest county figure of 16.3 percent for student population, an estimated 552 school-aged children would relocate within the geographic area of interest. This represents an increase of 0.6 percent in the current public school population of 86,195 and would be SMALL. Because the population increase associated with preconstruction and construction activities at the CRN Site and at ORR Sites 2 and 8 would generate the same number of students, impacts for the ORR Sites 2 and 8 also would be SMALL.

As described in Subsection 5.8.2.8, an estimated 250 operations workers would come from outside the 50-mi region. This would result in a population increase of 620 based on an average household size in Tennessee of 2.48 persons. Using the highest county figure of 16.3 percent for student population, an estimated 101 school-aged children would relocate within the geographic area of interest. This represents an increase of 0.1 percent in the current public school population of 86,195 and would be SMALL. During the overlap period between construction and operation, the population in the geographic area of interest would increase by 3385 persons, including an estimated 552 school-aged children. This represents an increase of 0.6 percent in current public school enrollment, which is SMALL. Because the population increase associated with operation activities and the overlap period between construction and operation at the CRN Site and at ORR Sites 2 and 8 would generate the same number of students, impacts for ORR Sites 2 and 8 also would be SMALL.

Redstone Arsenal Site 12

Air Quality

The geographic area of interest for air quality is a 5-mi radius during preconstruction and construction and a 10-mi radius during operations for each site. The Redstone Arsenal operates under a Clean Air Act Title V major source operating permit issued by the ADEM in 2003 (Reference 9.3-56). Madison County is regulated as an attainment area for all of the air quality criteria pollutants (1-h ozone (O_3), 8-h O_3, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter with a diameter of less than 10 microns, particulate matter with a diameter less than 2.5 microns, and lead) (Reference 9.3-57). The Sipsey Wilderness Area in Alabama is a Class I Regional Haze area located within the William B. Bankhead National Forest, approximately 40 mi southwest of the Redstone Arsenal (Reference 9.3-58).

Redstone Arsenal Site 12 is in a location regulated as attainment areas for all criteria pollutants. Thus existing air quality in the vicinity of Redstone Arsenal Site 12 is similar to the CRN Site and ORR Sites 2 and 8. Preconstruction-, construction-, and operation-related air emissions for the SMR Project would be similar regardless of the site chosen. As noted in the discussions above, the SMR Project's impacts on air quality at the CRN Site are expected to be SMALL. For Redstone Arsenal Site 12, the same general construction activities and mitigation measures are anticipated as for the CRN Site. During operations, there are no appreciable differences in air emissions expected. Therefore, the impacts to air quality from preconstruction, construction, and operation of the SMR Project at Redstone Arsenal Site 12 would not destabilize or noticeably alter air quality in the area and would therefore be SMALL.

Noise

The geographic area of interest for noise is within 5 mi of the site. Potential noise impacts from preconstruction and construction of the SMR Project at Redstone Arsenal Site 12 include indirect noise and vibration impacts to the public from construction-related traffic on local roads, and direct noise and vibration impacts to the surrounding communities and nearest residents from onsite activities. During operation, noise impact from the mechanical draft cooling towers would be the main source of continuous onsite noise. Operation of the transmission lines would be a source of offsite noise.

Based on the high volume of construction-related traffic and the use of trucks to carry materials to the site, the indirect noise and vibration impacts to the public from construction-related traffic on local roads associated with preconstruction and construction activities at the site would be minor to noticeable. Direct noise and vibrations impacts from preconstruction and construction activities onsite would be minor for surrounding communities, based on the sound levels generated by construction equipment and the distance to those communities. Impacts on nearby residents from onsite noise, such as the occupants of the nearby residential area adjacent to the Redstone Arsenal western boundary, would be noticeable. During operation, noise impact from the mechanical draft cooling towers would be minor to noticeable for nearby residents. There are no anticipated increases to the current ambient noise levels associated

with the operation of the transmission system, and the effect of the SMR Project on transmission line noise would be minor.

Based on noise levels generated by SMR Project-related activities and the location of sensitive receptors such as residents, the impacts from noise associated with preconstruction, construction, and operation of the SMR Project at Redstone Arsenal Site 12 would be SMALL for surrounding communities and MODERATE for nearby residents. Impacts from operation of the transmission system would be SMALL. Therefore, the impacts associated with noise levels generated by SMR Project-related activities from preconstruction/construction and operations would be SMALL to MODERATE.

Human Health

The geographic area of interest for human health is a radius of 50 mi around the site. Potential human health impacts from radiological and non-radiological exposures for Redstone Arsenal Site 12 are dependent upon site-specific meteorological data, water and other exposure pathways, and potential exposed populations. However, compliance with radiological emissions and dose impacts are not site-specific and, therefore, human health impacts for Redstone Arsenal Site 12 would be similar to the impacts from the CRN Site.

Radiological emissions and dose impacts would comply with regulatory dose limits (e.g., offsite dose less than 100 mrem/yr) for Redstone Arsenal Site 12 as they would for the CRN Site. Compliance at Redstone Arsenal Site 12 would not require mitigation above what would be required at the CRN Site. Therefore, human health impacts would be comparable and the impacts from preconstruction, construction, operations, as well as other project-related offsite activities for Redstone Arsenal Site 12 would be SMALL.

Population

Potential effects on population are associated with any influx of preconstruction, construction, and operations workers who live too far away to commute daily from their residence. The geographic area of interest for population is Madison and Morgan Counties, Alabama, the two counties where the majority of Redstone Arsenal employees are assumed to reside. As presented in Subsection 3.10.2, for the CRN Site at ORR, the in-migrating construction workforce would be 1115 workers and the in-migrating operations workforce would be 250 workers. It is conservatively assumed that 100 percent of these in-migrating workers would relocate within the geographic area of interest.

Redstone Arsenal is located in Madison County adjacent to the City of Huntsville, Alabama. The population of Huntsville, Alabama is 180,105 (Reference 9.3-59). The City of Madison, Alabama, located approximately 1 mi northwest of Redstone Arsenal, has a population of 42,938 (Reference 9.3-60). The data used is based on the U.S Census Bureau population by zip code. The total area and population of every zip code that is located entirely or partially within the 20-mi radius was included in the calculation. A total of approximately 642,975 people reside within this area of 3393.6 square miles. Therefore, the population density is 189 persons

per square mi. Redstone Arsenal employs approximately 35,000 people who spend a portion of each workday in the area (Reference 9.3-61).

The geographic area of interest (Madison and Morgan Counties, Alabama) had a total population of 454,301 in 2010 (Reference 9.3-39). Population projections by the State of Alabama estimate a total population for these counties of 612,655 by the year 2040 (Reference 9.3-62). Each construction and operations worker that relocates into the geographic area of interest is assumed to bring a family. The average household size in Alabama is 2.48 (Reference 9.3-63). Therefore, an in-migrating construction workforce of 1115 would increase the population in the geographic area of interest by 2765 people, or 0.6 percent of the geographic area of interest population in 2010. An in-migrating operations workforce of 250 would increase the population by 620 people, or 0.1 percent of the area of interest population in 2010. During the overlap period between preconstruction/construction and operation, the combined population increase of 3385 people (2765 associated with preconstruction/construction and 620 associated with operation) constitutes 0.7 percent of the 2010 population of the geographic area of interest. Therefore, for both preconstruction/construction and operations and for the overlap period when both preconstruction/construction activities and operation occur, the in-migrating construction and operations workers along with their families would represent less than 1 percent of the population in the geographic area of interest. Considering that the population and workforce in the Redstone Arsenal geographic area of interest are smaller than in the ORR geographic area of interest, the number of in-migrating workers would potentially be larger for Redstone Arsenal Site 12. However, even assuming that the entire overlap period workforce of 3666 would in-migrate, the resulting population increase of 9092 (3666 workers x 2.48 persons per household = 9092 persons) would represent less than 2 percent of the population in the geographic area of interest. Therefore, population impacts would be SMALL for Redstone Arsenal Site 12.

Housing

Definitions of significance levels of impacts that result from increased housing demand, as per NUREG-1437, Revision 1, are provided in Subsection 4.4.2.1 and summarized above under the discussion of impacts associated with the CRN Site and ORR Sites 2 and 8. The geographic area of interest for housing is Madison and Morgan Counties, Alabama.

For the geographic area of interest, there were 11,747 vacant housing units in Madison County and 4163 vacant housing units in Morgan County. Madison County had 4809 units for rent and 2293 units for sale. Morgan County had 1171 units for rent and 732 units for sale. (Reference 9.3-64; Reference 9.3-65)

Due to the large number of available vacant housing units in the geographic area of interest and the relatively small requirements for the in-migrating construction workforce (1115 workers), operations workforce (250 workers), and overlap period workforce (1365 workers), there would be no easily discernable change in housing availability, prices, and the rate of housing

construction or conversions. Therefore, the impacts on housing would be SMALL for the geographic area of interest for Redstone Arsenal Site 12.

Economy and Tax Revenues

Per NUREG-1437, Revision 1, economic impacts are considered SMALL if project-related employment accounts for less than 5 percent of total employment in the geographic area of interest, MODERATE if it represents 5 to 10 percent, and LARGE if it represents more than 10 percent. The geographic area of interest for economy and tax revenues is Madison and Morgan Counties, Alabama.

Madison and Morgan Counties had a total 2011 employment of 285,884 jobs. Government and government enterprises provide 18.8 percent of the jobs. Professional, scientific, and technical services, the next largest employment sector, provides 13.1 percent. Manufacturing is the third largest sector, with 11.0 percent of employment. Construction employs 12,427 persons, representing 4.3 percent of employment in the two counties. (Reference 9.3-66; Reference 9.3-67) A total of 17,595 people were unemployed in the two counties in 2011, which represents an unemployment rate of 7.6 percent (Reference 9.3-45).

The preconstruction and construction workforce of 3300 assumed for the proposed SMR Project accounts for less than 2 percent of the total 2011 workforce within the two counties in the geographic area of interest. Based on existing construction employment of 12,427 persons in the geographic area of interest, the estimated plant preconstruction and construction workforce represents an increase of approximately 27 percent in the construction workforce.

For the Redstone Arsenal site, 500 operations workers represent 0.2 percent of the total workforce within the two counties in the geographic area of interest, and 1000 refueling outage workers account for 0.4 percent of the total 2011 workforce. During the overlap period between preconstruction/construction and operation, the total workforce of 3666 represents less than 2 percent of the total workforce.

The employment of the preconstruction, construction, and operations workforce and temporary refueling outage workers and expenditures for goods and services associated with activities at the proposed SMR facility would have positive economic effects on the geographic area of interest. For Redstone Arsenal Site 12, SMR facility preconstruction, construction, and operation employment and the total employment during the overlap period between preconstruction/construction and operations would each account for less than 5 percent of total employment within the two-county geographic area of interest. Therefore, impacts on the economy of the geographic area of interest from the less than 2 percent increase in the workforce during preconstruction, construction, and operation would also be SMALL and beneficial.

Per NUREG-1437, Revision 1, tax impacts are considered SMALL if potential new tax payments, or tax equivalent payments, constitute less than 10 percent of total revenues for local

taxing jurisdictions, MODERATE if they represent 10 to 20 percent, and LARGE if they represent more than 20 percent.

As discussed in Subsection 2.5.2.3, TVA makes tax equivalent payments to eight states under Section 13 of the TVA Act of 1933, including the State of Alabama. TVA pays 5 percent of its gross proceeds from the sale of power (with certain exclusions) to states where its power operations are carried out. Payments to each state are determined based upon the proportion of TVA power property and power sales, in each state, compared to TVA's total power property and power sales, respectively.

The amount of the funding provided to the counties and municipalities is determined by the individual state. The Redstone Arsenal geographic area of interest includes Madison County and Morgan County, in Alabama. TVA paid the State of Alabama $106.1 million in tax equivalent payments in FY 2013-2014. Of those payments, the State of Alabama distributed $19.6 million to Madison County and $16.2 million to Morgan County. (Reference 9.3-68) Total annual tax revenues collected during FY 2013-2014 were $233.3 million for Madison County and $57.1 million for Morgan County, so the distribution payments represented 8.4 percent of total county revenues for Madison County and 28.4 percent of total county revenues for Morgan County.

Several types of taxes would be generated by preconstruction, construction, and operational activities at the SMR facility and by workforce expenditures. Sales and use taxes would be generated through retail expenditures of the construction and operations workforce, and through purchase of construction materials and supplies. Property tax revenues would be generated by the increased economic activity involving the construction and operations workforce. In Alabama, income tax would also be generated as a result of wages paid to workers.

Quantitative estimates of the impact payments associated with the SMR Project at Redstone Arsenal Site 12 are not available at this time. Within the Redstone Arsenal geographic area of interest, the TVA tax equivalent payments compared to the total taxes collected would be more than the current 8.4 percent for Madison County and more than 28.4 percent for Morgan County. Given the structure by which the TVA makes tax equivalent payments, the general distribution structure of funding by the State of Alabama, as well as the increase in income, sales, and property taxes, the potential impact of taxes for Redstone Arsenal Site 12 would be SMALL to LARGE and beneficial.

Transportation

NUREG-1437, Revision 1 presents criteria for the assessment of transportation impacts based on the effect of project-related traffic on the LOS for roadways within the relevant study area and are summarized within the transportation discussion associated with the ORR Sites. The geographic area of interest for transportation is Madison and Morgan Counties, Alabama.

Preconstruction and construction of the SMR Project requires dependable transportation alternatives for large vehicles and adequate road capacity to accommodate the construction workforce. The Alternative Sites were evaluated on the capacity of the surrounding transportation system to accommodate construction and worker vehicles required for preconstruction and construction of the SMR Project.

I-565 borders the northern portion of the Redstone Arsenal. The east side is bordered by US 231 and the west side by Zierdt Road. Traversing the installation are Martin Road that runs east/west, and Rideout Road that runs north/south. Wheeler Reservoir forms the southern boundary of Redstone Arsenal. Barge access is available at a barge dock facility constructed and used by the NASA located in the vicinity of Redstone Arsenal Site 12. It is anticipated that the construction and operations workforce would enter Redstone Arsenal Site 12 via Anderson Road from Rideout Road and I-565 (Figure 9.3-5). The following roads and projects have been identified for improvement in the vicinity of the facility, according to the 2035 Huntsville Area Transportation Study dated March 2010 (Reference 9.3-69):

- Patton Road from Aerobee Road to Red Arsenal Road
- Martin Road from Zierdt Road to Rideout Road
- Southern Bypass that connects I-565 to US 231 through Redstone Arsenal

According to the Alabama Department of Transportation, the surrounding roadways to the site have the following daily traffic volumes (Reference 9.3-70):

- I-565 (6 lane freeway) carries between 94,480 and 99,960 vehicles per day
- US 231 (6 lane highway) carries between 20,750 and 116,200 vehicles per day
- Rideout Road (6 lane road) carries 30,580 vehicles per day

No traffic volumes were provided on the Alabama Department of Transportation (ALDOT) website for Zierdt Road and Martin Road.

Using the volumes and Florida LOS Handbook, I-565 is currently operating at LOS D, US 231 at its highest traffic volumes is operating at LOS D (borderline LOS E), and Rideout Road is operating at LOS C or better (Reference 9.3-71). Based on these LOS results for the surrounding roads and the urban setting, it can be concluded that additional traffic to construct the proposed plant at this Site would create traffic concerns and would require roadway improvements.

During development of representative commuter and construction traffic impacts, crash data on the major roadway segments (including I-565 and AL 255) accessing the Redstone Arsenal Site were obtained from the ALDOT. As for the ORR Sites, peak overlap workforce traffic increases are anticipated to occur as the first SMR unit is operational while the second SMR unit is under

construction. Using the peak construction year of 2024 with 3666 total workers (3300 construction and 366 operational), an analysis of new vehicles trips and additional traffic accidents (including injuries and fatalities) was conducted. Total annual traffic accidents, injuries from traffic accidents, and fatalities due to traffic accidents would all be expected to increase as a result of construction at Redstone Arsenal Site 12. The increase in yearly traffic accidents during the peak year of construction on I-565 and AL 255 would be minor (approximately 4 percent for I-565 and approximately 2 percent for AL 255) and would not noticeably alter or destabilize traffic flow or safety on these roads, thus having a small impact.

A traffic assessment study would be conducted to determine the nature of the necessary improvements to minimize traffic congestion and increases in traffic accidents. Potential improvements would include widening at I-565 and Rideout Road; potential changes to the highway interchanges, and/or implementation of administrative controls to limit construction vehicle access during high peak traffic hours coinciding with the base traffic; and changes to address any site security gate access delays or queues that may affect adjacent intersections. The modifications required for preconstruction and construction (based on 3300 workers) would then accommodate the anticipated operation traffic (based on 366 workers) and overlap of preconstruction/construction and operation traffic (based on 3666 workers). BMPs such as posting signs near construction entrances and exits to make the public aware of areas with high construction traffic, development of a traffic control mitigation plan, use of staggered shift start and end times, use of carpooling, and scheduling of deliveries to avoid peak traffic periods would also be utilized. Implementation of these roadway modifications and BMPs would mitigate potential impacts to traffic with respect to congestion and accidents.

A major concern in the Tennessee Valley has been the lack of east-west routed limited-access interstate highways connecting Huntsville, Alabama, with cities such as Memphis, Tennessee; Atlanta, Georgia; and Chattanooga, Tennessee. (I-565, while an east-west interstate, is only approximately 22 mi in length and connects Huntsville to the north-south bound I-65 in Decatur, Alabama located to the southwest.) Studies have been conducted to determine a feasible interstate route to connect these urban areas in these three states, but funding for the project is pending (Reference 9.3-69).

Redstone Arsenal has a variety of options for transportation. Currently, the Huntsville urban area has excellent connectivity between the Huntsville International Airport and the highway system via I-565. The International Intermodal Center is located at the airport and is connected to the Wheeler Reservoir approximately 5.5 mi south of the airport. A River Port Development Study was conducted in 2000 that resulted in property being acquired for future port development. Cargo waterway service is available in the adjacent City of Decatur, Alabama, offering barge service for bulk commodities (Reference 9.3-69).

Further consideration for conventional intercity rail service has been studied concerning Amtrak between Huntsville, Alabama, and Birmingham, Alabama. However, Amtrak will not be adding any new service in the immediate future. (Reference 9.3-69)

In summary, the area surrounding Redstone Arsenal appears to have suitable accessibility for rail and barge traffic; however, there is a lack of limited-access interstate highways near Redstone Arsenal. Additionally, analysis of current level of service on the major roads in the vicinity of the Redstone Arsenal site indicate modifications would be necessary to accommodate preconstruction/construction traffic without impacts to traffic flow. Therefore, direct and indirect impacts to traffic during preconstruction and construction for Redstone Arsenal Site 12 would be MODERATE. Traffic impacts associated with the total employment during the overlap period between preconstruction/construction and operations would be similar to impacts during construction. Based on the smaller number of operation workers, impacts during operations would be SMALL. Therefore, the impacts associated with traffic during preconstruction/construction and operations would be SMALL to MODERATE.

Visual Intrusions

Definitions of significance levels of impacts that result from visual intrusions, as per NUREG-1437, Revision 1, are provided in Subsection 4.4.2.6 and are also summarized under the visual intrusions discussions for the ORR Sites. The geographic area of interest for visual intrusions includes the 2-mi radius surrounding the site.

The nature of the visual intrusions at the Redstone Arsenal Site 12 would be expected to be similar to the CRN Site. Most of the preconstruction and construction activities are not expected to be visible to the general public. However, the use of large cranes and earth-moving equipment onsite, the transportation of large materials to the site, and use of night time lighting would be visible to members of the public from the surrounding area. Offsite activities (including road, rail, and barge area improvements) required for project implementation would likely be more visible to observers. Preconstruction and construction activities would represent a greater level of visual intrusion for the residential area located adjacent to the western boundary of Redstone Arsenal in close proximity to Redstone Arsenal Site 12. There is the potential for widely shared opposition by these residents based on a reduced sense of place. Therefore, during preconstruction and construction, the visual intrusion impacts would be SMALL for the general public and LARGE for nearby residents based on the likelihood of those groups to complain about the SMR Project.

During operation, most of the structures associated with the SMR Project at Redstone Arsenal Site 12 are not expected to be visible to the general public. However, they would likely be visible from the nearby residential area adjacent to the Redstone Arsenal western boundary. The plume from the cooling towers would likely be visible under certain atmospheric conditions. The plume impacts would be greater on a clear, cloudless day than on an overcast day. Therefore, the impact of the visual intrusion of SMR structures and the cooling tower plume associated with operation of the SMR Project at Redstone Arsenal Site 12 would range from SMALL (no complaints) to LARGE (widely shared opposition), depending on the location of the observer and the atmospheric conditions.

Infrastructure

Demand from onsite construction activities as well as population increases in the geographic area of interest associated with preconstruction, construction, and operation were considered when evaluating the effects of the SMR Project on infrastructure. The geographic area of interest for infrastructure includes Madison and Morgan Counties, Alabama. The primary community infrastructure components evaluated for the Redstone Arsenal Site 12 are water supply facilities and wastewater treatment facilities.

Water Supply Facilities

Redstone Arsenal purchases the majority of its potable water from the City of Huntsville (Reference 9.3-72). Huntsville maintains two treatment plants, drawing water from the Tennessee River and five groundwater wells. Capacity is 90 mgd with demand averaging approximately 35 mgd (Reference 9.3-73). Additionally, the Arsenal has the capability to obtain raw water from the Tennessee River to produce a potable water supply from water treatment plants No. 1 (capacity of 2.6 mgd) and No. 3 (capacity of 4.5 mgd) on the Installation (Reference 9.3-72).

As presented in Subsection 4.4.2.7, the peak overlap workforce of 3666 workers for the SMR Project would require 183,300 gallons per day (gpd), or 0.18 mgd, of potable water. During the peak overlap period, an estimated 1365 workers would migrate into the geographic area of interest accompanied by 2020 family members, for a population increase of 3385. This represents an increased offsite demand of approximately 0.34 mgd. The Huntsville Utilities has a maximum potable water capacity of 90 mgd and an average daily consumption of 35 mgd, for an excess capacity of 55 mgd. The onsite potable water usage of 0.18 mgd represents 0.3 percent of Huntsville Utilities excess capacity. The offsite potable water usage of 0.34 mgd, which would be distributed across the two-county geographic area of interest, represents 0.5 percent of Huntsville Utilities excess capacity. Therefore, construction impacts to water supply facilities would be SMALL.

As presented in Subsection 5.2.8.7, potential impacts to potable water supplies would result from additional demands on water supply facilities associated with operation-related water needs and the increase in the local population (in-migrating operations workers). The peak operations workforce of 500 operations workers and 1000 outage workers would require a maximum of 0.08 mgd, of potable water. The operation-related population increase represents an increased demand of approximately 0.06 mgd. The onsite potable water usage of 0.08 mgd represents 0.1 percent of Huntsville Utilities excess capacity. The offsite potable water usage of 0.06 mgd, which would be distributed across the two-county geographic area of interest, represents 0.1 percent of Huntsville Utilities excess capacity. Therefore, operation impacts to water supply facilities would be SMALL.

Wastewater Treatment Facilities

Redstone Arsenal has a central wastewater treatment plant that processes all of the wastewater for the Installation (Reference 9.3-73). It serves approximately 38,000 customers, based on the number of customers as served by the water treatment system (Reference 9.3-72).

As presented in Subsection 4.4.2.7, at the peak overlap period, a maximum of 183,300 gpd of wastewater would be produced onsite based on 3666 overlap workers and a wastewater production rate of 50 gpd per worker. An estimated 1365 workers would migrate into the geographic area of interest accompanied by 2020 family members, for a population increase of 3385. The 3666 overlap workers represent approximately 10 percent of the 38,000 customers served by the Redstone Arsenal central wastewater treatment plant. The increased demand on the wastewater treatment facility would be temporary. The increase to the geographic area of interest population of an estimated 2765 construction-related residents would increase demand for wastewater treatment. Because the in-migrating population would not be expected to settle in one area exclusively, this increased demand would be spread among several facilities in the two county geographic area of interest and would be temporary. Therefore, construction impacts to wastewater treatment facilities would be SMALL.

As presented in Subsection 5.2.8.7, during operation a peak workforce of 500 operations workers and 1000 temporary outage workers are on site on any particular day. Assuming that half of their water consumption occurs at the CRN Site results in 40 to 50 gpd of wastewater per worker, and a maximum of 75,000 gpd or 0.08 mgd of wastewater produced on site. The 1500 operations and outage workers represent approximately 3.9 percent of the 38,000 customers served by the Redstone Arsenal central wastewater treatment plant. The increase to the geographic area of interest population of an estimated 620 operation-related residents would increase demand for wastewater treatment. Because the in-migrating population is not expected to settle in one area exclusively, this increased demand would be distributed among several facilities in the two-county geographic area of interest. The wastewater treatment facilities in the geographic area of interest would be able to absorb the increased demand without adversely affecting the current customers. Therefore, impacts to wastewater treatment facilities in the geographic area of interest for the operation workforce and the in-migrating population would be SMALL.

Education

Potential impacts to education were evaluated based on the estimated number of school-aged children that would relocate to the geographic area of interest as a result of the SMR Project. The geographic area of interest for education includes Madison and Morgan Counties, Alabama.

As described in Subsection 4.4.2.8, an estimated 1115 construction workers (based on the peak construction workforce) are assumed to come from outside the 50-mi region to work on preconstruction and construction activities for the SMR Project. This would result in a population increase of 2765 based on an average household size in Alabama of 2.48 persons (Reference

9.3-63). In the 2010 U.S. Census Bureau estimates, 17.5 percent of the population of Madison County was 5 to 17 years old (i.e., school age) and 17.7 percent of the population of Morgan County was school age. Using the highest county figure of 17.7 percent for student population, an estimated 489 school-aged children would relocate within the geographic area of interest. This represents an increase of 0.7 percent in the current public school population of 70,605 in the geographic area of interest. Because the population increase associated with preconstruction and construction activities at the Redstone Arsenal Site 12 would generate a small number of students compared to the total student population in the geographic area of interest, the impact of the SMR Project on education would be SMALL.

As described in Subsection 5.8.2.8, an estimated 250 operations workers would come from outside the 50-mi region. This would result in a population increase of 620 based on an average household size in Alabama of 2.48 persons. Using the highest county figure of 17.7 percent for student population, an estimated 110 school-aged children would relocate within the geographic area of interest. This represents an increase of 0.2 percent in the current public school population of 70,605 in the geographic area of interest. During the overlap period between construction and operation, the population in the geographic area of interest would increase by 3385 persons, including an estimated 599 school-aged children. This represents an increase of 0.8 percent in current public school enrollment. Because the population increase associated with operation and with the overlap period between construction and operation at the Redstone Arsenal Site 12 would generate a small number of students compared to the total student population in the geographic area of interest, the impact of the SMR Project on education would be SMALL.

9.3.4.1.6 Environmental Justice

EO 12898 (59 FR 7629) directs Federal agencies to identify and address, as appropriate, potential disproportionately high and adverse human health and environmental impacts on minority and low-income populations (Reference 9.3-75). Factors considered in evaluation of Alternative Sites in regard to environmental justice include the presence of minority and low-income communities that could potentially experience disproportionate adverse impacts. There are two components to consideration of potential environmental justice impacts: (1) whether the proposed action results in significant adverse health or environmental impacts and, if so, (2) whether disproportionate adverse impacts would be experienced by minority or low-income populations found within any of the communities near the Alternative Sites and whether those impacts differ between Alternative Sites. The environmental justice analysis for the ORR and Redstone Arsenal Alternative Sites was conducted in accordance with the methodology described in Subsection 2.5.4.1.

CRN Site and ORR Sites 2 and 8

Because of the proximity of ORR Sites 2 and 8 to the CRN Site, the demographic profile for ORR Sites 2 and 8 would be the same as described in Subsection 2.5.4 for the CRN Site. The geographic area of interest for environmental justice for the ORR Sites includes a 50-mi radius

around the center of the CRN Site. Three states fall into this radius: Tennessee, North Carolina, and Kentucky.

Minority Population

The analysis for minority populations around the CRN Site and ORR Sites 2 and 8 followed the NRC criteria for identifying minority populations as described in Subsection 2.5.4.2. Table 2.5.4-1 presents the results of the minority population analysis. The distributions of aggregate minority and Hispanic ethnicity block groups within the 50-mi radius are displayed in Figure 2.5.4-1. For each of the 759 block groups within the 50-mi radius, a total of 18 met the NRC criteria for Black minority population; four block groups met the criteria for Hispanic minority populations and one block group met the criteria for a minority population of another race. A total of 20 block groups met the criteria for aggregate minority populations. For all categories except the North Carolina aggregate minority population, 20 percentage points greater than the state average was the limiting criterion. For the aggregate minority population in North Carolina, 50 percentage points was the limiting criterion. Only one block group, located in Sevier County, Tennessee, met the criteria for two or more minority categories.

Most of the block groups (18 of 20) with an aggregate minority population fall within Knox County, Tennessee, within the boundaries of the City of Knoxville. The largest number of block groups (3 of 4) with a Hispanic minority population occurs in Loudon County, Tennessee. No block groups in Roane County (in which the CRN Site is located) or in Anderson County contain minority populations (Figure 2.5.4-1). The identified aggregate minority population closest to the CRN Site is in census tract 9801 block group 01 located approximately 20 mi to the east in Blount County, Tennessee. The closest Hispanic minority population is located in census tract 602.02 block group 04 in Loudon County, Tennessee, approximately 9 mi southeast of the CRN Site.

In addition to the identification of minority populations based on census data, two locations of potential significance to minority communities were identified: the Wheat Community Burial Ground and the community of Scarboro. The African American Wheat Community Burial Ground is located approximately 1 mi northwest of the northern boundary of the CRN Site on TN 58. Approximately 90 to 100 graves with no inscribed markers are present within this cemetery. It is presumed that slaves and their dependents that lived and worked on plantations and farms in the area are buried here. Historical records indicate the cemetery dates from the mid-19th century. (Reference 9.3-76) The Scarboro community is a small residential area in Anderson County within the City of Oak Ridge. The community was established in 1950 to provide housing and an elementary school to African American Oak Ridge residents. Scarboro has remained predominantly African American. (Reference 9.3-77) Although this small African American community is located within Anderson County, the community’s population is not large enough to result in any block group in the county being identified on Table 2.5.4-1 as a Black minority block group.

Low Income Population

The analysis for low-income populations around the CRN Site and ORR Sites 2 and 8 followed the NRC criteria for identifying minority populations as described in Subsection 2.5.4.3. Table 2.5.4-1 and Figure 2.5.4-2 illustrate the number and distribution of low-income block groups within the 50-mi radius based on the NRC criteria. Table 2.5.4-1 also displays the percentage of low-income individuals within each of the three states within the 50-mi radius. Among the 759 block groups within the 50-mi radius, 60 met the NRC criteria. The majority of the low-income population (27 block groups) in the geographic area of interest is in the City of Knoxville, in Knox County, Tennessee. There is one low-income population block group in Roane County where the CRN Site is located. The closest low-income population to the CRN Site is located in census tract 602.02 block group 01 in Loudon County, Tennessee, approximately 7 mi southeast of the CRN Site. As seen on Figures 2.5.4-1 and 2.5.4-2 there is some overlap between the locations of minority and low-income population groups around ORR Sites 2 and 8.

The environmental justice evaluation includes whether an alternative potentially results in significant adverse health or environmental impacts and if those impacts would be disproportionately experienced by a minority or low-income population.

Potential Physical Impacts

For the purpose of this environmental justice assessment, physical impacts under consideration due to SMR Project preconstruction, construction and operation include potential effects on land use, water, and ecology. Ecological resources are a concern in the event that any minority or low-income populations in the area are dependent on fishing or farming for subsistence.

As described in Subsection 9.3.4.1.1, the use of the CRN Site and ORR Site 2 for the SMR Project is consistent with the designated land use for the sites and with land use on adjacent areas of the ORR, and the impacts to established land use would be SMALL. At ORR Site 8, there are potential conflicts (SMALL to MODERATE) with the ORR's 10-yr site planning activities.

As described in Subsection 9.3.4.1.2, hydrological modeling and other analyses indicate that the Clinch River arm of the Watts Bar Reservoir is capable of handling anticipated cooling water withdrawals and thermal discharges for the SMR Project at the CRN Site, ORR Site 2, or ORR Site 8 with SMALL impacts. Analyses for the CRN Site and ORR Sites 2 and 8 concluded that impacts to water supply and water quality from construction and operations would be SMALL.

As described in Subsection 9.3.4.1.3, the analyses of the CRN Site concluded that designated natural areas and wetlands could be avoided, and impacts to terrestrial resources from construction and operations would be SMALL. ORR Site 2 is largely designated as a Potential Habitat Area and a Natural Area, with limited opportunities to avoid those areas, and the impacts to terrestrial biological resources would be MODERATE. ORR Site 8 would have a

MODERATE potential to adversely affect terrestrial biological resources within major portions of two large natural areas that include diverse communities and rare species.

As described in Subsection 9.3.4.1.4, the CRN Site and the ORR Sites 2 and 8 would each utilize reservoirs for their cooling water that exhibit acceptable flow characteristics for siting nuclear generation facilities, with each having a SMALL thermal impact on the aquatic ecology of the receiving water body. The potential for occurrence of listed or other special status aquatic species on these sites or in the reservoirs in the vicinity of the intake or discharge structures for these sites is minimal. The impacts from entrainment, impingement, or other effects on fish and other aquatic organisms due to the operation of the cooling water intake system would be SMALL. The results of this assessment and the expectation that Section 316(a) and (b) requirements would be met indicate that impacts on aquatic ecology the CRN Site and ORR Sites 2 and 8 would be SMALL.

The minority and low-income block groups closest to the CRN Site and ORR Sites 2 and 8 are located approximately 9 mi and 7 mi, respectively, southeast of the CRN Site in Loudon County, Tennessee. The predominantly African-American Scarboro community is located in the City of Oak Ridge approximately 0.5 mi from the ORR Y-12 plant. The geographic area of interest for land use and terrestrial biological resources is the project site and any offsite areas that would be required for additional facilities (e.g., roads, rail lines, transmission lines, pipelines, and barge facilities) associated with the SMR Project. Impacts to land use and terrestrial biological resources at any of the three Alternative Sites would be localized and would not adversely affect minority or low-income populations.

The geographic area of interest for water use and water quality impacts is the drainage basin of the receiving reservoir, and the potential for the SMR Project to contribute to impacts is expected to be highest in close proximity to a site and to decrease with distance away from that site. The geographic area of interest for aquatic resources is defined as the drainages associated with the project site and associated offsite areas where ecological effects from the operation of the SMR Project would occur. Considering that minority and low-income populations are not located close to the CRN Site and ORR Sites 2 and 8 or to the Clinch River arm of the Watts Bar Reservoir, those populations would not be adversely affected by SMR Project effects on water use and quality and aquatic resources.

Based on the evaluation of land use impacts, water-related impacts, and ecological impacts in relation to the distribution patterns of minority and low-income populations, the potential for disproportionately high and adverse impacts to minority and low-income populations at each of the CRN Site and ORR Sites 2 and 8 would be SMALL.

Potential Socioeconomic Impacts

The socioeconomic resources with the greatest potential to affect minorities and low-income populations are housing and transportation, as well as human health.

As discussed in Subsection 9.3.4.1.5, the increased demands on housing associated with the CRN Site and ORR Sites 2 and 8 (1115 in-migrating households during construction and 250 during operation) are relatively small compared to the large numbers of vacant housing units in the geographic areas of interest (26,403 vacant units in ORR geographic area of interest). Based on the existing housing supply, there would be no easily discernable change in housing availability, prices, and the rate of housing construction or conversions for the ORR Sites. Therefore, the potential impacts on housing would be SMALL for ORR Sites 2 and 8. However, increased demand for low-cost housing by construction workers would have the potential to drive up prices, which would disproportionately impact low-income populations within the geographic area of interest. However, it would not be a significant adverse impact, considering the large inventory of vacant housing and the availability of temporary housing provided by recreational facilities, and would be temporary during preconstruction and construction activities. Therefore, the potential for disproportionately high and adverse housing impacts to low-income populations for the CRN Site and ORR Sites 2 and 8 would be SMALL.

The evaluation of transportation in Subsection 9.3.4.1.5 indicates that the operation of individual drivers in the ORR geographic area of interest would begin to be severely restricted during construction, resulting in MODERATE and temporary impacts to traffic for the CRN Site and ORR Sites 2 and 8. Considering the lower volume of operations traffic and the likely implementation of road improvements to accommodate construction traffic, the operation of drivers in the ORR study area is not expected to be substantially affected by the presence of other drivers during the SMR Project operations. Therefore, operations traffic impacts for CRN Site and ORR Sites 2 and 8 would be SMALL. There is the potential for adverse impacts to minority and low-income populations from traffic on access roads to the CRN Site and ORR Sites 2 and 8. The minority and low-income block groups closest to the CRN Site and ORR Sites 2 and 8 are located approximately 9 mi and 7 mi, respectively, southeast of the CRN Site in Loudon County, Tennessee. The primary roads used for access to the Alternative Sites are Bear Creek Road, TN 58 and TN 95. These roads, and other roads providing access to them, do not pass through the identified block groups. Therefore, the potential for disproportionately high and adverse impacts from traffic to minority or low-income populations would be SMALL.

Subsection 9.3.4.1.5 discusses potential human health impacts from radiological and non-radiological exposures. The discussion concluded that construction and operational-related impacts to human health from radiological exposures for the CRN Site are within regulatory limits for the protection of human health (less than 100 mrem/yr) and thus impacts would be SMALL. Because the other ORR Sites 2 and 8 have meteorology, water and other exposure pathways and potential exposed populations similar to the CRN Site, human health impacts from radiological exposures would be comparable. Health impacts from non-radiological hazards during construction and operation include localized impacts from noise, vibrations, and dust along with occupational injuries to workers. Such impacts affect a limited geographic area and are expected to be SMALL for the ORR Sites. Considering that the nearest minority or low-income block group is located approximately 7 mi from the CRN Site, the potential for

disproportionately high and adverse impacts to human health for that population would be SMALL.

The impacts from construction and operation of the SMR Project at the CRN Site and ORR Sites 2 and 8 associated with the remaining socioeconomic resources, as presented in Subsection 9.3.4.1.5, would be SMALL for air quality and economy, SMALL for tax revenues, and SMALL to MODERATE for visual resources. The impacts to air quality would not destabilize or noticeably alter air quality in the ORR geographic area of interest and would be SMALL. Construction employment and operations employment each account for less than 5 percent of employment within the ORR area; the impact on the economy of those areas would be SMALL. The potential impact of tax revenues within the geographic areas of interest, which would be beneficial, would be less than 10 percent when compared to the total amount of taxes collected in each of the four counties within the ORR geographic area of interest (SMALL). Based on the likelihood of the affected public to complain about the visual intrusions and the potential for measurable socioeconomic impacts, the visual impacts for the ORR Sites would be SMALL for the general public and MODERATE for nearby residents and recreational users. There is a potential for disproportionate air quality and visual intrusion impacts to minority or low-income populations based on location. However, the nearest minority or low-income block group is located approximately 7 mi from the CRN Site and there are other residents who live closer to the Site. Accordingly, the potential for disproportionately high and adverse impacts to air quality and visual resources for the identified minority and low-income block groups would be SMALL.

Redstone Arsenal Site 12

The geographic area of interest for environmental justice for Redstone Arsenal Site 12 includes a 50-mi radius around the center of Redstone Arsenal Site 12. Two states fall into this radius, Alabama and Tennessee.

Minority Population

The analysis for minority populations around Redstone Arsenal Site 12 also followed the NRC criteria for identifying minority populations as described in Subsection 2.5.4.2. Table 9.3-5 presents the results of the minority population analysis for Redstone Arsenal Site 12. The distributions of aggregate minority and Hispanic ethnicity block groups within the 50-mi radius of Redstone Arsenal Site 12 are displayed in Figure 9.3-13. For each of the 674 block groups within the 50-mi radius of Redstone Arsenal Site 12, a total of 56 met the NRC criteria for Black minority population; 14 block groups met the criteria for a minority population of some other race. No block groups met the criteria for Hispanic minority populations. A total of 74 block groups met the criteria for aggregate minority populations. For all categories except the Alabama aggregate minority population, 20 percentage points greater than the state average was the limiting criterion. For the aggregate minority population in Alabama, 50 percentage points was the limiting criterion. No block group met the criteria for two or more minority categories.

Most of the block groups (54 of 74) with an aggregate minority population fall within Madison County, Alabama, within the boundaries of the City of Huntsville (Figure 9.3-13). The identified aggregate minority population closest to Redstone Arsenal Site 12 is in census tract 011200 block group 1, located approximately 1.5 mi to the southwest of Redstone Arsenal Site 12 in the Town of Triana in Madison County, Alabama. This is also the closest Black minority population block group.

Triana, Alabama is located along Huntsville Spring Branch and adjacent to the Wheeler Reservoir/Wheeler National Wildlife Refuge. In 1979, extensive DDT contamination was discovered in Huntsville Spring Branch. Levels in fish taken from the stream significantly exceeded the federal limits for DDT. The source was a former DDT manufacturing facility located within the grounds of Redstone Arsenal and operated by the Olin Corporation from 1947-1970. The residents of Triana depended heavily on fish from Huntsville Spring Branch as both a food source and a source of income. In December 1982, the Olin Corporation reached an out-of-court settlement with the residents of Triana and the federal government. Olin provided compensation to the residents, funded a long-term healthcare program for the community, and cleaned up the DDT in the area. Since cleanup began in 1984, DDT levels in the major fish species have been reduced significantly and are at or near normal levels. (Reference 9.3-78)

Low Income Population

The analysis for low-income populations around the Redstone Arsenal Site 12 followed the NRC criteria for identifying minority populations as described in Subsection 2.5.4.3, Table 9.3-5, and Figure 9.3-14 illustrate the number and distribution of low-income block groups within the 50-mi radius based on the NRC criteria. Table 9.3-5 also displays the percentage of low-income individuals within both Alabama and Tennessee. Among the 674 block groups within the 50-mi radius, 13 met the NRC criteria. The majority of the low-income population in the geographic area of interest is in the City of Huntsville, in Madison County, Alabama. Census tract 002300 block group 5 contains the closest low-income population, and is located in Madison County, Alabama, approximately 6.5 mi northeast of Redstone Arsenal Site 12. As seen on Figures 9.3-13 and 9.3-14, there is some overlap between the locations of minority and low-income population groups around Redstone Arsenal Site 12.

The environmental justice evaluation includes evaluation of whether an alternative potentially results in significant adverse health or environmental impacts and if those impacts would be disproportionately experienced by a minority or low-income population.

Potential Physical Impacts

For the purpose of this environmental justice assessment, physical impacts under consideration due to SMR Project construction and operation include potential effects on land use, water, and ecology. Ecological resources are a concern in the event that any minority or low-income populations in the area are dependent on fishing or farming for subsistence.

At Redstone Arsenal Site 12, there are MODERATE concerns associated with the land use designated for the site in the Arsenal's current Master Plan and the proximity of a residential community adjacent to Redstone Arsenal Site 12's western boundary.

Based on hydrology, water quality, depth to aquifers in use, and water availability as a resource, Wheeler Reservoir, the likely cooling water source for Redstone Arsenal Site 12, is suitable for the SMR Project. Analyses for Redstone Arsenal Site 12 concluded that impacts to water supply and water use from construction and operations would be SMALL.

Redstone Arsenal Site 12, which is an open, flat area covered predominantly by grasses and forbs, with areas of emergent marsh and forest along the south margin and no known occurrences of listed terrestrial species, would have a SMALL potential to have adverse effects on terrestrial biological resources.

As described in Subsection 9.3.4.1.4, Redstone Arsenal Site 12 would each utilize reservoirs for its cooling water that exhibit acceptable flow characteristics for siting nuclear generation facilities, having a SMALL thermal impact on the aquatic ecology of the receiving water body. The potential for occurrence of listed or other special status aquatic species on these sites or in the reservoirs in the vicinity of the intake or discharge structures for the site is minimal. The impacts from entrainment, impingement, or other effects on fish and other aquatic organisms due to the operation of the cooling water intake system would be SMALL. The results of this assessment and the expectation that Section 316(a) and (b) requirements would be met indicate that impacts on aquatic ecology for Redstone Arsenal Site 12 would be SMALL.

The minority block group closest to Redstone Arsenal Site 12 is located approximately 1.5 mi to the southwest of Site in the Town of Triana in Madison County, Alabama. The predominantly African-American community is located along Huntsville Spring Branch and adjacent to the Wheeler Reservoir/Wheeler National Wildlife Refuge. The majority of low-income block groups in the geographic area of interest are located in the City of Huntsville, Alabama, including the closest low-income block group, which is approximately 6.5 mi northeast of Redstone Arsenal Site 12. The geographic area of interest for land use and terrestrial biological resources is the project site and any offsite areas that would be required for additional facilities (e.g., roads, rail lines, transmission lines, pipelines, and barge facilities) associated with the SMR Project. Impacts to land use and terrestrial biological resources at Redstone Arsenal Site 12 would be localized and would not adversely affect minority or low-income populations.

The geographic area of interest for water use and water quality impacts is the drainage basin of the receiving reservoir, and the potential for the SMR Project to contribute to impacts is expected to be highest in close proximity to a site and to decrease with distance away from that site. The geographic area of interest for aquatic resources is defined as the area of Redstone Arsenal Site 12 and associated linear facilities extending off the site, as well as the middle portion of Wheeler Reservoir. The residents of Triana have been known to depend heavily on fish from Huntsville Spring Branch as both a food source and a source of income (Reference 9.3-78). Considering that a minority population known to have been dependent on fishing for

subsistence is located close to Redstone Arsenal Site 12, pathways exist for adverse (i.e., both harmful and significant) and disproportionate impacts to the community due to project-related effects on water quality and aquatic resources. Based on the identification of small impacts on those resources from construction and operation of the SMR Facility, however, minority and low-income populations would not be adversely affected.

Based on the evaluation of land use impacts, water-related impacts, and ecological impacts in relation to the distribution patterns of minority and low-income populations, the potential for disproportionately high and adverse impacts to minority or low-income populations for Redstone Arsenal Site 12 would be SMALL.

Potential Socioeconomic Impacts

The socioeconomic resources with the greatest potential to affect minorities and low-income populations are housing and transportation, as well as human health.

As discussed in Subsection 9.3.4.1.5, the increased demands on housing associated with the SMR Project (1115 in-migrating households during construction and 250 during operation) are relatively small compared to the large numbers of vacant housing units in the geographic areas of interest (15,910 vacant units in the Redstone Arsenal area of interest). Based on the existing housing supply, there would be no easily discernable change in housing availability, prices, and the rate of housing construction or conversions for Redstone Arsenal Site 12. Therefore, the potential impacts on housing would be SMALL. However, increased demand for low-cost housing by construction workers would have the potential to drive up prices, which would disproportionately impact low-income populations within the geographic area of interest. However, it would not be a significant adverse impact, considering the large inventory of vacant housing and the availability of temporary housing provided by recreational facilities, and would be temporary during preconstruction and construction activities. Therefore, the potential for disproportionately high and adverse housing impacts to low-income populations for Redstone Arsenal Site 12 would be SMALL.

The evaluation of transportation in Subsection 9.3.4.1.5 indicates that the operation of individual drivers in the Redstone Arsenal area of interest would begin to be severely restricted during construction, resulting in MODERATE and temporary impacts to traffic. Considering the lower volume of operations traffic and the likely implementation of road improvements to accommodate construction traffic, the operation of drivers in the Redstone Arsenal areas is not expected to be substantially affected by the presence of other drivers during SMR Project operations. Therefore, operations traffic impacts for Redstone Arsenal Site 12 would be SMALL. There is the potential for adverse impacts to minority and low-income populations from community or delivery traffic on access roads to Redstone Arsenal Site 12. The minority block group closest to Redstone Arsenal Site 12 is located approximately 1.5 mi to the southwest of Site in the Town of Triana. The majority of low-income block groups in the geographic area of interest are located in the City of Huntsville, Alabama, including the closest low-income block group, which is approximately 6.5 mi northeast of Redstone Arsenal Site 12. The primary roads

used for access to Redstone Arsenal Site 12 are I-565 along the northern boundary of the installation, US 231 to the east, and Zierdt Road along the western boundary of the installation. One of these roadways, Zierdt Road, ends in the minority community of Triana southwest of the Site. Vehicles traveling to Redstone Arsenal Site 12 along Zierdt Road would not pass through Triana, however, because they would approach the Site from the north or west, not from the south. Also, vehicles would not need to use roadways within the City of Huntsville, where most of the minority and low-income block groups are located, to access Redstone Arsenal Site 12. Therefore, the potential for disproportionately high and adverse impacts from traffic to minority or low-income populations would be SMALL.

Subsection 9.3.4.1.5 discusses potential human health impacts from radiological and non-radiological exposures. The estimated human health impacts from radiological exposures at Redstone Arsenal Site 12 are expected to be SMALL because of the small, contained nature of the reactors and because of the anticipated use of a closed cooling water system in the Wheeler Reservoir. Health impacts from non-radiological hazards during construction and operation include localized impacts from noise, vibrations, and dust along with occupational injuries to workers. Such impacts affect a limited geographic area are expected to be SMALL. There are residential areas adjacent to Redstone Arsenal western boundary that are located closer to Redstone Arsenal Site 12 than any minority or low-income block groups. Human health impacts would be expected to be greater for those residents than for the identified block groups. Given that human health impacts were determined to be small for the general population and that minority and low-income block groups are located farther from Redstone Arsenal Site 12 than other residents, the potential for disproportionately high and adverse human health impacts to minority or low-income populations would be SMALL.

The impacts from construction and operation of two or more SMRs at Redstone Arsenal Site 12 associated with the remaining socioeconomic resources, as presented in Subsection 9.3.4.1.5, would be SMALL for air quality and economy, SMALL to LARGE for tax revenues, and SMALL to LARGE for visual intrusions. The impacts to air quality would not destabilize or noticeably alter air quality in the Redstone Arsenal area of interest, and would be SMALL. Construction employment and operations employment each account for less than 5 percent of employment within the Redstone Arsenal area; the impact on the economy of those areas would be SMALL. The potential impact of tax revenues within the geographic areas of interest, which would be beneficial and for the Redstone area of interest, would be less than 10 percent for Madison County (SMALL) and more than 20 percent for Morgan County (LARGE). Based on the likelihood of the affected public to complain about the visual intrusions and the potential for measurable socioeconomic impacts, the visual impacts for the Redstone areas would be SMALL for the general public and LARGE for Redstone Arsenal nearby residents. There is the potential for disproportionate air quality and visual intrusion impacts to minority or low-income populations based on location. The nearest minority or low-income block group, the Town of Triana, is located approximately 1.5 mi to the southwest of Redstone Arsenal Site 12. Considering that there are other residential neighborhoods located closer to the Site, adjacent to the western boundary of Redstone Arsenal, the potential for disproportionately high and adverse

impacts related to air quality and visual intrusions for the identified minority and low-income block groups would be SMALL.

9.3.4.1.7 Historic and Cultural Resources

This subsection provides an evaluation of alternative sites with regard to potential impacts to historic and cultural resources. A detailed discussion of CRN Site-specific information is included in Section 2.5. The geographic area of interest for this evaluation was the project site and any offsite areas that would be required for additional facilities (e.g., roads, rail lines, transmission lines, pipelines, and barge facilities) associated with full project implementation.

CRN Site and ORR Sites 2 and 8

As described in Subsection 2.5.3, no National Register of Historic Places (NRHP)-listed properties are located on or immediately adjacent to the CRN Site or the Barge/Traffic Area. Twenty-six NRHP-listed properties (23 individual properties and three historic districts) are located within a 10-mi radius of the center of the CRN property. As stated in Subsection 4.1.3, fifty-nine recorded archaeological sites, four isolated finds, one non-site locality, and one cemetery have been identified within or immediately adjacent to the CR SMR Project Area of Potential Effect (APE) which is defined in Subsection 2.5.3 as (1) the approximate 1200-ac Clinch River Property, (2) an additional approximate 105 ac northwest of the property near the CRN Site entrance and along Bear Creek Road and Tennessee State Highway (TN) 58, and (3) the Melton Hill Dam including a 0.5 mi radius around the Melton Hill Dam. Of these sites, one is considered eligible for listing on the NRHP; 16 are considered potentially eligible for the NRHP; and 42 are considered not eligible for the NRHP. Ten of the eligible and potentially eligible sites are avoidable. Within the CRN Site, sites 40RE0107, 40RE0595, 40RE0549, 40RE0104, and 40RE0105 will potentially be impacted by CR SMR Project preconstruction and construction activities. In the Barge/Traffic Area, sites 40RE138 and 40RE233 may be affected by CR SMR Project preconstruction and construction activities.

Approximately 45 known prehistoric sites, 250 historic pre-World War II structures, 32 cemeteries, several “historically significant” Manhattan Project-era structures, and six properties listed on the NRHP are reported within the reservation boundary in the 2011 Oak Ridge Reservation Annual Environmental Report. The prehistoric sites are predominantly burial mounds and archaeological evidence of previous structures. The six NRHP-listed sites are as follows (Reference 9.3-15):

- Freels Bend Cabin
- Graphite Reactor
- New Bethel Baptist Church and Cemetery
- Oak Ridge Turnpike Checking Station
- George Jones Memorial Baptist Church and Cemetery

- Scarboro Road Checking Station

There are no NRHP-listed properties located on or immediately adjacent to ORR Site 2. Eighteen NRHP-listed properties are located within a 10-mi radius of the center of ORR Site 2; all were previously described in Subsection 2.5.3. A total of nine cultural resource surveys have been conducted within portions of ORR Site 2 from 1974 through 2011. Within ORR Site 2 there are two archaeological sites (40RE233 and 40RE577) recommended as eligible for the NRHP, one site (40RE138) recommended as potentially eligible for the NRHP, and one site (40RE575) recommended as not eligible for the NRHP. Additionally, there is one historic cemetery, the Wheat Community African American Burial Ground (40RE219) located within ORR Site 2. (Reference 9.3-79) The proposed layout for ORR Site 2 (Figure 9.3-6) would avoid or be able to be easily adjusted to avoid the previously identified archaeological sites.

There are no NRHP-listed properties located on or immediately adjacent to ORR Site 8. Twenty-one NRHP-listed properties are located within a 10-mi of the center of ORR Site 8. The majority of these are the same structures described in Subsection 2.5.3, with the exception of Boyd-Harvey House. Two cultural resource surveys were conducted within the boundaries of ORR Site 8 in 1974 and 1996. Within ORR Site 8 there is one archaeological site (40RE117) recommended as potentially eligible for the NRHP (Reference 9.3-79). The proposed layout for ORR Site 8 (Figure 9.3-7) would avoid the previously identified archaeological sites.

As described in Subsection 4.1.3, to avoid, minimize, and mitigate potential effects to cultural and historic properties, TVA has executed a Programmatic Agreement (PA) pursuant to 36 CFR 800.14(b)(3). Should ORR Site 2 or ORR Site 8 be selected for siting the SMR Project, the APE would be revised and the Sites would be evaluated for cultural and historic resources in accordance with the stipulations of the PA.

Direct effects from SMR Project construction to cultural and historic resources are possible at the CRN Site and two Alternative ORR sites. Based on final facility designs, Phase II testing may be required and a final assessment and any required mitigation would be dependent on the outcome of the Phase II testing. Therefore, impacts of construction activities to cultural and historic resources at each of the three sites would be SMALL to MODERATE. Once construction is completed, ongoing operations would have a SMALL impact to cultural and historic resources. The overlap period associated with the incremental deployment of two or more SMRs would also have SMALL to MODERATE impact to cultural and historical resources, similar to the impacts associated with the initial construction; however, these impacts will be mitigated through activities specified by the PA.

Redstone Arsenal Site 12

Approximately 1000 archaeological sites have been identified at Redstone Arsenal and approximately 418 of these sites are potentially eligible for listing on the NRHP (Reference 9.3-80).

Four NRHP-listed sites are present within the Redstone Arsenal boundary. These sites include:

- Neutral Buoyancy Space Simulator
- Propulsion and Structural Test Facility
- Redstone Test Stand
- Saturn V Dynamic Test Stand

There are no NRHP-listed properties located on or immediately adjacent to Redstone Arsenal Site 12. A total of 50 NRHP-listed properties are located within a 10-mi radius of the center of Redstone Arsenal Site 12; five of these properties have been designated as National Historic Landmarks. The five National Historic Landmarks are: The Saturn V Space Vehicle, the Neutral Buoyancy Simulator, the Redstone Test Stand, the Saturn V Dynamic Test Stand, and the Episcopal Church of the Nativity (located in the City of Huntsville). Three cultural resource surveys were conducted within the boundaries of Redstone Arsenal Site 12 in 2000, 2003, and 2008. Within Redstone Arsenal Site 12 there are four archaeological sites (1MA879, 1MA880, 1MA882, and 1MA1552) recommended as potentially eligible for the NRHP and one site (1MA1553) recommended as not eligible for the NRHP. (Reference 9.3-79) The proposed layout for Redstone Arsenal Site 12 (Figure 9.3-8) would impact some of these archaeological sites but could be modified to avoid potential impacts.

As described in Subsection 4.1.3, to avoid, minimize, and mitigate potential effects to cultural and historic properties, TVA has executed a PA pursuant to 36 CFR 800.14(b)(3). Should Redstone Arsenal Site 12 be selected for siting the SMR Project, the APE would be revised and the site would be evaluated for cultural and historic resources in accordance with the stipulations of the PA.

Direct effects from SMR Project construction to cultural and historic resources are possible at Redstone Arsenal Site 12. Based on final facility designs, Phase II testing may be required and a final assessment and any required mitigation would be dependent on the outcome of the Phase II testing. Therefore, impacts of construction activities to cultural and historic resources at Redstone Arsenal Site 12 would be SMALL to MODERATE. Once construction is completed, ongoing operations would have a SMALL impact to cultural and historic resources. The overlap period associated with the incremental deployment of two or more SMRs would also have SMALL to MODERATE impact to cultural and historical resources, similar to the impacts associated with the initial construction; however, these impacts will be mitigated through activities specified by the PA.

9.3.4.1.8 Waste Management

Potential impacts of waste management for the CRN Site on land use are described in Subsections 4.1.1.1 and 5.1.1.1. Additional impacts from the management of waste including solid nonradioactive, hazardous, and mixed waste, and discharges to air and water are described in Section 5.5. Impacts of radioactive waste disposal and transportation are described

in Subsections 5.7.1.6 and 5.7.2, respectively. The geographic area of interest for this evaluation was the project site and any offsite areas that would be required for additional facilities (e.g., roads, rail lines, transmission lines, pipelines, and barge facilities) associated with full project implementation as well as any offsite areas required for waste disposal. In the evaluations provided in each of these subsections, it was determined that the impacts of waste management at the CRN Site would be SMALL.

TVA expects to construct and operate an onsite landfill for construction, site clearing, and grading debris at the selected site. The construction landfill would be sized to accommodate the anticipated materials and would be located in the permanently cleared laydown area on the selected site. The landfill would be constructed in accordance with all relevant permits and licenses. No radioactive, hazardous, or municipal waste would be disposed of in this landfill. The landfill would be closed at the end of the construction period. Construction and operational debris and associated waste not placed in an onsite disposal pit would be removed from the site and disposed of in an appropriately licensed disposal facility.

Waste management would be handled at ORR Site 2, ORR Site 8, and Redstone Arsenal Site 12, similar to the CRN Site, and therefore, the impacts of waste management at all sites would also be SMALL.

9.3.4.1.9 Postulated Accidents

The geographic area of interest for postulated accidents is a 50-mi radius from the project site.

CRN Site and ORR Sites 2 and 8

In Section 7.1, a suite of design-basis accidents for two or more SMRs at the proposed CRN Site was considered. The evaluation involved calculation of doses for specified periods at the exclusion area and low-population zone boundaries, and comparison of those doses to doses based on regulatory limits and guidelines. For the CRN Site, the characteristics of local topography and meteorology result in doses for each accident sequence considered that are below the corresponding regulatory limits and guidelines and were considered SMALL. The release characteristics would be the same at each of the Alternative ORR Sites.

Assessment of the meteorological conditions at the proposed CRN Site and two Alternative Sites did not indicate any limiting conditions. Topographic and meteorological conditions at the two alternative Oak Ridge sites (ORR Sites 2 and 8) are very comparable to the CRN Site. The geographic location of the Oak Ridge sites is situated in the vicinity of alternating ridges and valleys. In addition, the combination of high pressure associated with the Azores-Bermuda anticyclonic circulation and the nearby ridges result in generally light wind speeds (< 5 mi per hour [mph]) for all sites (Reference 9.3-81). Because the CRN Site is located in close proximity to the two ORR Alternate Sites, the onsite meteorological data is representative of the meteorological conditions at these alternate sites.

Additionally, it is noted that the location of the exclusion area boundary (EAB) at each of the ORR Sites can be defined as either within the currently government controlled areas (CRN Site) or within close proximity such that minimal impact to the surrounding land use would be required (ORR Site 2 and 8).

It is unlikely that differences in local meteorological conditions would be sufficient to cause doses from design-basis accidents for two or more SMRs at any one of the Alternative Sites to exceed regulatory limits or guidelines or the impacts from a similar accident at the CRN Site. Therefore, the impacts from postulated accidents at both ORR Sites 2 and 8 would also be SMALL.

Redstone Arsenal Site 12

Topographic conditions at the Redstone Arsenal Site include predominately flat terrain with the Tennessee River situated south of the site, and hills and plateaus surrounding the area to the north and east. Analyses of wind speed data obtained from the nearby National Weather Station in Huntsville, Alabama (located approximately 9 mi to the northwest of Redstone Arsenal Site 12), show average wind speeds near 7 mph (Reference 9.3-82). Flatter terrain and higher average wind speeds than the CRN Site will result in more favorable dispersion conditions at Site 12.

Additionally, it is noted that the location of the EAB at Redstone Arsenal Site 12 can be defined as within the currently government controlled areas. (Note that the nuclear island for Redstone Arsenal Site 12 can be located to the southeast corner of the site such that the projected EAB would not extend past the Redstone Arsenal property boundary.)

It is unlikely that differences in local meteorological conditions would be sufficient to cause doses from design-basis accidents for two or more SMRs at Redstone Arsenal Site 12 to exceed regulatory limits or guidelines or the impacts from a similar accident at the CRN Site. Therefore, the impacts from postulated accidents at Redstone Arsenal Site 12 would also be SMALL.

9.3.4.2 Cumulative Impacts

As a federal agency, TVA typically conducts cumulative impact analyses in accordance with Council on Environmental Quality (CEQ) requirements. Cumulative impacts are defined in the regulations of the CEQ implementing the National Environmental Policy Act (NEPA; 40 CFR 1508.7), as follows:

> "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

This cumulative impact analysis is designed to assess the incremental impact of the SMR Project when added to the impacts from other past, present, and reasonably foreseeable future actions. Potential impacts would include large changes to any of the analyzed resources which would not occur if the project were not constructed. For each resource area, the geographic area of interest applicable to the cumulative impact analysis is defined for the ORR and Redstone areas. Typically the geographic area of interest used in the cumulative analysis is a broad regional area that encompasses the past, present, and reasonably foreseeable projects. These projects are listed in Table 4.7-1 and shown on Figure 4.7-1 for the ORR geographic area of interest, and listed in Table 9.3-6 and shown on Figure 9.3-15 for the Redstone Arsenal geographic area of interest.

Past actions are projects prior to the early site permit application (ESPA) and present actions are projects occurring during the ESPA (including preconstruction), while future actions commence upon NRC authorized construction of the proposed unit and continue through operation and decommissioning of the SMR Project. For the purposes of this evaluation, reasonably foreseeable actions are projects that are clearly indicated in an available long term master plan or comparable document and/or have received funding and/or have applied for a permit associated with construction or operation.

The cumulative impacts associated with preconstruction, construction, and operation of the SMR Project at the CRN Site are provided in Sections 4.7 and 5.11. Each environmental and socioeconomic resource area was researched and a geographic area of interest was established for each of the resources areas associated with each of the Alternative ORR Sites. It was determined that the geographic area of interest was the same for the CRN Site and each of the two Alternative ORR Sites. A summary of the contribution of the Alternative Sites to cumulative impacts for each environmental and socioeconomic criterion is provided in Table 9.3-7. These contributions for each environmental and socioeconomic criterion are discussed in the following subsections. Due to the close proximity of ORR Sites 2 and 8 to the CRN Site, the geographic area of interest is the same for each of these three ORR sites. Thus, the past, present, and future projects within the geographic area of interest would also be the same for each of the three ORR sites.

The cumulative impacts for the resource areas evaluated would be similar for each of the three ORR Sites because, for most resource areas, the site-specific differences between the three sites are not substantial enough to alter the overall incremental contribution to cumulative impacts in the larger geographic area of interest. However, for Land Use, Water Use and Terrestrial Ecology the impacts associated with construction and operation at ORR Sites 2 and 8 could result in different impact evaluations than that for the CRN Site. In the case of Land Use, the siting of the SMR Project on ORR Site 8 would require the re-designation of land use from future aquatic-terrestrial interface studies to power production. This difference in potential cumulative impacts to Land Use is discussed specifically for ORR Site 8 in Subsection 9.3.4.2.1. For most surface water and groundwater impacts, the cumulative impacts associated with ORR Sites 2 and 8 are the same as those associated with the CRN Site, as evaluated in Subsection 5.11.3.2.1. This is because the plant parameters that affect surface water and groundwater,

including total and consumptive water use volumes, would be the same regardless of location, and because the close proximity of the sites suggests that the surface water bodies and groundwater resources affected by plant operations are largely the same. The only exceptions are impacts to onsite water bodies and wetlands, and impacts associated with water withdrawal from Melton Hill Reservoir rather than Watts Bar Reservoir, as would be the case for ORR Site 8. These differences are discussed in Subsections 9.3.4.2.2 and 9.3.4.2.3. In the case of Terrestrial Ecology, ORR Sites 2 and 8 would impact natural areas and have a potential to adversely affect biological resources within these natural areas. This difference in potential cumulative impacts to Terrestrial Ecology is discussed in more detail in Subsection 9.3.4.2.3.

Because the cumulative impacts would be the same for each of the three ORR Sites for other environmental and socioeconomic criteria, the cumulative impacts associated with other environmental and socioeconomic criteria for ORR Site 2 and 8 are not discussed in detail in the following subsections.

9.3.4.2.1 Cumulative Land Use Impacts

CRN Site and ORR Sites 2 and 8

The cumulative impacts to land use from preconstruction, construction and operation associated with the CRN Site are provided in Subsections 4.7.2 and 5.11.2. The geographic area of interest for land-use impacts is a 30-mi radius around the CRN Site, including parts of Roane, Anderson, Knox, and Loudon Counties along with population centers Kingston, Lenoir City, Oak Ridge, Athens, Maryville/Alcoa, and Knoxville. The cumulative impacts to land use in the geographic area of interest from past, present, and reasonably foreseeable projects were determined to be noticeable, but not destabilizing, and would be considered MODERATE. However, the incremental contribution to cumulative impacts associated with the SMR Project at the CRN Site would be SMALL.

As indicated previously, the siting of the future SMR facility on ORR Site 8 would require the re-designation of land use from future aquatic-terrestrial interface studies to power production. This could result in a cumulative land use impact for ORR Site 8 that is different from the CRN Site.

Two locations (the Copper Ridge and Gravel Hill watersheds) within ORR Site 8 are designated in the ORR 10-Yr Site Plan for potential future land-water interface studies. These studies were anticipated to begin within the second half of the 10-Yr land plan period (Reference 9.3-7). The nature and status of these potential studies are unknown. It is possible these studies were not started, were started and have been or are nearly completed, or are long-term studies. Because of the unknown nature of these studies, the potential for land use impacts at ORR Site 8 could be noticeable.

The cumulative impacts associated with preconstruction, construction and operation activities associated with the CRN Site are provided in Sections 4.7 and 5.11. A summary of the

contribution of the Alternative Sites to cumulative impacts for each environmental and socioeconomic criterion is provided in Table 9.3-7. Due to the close proximity of ORR Sites 2 and 8 to the CRN Site, the geographic area of interest for each of these sites is the same. Thus, the past, present, and future projects within the geographic area of interest would also be the same. Because this cumulative impact analysis is designed to assess the incremental contribution of the potential action when added to other past, present, and reasonably foreseeable future actions, the cumulative impacts for the resource areas evaluated would be similar for ORR Site 2, ORR Site 8, and the CRN Site; the site-specific differences (specifically the existence of the potential land-water interface studies) are not substantial enough to alter the overall cumulative impacts in the larger geographic area of interest. Therefore cumulative impacts to land use in the geographic area of interest with land use at ORR Sites 2 and 8 would be the same as the CRN Site and MODERATE. Also, the incremental contribution to cumulative impacts associated with land use at ORR Sites 2 and 8 would be SMALL.

Redstone Arsenal Site 12

The geographic area of interest for land use impacts is a 30-mi radius around Redstone Arsenal Site 12, including parts of Madison, Limestone, Lawrence, Morgan, Marshal and Jackson Counties in Alabama and Lincoln County, Tennessee along with population centers Huntsville, Madison, Athens, Decatur, Hartselle and Arab (Reference 9.3-83).

The history of land use at the Redstone Arsenal is long and varied. Prior to the Army's acquisition of the site in the early 1940s, approximately 550 families were present in several small rural communities (Reference 9.3-84). The property was originally chosen for a chemical manufacturing and storage facility to supplement the production of the Chemical Warfare Service's only chemical manufacturing plant at Edgewood Arsenal, Maryland (Reference 9.3-85). Between 1942 and 1945, Redstone Arsenal produced incendiaries, chlorine gas, mustard gas, loaded ammunition units, hand grenades, colored smoke, and white phosphorus (Reference 9.3-86). After the end of World War II, activities at Redstone Arsenal were severely curtailed and the destruction of munitions and deconstruction of various buildings and programs commenced (Reference 9.3-87). In 1949, operations turned to missile research. Portions of the munitions arsenal were reactivated during the Korean War while missile research and development continued (Reference 9.3-88). Redstone Arsenal has remained military since its development during World War II. This conversion from rural communities to a large military operation resulted in substantial impacts to land use.

Subsection 9.3.4.1.1 provides the current land use at Redstone Arsenal. Redstone Arsenal has seen several changes and expansions since the 2005 Base Realignment and Closure Program (BRAC) round. Several Army organizations have moved to Redstone Arsenal, including the Army Materiel Command's four star headquarters, the Space and Missile Command's three star headquarters, the majority of the Department of Defense's Missile Defense Agency, the Army Security Assistance Command two-star headquarters, the Aviation Technical Test Center from Fort Rucker, and the second recruiting brigade and the second medical recruiting battalion from Georgia. (Reference 9.3-89) As the BRAC program continues, it is likely that more army and

other military services and departments will be relocated to Redstone Arsenal. However, most of these departmental changes would occur in the residential, city center, and professional zones of the arsenal. These zones are not located near Redstone Arsenal Site 12, which is located in the industrial zone (Reference 9.3-90). Construction and personnel relocations due to the BRAC program would not contribute to cumulative impacts to land use resources associated with the construction and operation of the SMR Project, as these changes would occur in an already-developed area at Redstone Arsenal.

Redstone Arsenal is developing a 468-ac office and mixed use park called Redstone Gateway (Reference 9.3-91). The park will be located south of the intersection of I-565 and Highway 255/Rideout Road) in the northwest portion of the professional zone in the arsenal (Reference 9.3-92). The Army plans to construct an estimated 10 to 14 megawatt solar power array on the arsenal property (Reference 9.3-93). Detailed plans have not been developed, but the array would take up considerable space, and probably be located in the industrial zone. The construction and operation of the array would be considered a change in land use, although the property has been developed before and is zoned for industrial use. Due to their large scale and potential proximity to Redstone Arsenal Site 12, these projects may contribute to cumulative impacts to land use during construction and operation of the SMR Project. However, impacts would be minor because the land use has already been designated as professional and industrial for these areas.

Redstone Arsenal is developing a master plan for the future of the army resources located on site. Objectives include the continuation of administrative space consolidation, reduction of offsite office space leases, on-post facility revitalization, development of the airfield, the city center and the Huntsville Spring Branch, Goss Road development, Martin Road development, and transportation infrastructure improvements both onsite and regionally. (Reference 9.3-94) The master plan and associated projects are designed to improve the existing conditions on and around the arsenal, and may contribute to cumulative impacts to land use in the area. However, potential impacts would be small as the areas proposed for development have already been designated professional, residential, or industrial by Redstone Arsenal. Additionally, these areas have already been developed for various industrial or military uses. Therefore, although new developments may be occurring and are proposed, the land use category would not change. Thus, new developments would not contribute to any potential adverse cumulative impacts to land use associated with the SMR Project.

The City of Huntsville, located within a 30-mi radius around Redstone Arsenal Site 12, has developed a variety of master plans, including a long range transportation plan for the year 2040. This plan serves as a decision guide for the urbanized Huntsville area over the next 25 years, with an emphasis on the next 3 to 5 yr. The plan includes a projection of an increase of 68,000 households and 133,000 jobs by 2040. The reason given for this massive growth is the BRAC program. (Reference 9.3-95)

According to the 2014 annual development review released by the City of Huntsville, between 101 and 254 residential building permits were issued for the census tract (112) immediately to

the west of Redstone Arsenal Site 12. Less than five permits were issued within the census tract to the north of Redstone Arsenal Site 12. In addition to building permits, 101 to 282 certificates of occupancy were issued to residences within census tract 112, indicating that the structures had been built and were either occupied, or ready to be occupied. (Reference 9.3-96) This number of permits and occupancy certificates is the highest in the urbanized Huntsville area. This high development rate indicates a strong influx of population to the area, and in the immediate vicinity of Redstone Arsenal Site 12.

The developed areas near Redstone Arsenal Site 12 were not previously occupied by structures; therefore, this would constitute a change in land use in the geographic area of interest. It is likely that changes in population due to the construction and operation of the SMR Project would contribute to cumulative impacts to land use. Due to the SMR Project and growth in the Huntsville area related to changes at Redstone Arsenal, additional homes may need to be constructed to accommodate the projected increase in population. Although the City of Huntsville has already projected substantial population growth and is planning for this change, the cumulative impact to land use would be high; however, the incremental contribution from the construction and operation of the SMR Project would be minor.

Other cities in the 30-mi radius around Redstone Arsenal Site 12 are planning for growth. The City of Madison, Alabama experienced a population growth of 41 percent since 2000 and anticipates 12 percent growth in the next five years. In their growth plan, the City identifies technology-based employment in both Madison and Huntsville as the source of growth. The plan identifies six key development areas and addresses current and future growth-related transportation issues. Development guidelines include commercial development, residential development, walk-able and bike-able transportation routes, and major street network improvements. (Reference 9.3-97) Due to the projected growth in Madison, and existing development plans, the addition of a construction and operation workforce for the SMR Project is not expected to require an excessive amount of new development. This projected population increase in combination with the SMR Project construction and operation would have a minor impact to land use in the Madison area.

Two new residential developments are in progress in the Town of Triana, just southwest of Redstone Arsenal Site 12 (Reference 9.3-98). The Terrace of Savannah and the Town Lake Subdivision are currently either under construction or are occupied. This residential development further illustrates the population increases in the vicinity of Redstone Arsenal Site 12. These projects could have a cumulative impact on land use in conjunction with the construction and operation of the SMR Project; however, these impacts would be minor. The Town of Triana has applied for a Community Development Block Grant in order to develop a comprehensive plan. (Reference 9.3-99). Impacts to land use due to the combined demands of a construction and operation workforce for the SMR Project and the projected increases in population in Triana would need to be addressed. With the comprehensive plan in place, cumulative impacts to land use would be mitigated.

The City of Arab, Alabama, located approximately 25 mi southeast of Redstone Arsenal, updated its zoning map in 2013. General business areas tend to be located along State Route 53 with high, medium and low residential areas in successive distances from the road. Industrial areas are located on the outskirts of the city. (Reference 9.3-100). The city developed a strategic plan in 2012. The broad focus areas in the plan are economic development, public services and infrastructure, quality of life, and tax base and revenue. Most of the plan focuses on revitalization and expansion of the downtown area. Discussions regarding the possibility of developing a research park were also noted. Expansion of the sewer system and housing developments were addressed, predicting a minor increase in population. The plan states that a comprehensive plan would be developed in 2013; however, this plan is not available on the City website and may not have been completed yet. (Reference 9.3-101). Due to the distance from Redstone Arsenal Site 12, it is not likely that in-migrating SMR Project construction and operations workers would choose Arab as their home city, and only a minor increase in residential and business development would occur. Therefore, although the SMR Project would contribute to impacts to land use in Arab, these impacts would be minor.

The City of Hartselle, Alabama is located approximately 17 mi southwest of Redstone Arsenal. Hartselle has a zoning ordinance and map, although their comprehensive plan was not available on the city website at the time of this report. Due to the distance from Redstone Arsenal Site 12 and its small size, in-migrating workers are not likely to select Hartselle as a home city. Therefore, construction and operation of the SMR Project at Redstone Arsenal Site 12 would not contribute to cumulative impacts to land use in Hartselle.

Decatur, Alabama is located approximately 15 mi west of Redstone Arsenal. The City of Decatur's Planning Department developed a comprehensive master plan which was adopted in 1999 (Reference 9.3-102). Since 1999, the Downtown Decatur Redevelopment Authority has produced a series of plans and documents regarding goals and projects intended to revitalize downtown Decatur. The revitalization plans focus on the years 2015 to 2019 and describe plans for residential development in the city center, the establishment of the Education and Technology Business Park, development of the Decatur Downtown Commons, and streetscape and economic development of the 6th Avenue Gateway Corridor. Additionally, enhancement and restoration of the Railroad Depot and turning the River Clay Arts Festival into a signature benchmark event are planned. (Reference 9.3-103). The 2015 State of the City address states that approximately 280 new businesses opened in 2014, including expansions of existing industries. Ongoing projects include the renovation of the Decatur Depot, a jail expansion, Phase 2 of the construction of the Alabama Center for the Arts and several road and sewer projects. (Reference 9.3-104) With the rapid development and growth of the City of Decatur, the SMR Project construction and operations phases could contribute to cumulative impacts to land use in the Decatur area. The City of Decatur has considerable attractions which may appeal to commuting in-migrating workers. Additional population growth in the City of Decatur area could contribute to the need for additional housing, schools, hospitals and other community services, which would change land use practices. However, this impact to land use resources would be minor.

Athens, Alabama is located approximately 19 mi northwest of the Redstone Arsenal Site 12. The City of Athens adopted a land use and development plan in 2013, citing continued growth in Huntsville as a factor to its increasing growth. Prior to the plan, growth in Athens was largely suburban and low density. The plan recognizes that suburban sprawl, if allowed to continue, would degrade the character and aesthetics of the Athens area. Therefore, recommendations for separate planning approaches to edge, suburban, and urban areas are given. The focus is on retaining the rural character of the edges, while using in-fill, high density housing and business neighborhoods within the city center and specific existing high density areas. (Reference 9.3-105) Cumulative impacts to land use due to the SMR Project construction and operation are possible due to the influx of new populations. A larger number of residents could spur development in currently undeveloped areas. However, as Athens has developed a highly detailed development plan, with an emphasis on in-fill and redevelopment, these impacts would be minor.

In addition to population growth pressures, the land-based treatment and disposal of nonradioactive solid waste will also impact land use in the geographic area of interest. Cumulative impacts from preconstruction and construction waste, as well as operational waste, is primarily related to the type and amount of waste generated and the available capacity of treatment and disposal facilities. Although the waste type and amount generated by the SMR Project at the Redstone Arsenal Site 12 will be similar to the waste generated at the CRN Site by the SMR Project as discussed in Subsection 3.6.3.3 and will be managed and mitigated using TVA procedures and BMPs, the available capacity of regional treatment and disposal facilities will be specific to Redstone Arsenal Site 12.

To minimize cumulative impacts to an offsite facility, TVA expects to construct and operate an onsite landfill for construction, site clearing, and grading debris at the selected site. The construction landfill would be sized to accommodate the anticipated materials and would be located in a permanently cleared laydown area on the selected site. The landfill would be constructed in accordance with relevant permits and licenses. No hazardous or municipal waste would be disposed of in this landfill. The landfill would be closed at the end of the construction period.

Preconstruction, construction and operational nonhazardous solid waste would be managed by a TVA-approved solid waste disposal vendor and disposed in a state-approved sanitary landfill. Similar to the CRN Site, the anticipated contribution to regional sanitary landfills is minor.

Hazardous wastes from construction and operational activities, including oil wastes, paint wastes, solvent wastes, laboratory wastes, and universal wastes, would be disposed using TVA management procedures and a TVA-approved vendor. Because TVA would employ waste management and minimization practices, the impact of this contribution would be minor. Similarly, because offsite disposal of hazardous waste in the immediate vicinity, excluding contributions from Redstone Arsenal, exceeded 10 million tons in 2014, the impact from construction and operational activities associated with the construction and operation of the SMR Project would be minor.

In summary, the cumulative impacts to land use in the geographic area of interest from past, present, and reasonably foreseeable projects would be noticeable, but not destabilizing, and would be considered MODERATE. As discussed in Subsection 9.3.4.1.1, site-specific land use impacts associated with the construction and operation of the SMR Project at Redstone Arsenal Site 12 would be noticeable due to the need to re-designate the land use at Redstone Arsenal Site 12 from weapons testing to power production. However, based on the cumulative impacts that can be attributed to other past, present, and reasonably foreseeable future projects, the incremental contribution to cumulative impacts associated with land use from the preconstruction, construction and operation of the SMR Project in the geographic area of interest would be SMALL.

9.3.4.2.2 Cumulative Water Use Impacts

CRN Site and ORR Sites 2 and 8

The cumulative impacts to water use from preconstruction, construction and operation associated with the CRN Site are provided in Subsections 4.7.3 and 5.11.3. The geographic area of interest for surface water hydrology impacts was determined to be the Clinch River arm of the Watts Bar Reservoir. The cumulative impacts to water use in the geographic area of interest from past, present, and reasonably foreseeable projects was determined to be SMALL for surface water use and quality and MODERATE for groundwater use and quality. However, for each of the specific areas, the incremental contribution to cumulative impacts associated with the SMR Project at the CRN Site would be SMALL. The cumulative impacts would be the same for the SMR Project at ORR Sites 2 and 8.

As indicated previously, for most surface water and groundwater use impacts, the cumulative impacts associated with ORR Sites 2 and 8 are the same as those associated with the CRN Site, as evaluated in Subsections 5.11.3.2.1 and 5.11.3.2.2. However, some surface water use impacts could be different for each of the three ORR Sites; these are discussed in more detail below.

Surface Water Use Impacts

The cumulative surface water use impacts of the SMR Project at the CRN Site are discussed in Subsection 5.11.3.2.1. That analysis was based on a geographic area of interest which is the drainage basins for Watts Bar, Melton Hill, and Fort Loudoun Reservoirs. This geographic area of interest encompasses the seven-county area (Anderson, Knox, Loudon, Meigs, Morgan, Rhea, and Roane counties) surrounding the CRN Site. This geographic area of interest also encompasses ORR Sites 2 and 8, so it is also the geographic area of interest for ORR Sites 2 and 8.

The location of the water withdrawal, and therefore the water users who are potentially affected, varies between the three ORR Sites. Because consumptive use of surface water affects the availability of water only within the reservoir from which it is withdrawn and downstream reservoirs, consumptive water use at the CRN Site and ORR Site 2 can only affect the

availability of water in Watts Bar Reservoir and downstream reservoirs. Consumptive surface water use at the CRN Site and ORR Site 2 cannot affect water availability in any upstream reservoirs, including Melton Hill Reservoir. In contrast, consumptive water use at ORR Site 8 can reduce surface water availability within Melton Hill Reservoir, Watts Bar Reservoir, and any other downstream reservoirs. Therefore, the difference in cumulative impacts between the CRN Site, ORR Site 2, and ORR Site 8 is related only to the effect of surface water use at ORR Site 8 on surface water users and pool level within Melton Hill Reservoir. This cumulative impact of surface water use may include reducing the availability of water for other users, or affecting the pool level or hydrology in a manner which could impact recreation or navigation.

With respect to cumulative impacts associated with ORR Site 8 withdrawal from Melton Hill Reservoir, the magnitude of the potential impact to other water users is the same as that for the CRN Site and ORR Site 2 withdrawal from Watts Bar Reservoir. This is because the total and consumptive water use associated with the SMR Project would be the same at each of the three ORR Sites, and the 7Q10 flow rate within Melton Hill Reservoir is the same as that in Watts Bar Reservoir. For ORR Site 8, the impact would also affect users within Melton Hill Reservoir. As shown in Table 2.3.2-3, the additional potentially affected users include the City of Oak Ridge Department of Public Works, Centennial Golf Course, Bull Run Fossil Plant, Anderson County Utility Board, Rexnord Corporation Link-Belt Bearing, Clinton Utilities Board, West Knox Utility District, and Hallsdale Powell Utility District. For each of the three ORR sites, the maximum water withdrawal rate is approximately 17.5 percent of the 7Q10 flow rate, and the consumptive use is 7.1 percent (28 cfs/390 cfs = 0.071, or 7.1 percent) of the 7Q10 flow rate, indicating that the direct impacts of water withdrawal at each of the sites would be minimal.

Consumptive water withdrawal can also affect the pool level in the reservoirs and, as a result, it can impact recreation and navigation. As discussed in Subsection 5.2.1.2.1, the expected maximum consumptive use of water at the CRN Site, about 12,808 gpm (28.5 cfs), is essentially inconsequential compared to the combined average conveyances from Melton Hill Dam and Fort Loudoun Dam (28.5 cfs/(18,310 + 4,670 cfs) = 0.001 or 0.1 percent). This analysis also applies to ORR Site 2, because it involves the same consumptive water use on the same arm of the reservoir. For ORR Site 8, the impact of the consumptive use on recreation and navigation involves only Melton Hill Reservoir. The expected maximum consumptive use of water at ORR Site 8, about 12,808 gpm (28.5 cfs), comprises a higher proportion of the flow within Melton Hill Reservoir, because Melton Hill Reservoir is a smaller surface water body. For ORR Site 8, the maximum consumptive water use would reduce the average flow rate in Melton Hill Reservoir by 0.6 percent (28.5 cfs/4,670 cfs = 0.006 or 0.6 percent). The calculation based on the consumptive use and the 7Q10 flow is 28.5 cfs/390 cfs = 0.073 or 7.3 percent. Therefore, the incremental contribution of the SMR Project at ORR Site 8 to cumulative impacts to recreation and navigation within Melton Hill Reservoir would be higher than that of the CRN Site or ORR Site 2 on Watts Bar Reservoir, but it would still be SMALL.

Redstone Arsenal Site 12

Cumulative surface water use, groundwater use, surface water quality, and groundwater quality impacts are presented separately for surface water and groundwater.

Surface Water Use Impacts

For purposes of the cumulative impact analysis of Redstone Arsenal Site 12, the geographic area of interest for surface water use impacts is the drainage basin of Wheeler Reservoir, which comprises parts of six counties surrounding Redstone Arsenal Site 12. These six counties include Madison, Limestone, Morgan, Lawrence, Lauderdale, and Marshal Counties. Water use within the drainage basin of the Wheeler Reservoir could be impacted by projects both upstream and downstream of Redstone Arsenal Site 12. The potential for the SMR Project to contribute to such impacts is expected to be highest in close proximity to Redstone Arsenal Site 12, and decreases with distance from Redstone Arsenal Site 12.

As discussed in Subsection 9.3.4.1.2, Wheeler Reservoir is part of the TVA network of dams and reservoirs and the local surface water supply in Wheeler Reservoir is able to sustain the SMR Project at Redstone Arsenal Site 12.

Withdrawal and consumption of surface water for dust suppression during construction of the SMRs would be less than 0.002 percent of the minimum daily flow rate in the Clinch River arm of the Watts Bar Reservoir, as discussed in Subsection 4.2.2.1. Construction of the proposed SMR facility at Redstone Arsenal Site 12 would not be expected to contribute substantially to cumulative impacts to the flow rate in Wheeler Reservoir because the flow rate in Wheeler Reservoir is substantially higher than that in the Clinch River arm of the Watts Bar Reservoir (a 7Q10 flow of 390 cfs in Watts Bar versus 6291 cfs for the reach of Wheeler Reservoir near Redstone Arsenal), and the amount of water needed to support construction is expected to be approximately the same at each site.

In addition to moderating flow rates, TVA's system of dams and reservoirs serves to provide water supply for a variety of municipal, industrial, and agricultural users within the geographic area of interest. Surface water withdrawals in the Wheeler Lake watershed totaled 2959 mgd in 2010. The vast majority of this (2731 mgd) was withdrawn to support thermoelectric power production; an additional 139 mgd was withdrawn for other industrial uses. Public water supply was the third highest use, at approximately 79 mgd. Surface water users who contribute to the cumulative water use, and who could be impacted by cumulative water use impacts, include Decatur Utilities (33.38 mgd in 2010), Huntsville Utilities Water Department (38.08 mgd), Redstone Arsenal (1.69 mgd), and the West Morgan East Lawrence Water and Sewer Authority (5.47 mgd) (Reference 9.3-16).

The City of Huntsville pumps some of its water from the Tennessee River and some of it from groundwater sources. The City Utilities Department is responsible for supplying water to over 90,000 customers. Each of the City's two surface water treatment plants are capable of treating

48 mgd and the average daily pumpage being approximately 35 mgd. (Reference 9.3-106) The estimated surface water withdrawals in Madison County for the year 2010 totaled approximately 45 mgd (Reference 9.3-16). This withdrawal amount leaves the Huntsville Utilities Department approximately 51 mgd of treatment capacity.

The Limestone County Water and Sewer Authority serves approximately 20,000 customers and provides water to the City of Athens, City of Ardmore, City of Madison, East Lauderdale County, and Giles County, Tennessee. Its two water treatment plants have a total capacity of 7.25 mgd. The surface water portion of this supply is pumped from the Elk River at the North Limestone Treatment Facility, located approximately 5 mi north of Elkmont. (Reference 9.3-107) Surface water users within Limestone County withdrew 2788 mgd of surface water in 2010. Of this total, 2724 mgd was used by the thermoelectric industry, which is generally a flow-through process. Approximately 20 mgd was used for public supply, agriculture, and mining. (Reference 9.3-16).

Decatur Utilities serves approximately 25,000 customers in all portions of the City of Decatur and provides water to the City of Hartselle, the Northeast Morgan County Water District, and parts of Limestone County. The town of Trinity and the West Morgan East Lawrence Water District have the capability to buy water from Decatur Utilities upon request. The water is obtained from Wheeler Reservoir. The Water Treatment Plant has the capacity to treat 68 mgd with an average of 30 mgd of raw water. (Reference 9.3-108) Surface water users in Morgan County withdrew approximately 119 mgd in 2010. Of this 119 mgd, 78 mgd was for industrial use and presumably did not run through the treatment plant. (Reference 9.3-16) Therefore, the Decatur Utilities Water Treatment Plant has approximately 27 mgd of treatment capacity remaining.

In addition to the analysis of impacts within the geographic area of interest, the analysis in Subsection 5.11.3.2.1 included an evaluation of the cumulative impact of consumptive water use for the SMR Project compared to the overall availability of surface water within the Tennessee River watershed. The SMR Project withdraws an average of 26 mgd (44 mgd maximum), which would increase the current projected average total withdrawal within the Tennessee River watershed to 9475 mgd (9493 mgd maximum). The SMR Project withdrawal represents approximately 0.27 percent (0.46 percent maximum) of the current projected total withdrawal within the Tennessee River Watershed. This analysis, and its conclusions, applies equally to the CRN Site, ORR Sites 2 and 8, and Redstone Arsenal Site 12.

The increase in population due to construction and operational workforce in-migration could indirectly contribute to adverse impacts to water use and supply in the geographic area of interest. However, most of the population centers in the geographic area of interest are currently planning for population increases; therefore these impacts would be minimal.

As discussed in Subsection 4.7.1.2, the impact of global climate change on surface water availability in the region is unknown. The change in precipitation rates in the region due to global climate change is unknown. Global climate change is anticipated to reduce water availability through an increase in evaporation and transpiration rates as a result of increasing

temperatures (Reference 9.3-109). However, because there is abundant surface water in the Redstone Arsenal area, cumulative impacts due to climate change would be considered negligible in the geographic area of interest.

Overall, past, present, and reasonably foreseeable future projects, combined with the additional potential for a decrease in surface water availability due to global climate change, would result in cumulative impacts on surface water availability in the geographic area of interest for Redstone Arsenal Site 12 to be SMALL. Although surface water uses for municipal, agricultural, and industrial purposes remove surface water from the geographic area of interest, TVA's management of the dam and reservoir system counteracts this adverse effect by beneficially storing excess surface water for use during periods of low precipitation, ensuring availability of water for all uses in all but the worst droughts. The incremental additional impact associated with surface water use for construction and operation of the SMR at Redstone Arsenal Site 12 would not reverse the beneficial effect of the reservoir management system. Therefore, its incremental contribution to cumulative impacts on surface water use would be SMALL.

Groundwater Use Impacts

The geographic area of interest for cumulative impacts to the quality of groundwater is the subwatersheds of the streams and creeks that drain to the reservoir near Redstone Arsenal and/or areas that are directly connected to groundwater flow at Redstone Arsenal Site 12.

The processes used to construct the SMR Project on Redstone Arsenal Site 12 would be the same as those for the CRN Site. Dewatering may be necessary in order to construct the power blocks. As with the CRN Site, previous groundwater conditions are expected to resume after construction, and cumulative impacts are not expected. It is assumed that operating the SMR Project at Redstone Arsenal Site 12 would use surface water sources and therefore would not directly impact local groundwater use.

The cumulative impacts to groundwater use from past, present, and reasonably foreseeable future projects and activities in the geographic area of interest are SMALL and the incremental contribution of the SMR Project to cumulative impacts associated with groundwater use at Redstone Arsenal Site 12 also would be SMALL.

Surface Water Quality Impacts

For purposes of this cumulative impact analysis, the geographic area of interest for surface water use impacts at Redstone Arsenal Site 12 is the Wheeler Reservoir. Although projects within the drainage basin of the Tennessee River both upstream and downstream of Redstone Arsenal Site 12 can affect surface water quality throughout the entire basin, the potential for the SMR Project to contribute to such impacts is expected to be highest in close proximity to Redstone Arsenal Site 12, and to decrease substantially with distance from the Site.

Indian Creek, Huntsville Spring Branch, and McDonald Creek, all of which empty into Wheeler Reservoir, are the major systems flowing through the Redstone Arsenal. Intakes along the Wheeler Reservoir are used by Redstone Arsenal for domestic and industrial water systems (Reference 9.3-35). As part of TVA's river operations program, TVA has monitored the ecological health of Wheeler Reservoir since 1994. Based on dissolved oxygen, chlorophyll, fish, bottom life, and sediment data from 1994 to 2011, Wheeler Reservoir rated either good or fair every year with the exception of 2007 and 2011, when it rated poor. Lower ecological health scores occur during years with lower flow because of higher chlorophyll concentrations and lower dissolved oxygen levels. (Reference 9.3-17)

Two streams on the Redstone Arsenal have been designated by the EPA as impaired: Huntsville Spring Branch and Indian Creek. The pesticide DDT was the primary cause of impairment for these two streams. No impaired water bodies have been identified on Redstone Arsenal Site 12. (Reference 9.3-18)

Information on surface water quality in Wheeler Reservoir was obtained from studies of the USGS in the Lower Tennessee River Basin and the ADEM 303(d) list. These studies provide a baseline for surface water and sediment quality based on analyses which occurred from 1999 to 2015, effectively representing the cumulative impact of past and present projects. Impacts to surface water and sediment quality as a result of industry, mining, agriculture, urbanization, and toxic spills and releases have been identified. Surface water quality impacts include elevated phosphorus and pH impacts as a result of agriculture; elevated concentrations of perfluorooctane sulfonate as a result of an industrial point discharge, and elevated mercury from atmospheric deposition (Reference 9.3-110). Although water quality impacts from past and present projects have been documented, surface water quality in the Lower Tennessee River Basin meets existing guidelines for drinking water quality and the protection of aquatic life (Reference 9.3-111). New pollutant sources due to the projected population increase in the geographic area of interest are expected; an example is a planned expansion of the Madison wastewater treatment facility (Reference 9.3-112).

Global climate change may adversely affect surface water quality as increasing air and water temperatures, more intense precipitation and runoff, and intensifying droughts can result in increases in sediment, nitrogen, and other pollutant loads (Reference 9.3-109). Changes in agricultural practices in response to climate change can lead to an increase in the release of pollutants to streams. Other factors, including operation of new projects under the regulation of the CWA and the inclusion of water quality standards in the development of TVA's river management programs, have had the opposite effect, resulting in improvement of surface water quality.

Potential adverse impacts associated with construction of the SMR Project at Redstone Arsenal Site 12 include erosion and sedimentation and elevated turbidity levels at the intake and discharge structures. With appropriate permitting and BMPs, these impacts are expected to be minimal. Potential negative impacts to water quality during operations would be associated with the cooling water discharge as a result of the concentration and discharge of chemicals added

to the recirculating cooling water to prevent corrosion and biofouling, and from elevated temperatures in the discharge. It was determined that Wheeler Reservoir would be capable of handling the anticipated thermal discharges.

Cumulative impacts to surface water quality from past and present activities have occurred. The impacts from past activities are detectable, but surface water and sediment quality generally complies with relevant regulatory criteria and is therefore not destabilizing. In addition, TVA's management has had a beneficial effect on water quality by managing water flows to increase aeration and dilute industrial discharges. Given that construction-related discharges would be managed in accordance with an approved SWPPP and an NPDES permit for stormwater discharges, and BMPs would be followed during preconstruction and construction, the contribution of preconstruction and construction activities to surface water quality would be minimal.

Past and present projects in the geographic area of interest, combined with the additional potential for a future decrease in surface water quality due to climate change, result in cumulative impacts on surface water quality that are considered MODERATE. However, the incremental contribution to this cumulative impact on surface water quality from preconstruction, construction, and operation of the SMR at Redstone Arsenal Site 12 would be SMALL.

Groundwater Quality Impacts

The geographic area of interest for cumulative impacts to the quality of groundwater is the subwatersheds of the streams and creeks that drain to the reservoir near Redstone Arsenal and/or areas that are directly connected to groundwater flow of Site 12.

Redstone Arsenal was placed on the National Priorities List as a Superfund site in 1994 because of contaminated groundwater, soil, sediment and surface water resulting from arsenal operations and waste disposal practices and manufacture of DDT and other chemicals onsite. Contaminants of concern include solvents, metals, pesticides, chemical warfare material, and hazardous remnants from rocket fuel research, development, and testing, including perchlorate. NASA and the Army have addressed soil contamination with remediation and institutional controls to restrict digging and control land use. Fencing surrounds portions of the arsenal to prevent public access. Institutional controls also prohibit use of groundwater at the arsenal. (Reference 9.3-113) Contaminants of concern in the groundwater include arsenic, mercury, perchlorate, and trichloroethylene (Reference 9.3-114).

Indirect impacts are possible due to run off from the SMR Project and recharge of the aquifer from surface water sources. However, in order for the SMR Project to impact groundwater in this fashion, a large amount of contaminants would have to be released either to the groundwater or surface water on the site. As this situation is unlikely during the course of construction or operation of the SMR Project due to use of BMPs and compliance with an Integrated Pollution Protection Plan, the contribution of the SMR Project at Redstone Arsenal

Site 12 to cumulative impacts to groundwater in the geographic area of interest would be negligible.

As discussed in Subsection 9.3.4.1.2, site-specific groundwater use and quality impacts associated with the construction and operation of the SMR Project at Redstone Arsenal Site 12 would be SMALL. Although there has been a MODERATE impact on groundwater quality in the geographic area of interest due to past, present, and reasonably foreseeable future projects, the additional incremental contribution to cumulative impacts in the geographic area of interest from the preconstruction, construction and operation of the SMR Project at Redstone Arsenal Site 12 would be SMALL.

9.3.4.2.3 Cumulative Ecological Impacts

CRN Site and ORR Sites 2 and 8

The cumulative impacts to terrestrial and aquatic ecology from preconstruction and construction associated with the SMR Project at the CRN Site are provided in Subsections 4.7.4.1 and 4.7.4.2, respectively. The cumulative impacts to terrestrial and aquatic ecology from operation of the SMR Project at the CRN Site are provided in Subsections 5.11.4.1 and 5.11.4.2, respectively. Due to the proximity of ORR Sites 2 and 8 to the CRN Site, these ORR sites have essentially the same geographic area of interest for terrestrial impacts (i.e., a 5-mi radius). The cumulative impacts to terrestrial ecology in the geographic area of interest from past, present, and reasonably foreseeable future projects were determined to be SMALL to MODERATE. The incremental contribution of preconstruction, construction, and operation of the SMR Project at the CRN Site to these cumulative impacts on terrestrial ecology would be SMALL.

Although ORR Sites 2 and 8 demonstrated the potential to have a MODERATE impact to the terrestrial ecology associated with the direct and indirect impacts from project site and offsite areas required for ancillary facilities, the incremental future contribution to cumulative impacts on terrestrial ecology in the cumulative geographic area of interest from the SMR Project at ORR Site 2 or Site 8 would be SMALL. The habitat areas that would be affected on ORR Site 2 or ORR Site 8 would be relatively small in the context of the geographic area of interest and the extensive natural areas remaining on the ORR, and terrestrial ecological resources in this larger area would not be noticeably altered or destabilized. Therefore, the incremental contribution of preconstruction, construction, and operation of the SMR Project at ORR Sites 2 and 8 to the cumulative impacts on terrestrial ecology would be SMALL and the same as those associated with the CRN Site.

The cumulative impacts to aquatic ecology in the geographic area of interest from past, present, and reasonably foreseeable future projects at the CRN Site and ORR Sites 2 and 8 was determined to be SMALL to LARGE. However, the incremental contribution of preconstruction, construction, and operation to cumulative impacts associated with the SMR Project at the CRN Site would be SMALL. The cumulative impacts and the incremental contribution to cumulative impacts associated with ORR Sites 2 and 8 would also be SMALL.

Redstone Arsenal Site 12

Terrestrial Ecology and Wetlands Impacts

For the purposes of this cumulative analysis of the impacts on terrestrial ecology from preconstruction, construction, and operation of an SMR facility at Redstone Arsenal Site 12, the geographic area of interest is defined as the area within approximately a 5-mi radius of Redstone Arsenal Site 12. This area is expected to encompass other projects, facilities, and activities potentially capable of interacting with the SMR Project to affect terrestrial ecological resources during preconstruction, construction, and operation. Table 9.3-6 identifies the past, present, and reasonably foreseeable projects and facilities considered in the cumulative impacts analysis. Of the projects within the geographic area of interest for cumulative impacts on terrestrial ecology (5-mi), none involves substantial land clearing and development activities that would have more than a minor impact on the terrestrial and wetland habitats in the area.

Subsection 9.3.4.1.3 describes the terrestrial ecology of Redstone Arsenal Site 12 and concludes that impacts to terrestrial ecology during construction and operation of the SMR Project at Redstone Arsenal Site 12 would be MODERATE, principally due to impacts within Wheeler NWR that would be associated with the installation of intake and discharge pipelines and a transmission through the NWR. Much of the geographic area of interest surrounding Redstone Arsenal Site 12 provides forest habitats similar to the habitat on Redstone Arsenal Site 12 and offers alternative habitat for displaced wildlife. The construction and operation of the SMR Project at Redstone Arsenal Site 12 would contribute minimally to the conversion of forest to other land uses and the fragmentation of forest habitats that have already occurred historically and are likely to continue due to other development in the geographic area of interest. A total of approximately 216.3 ac of terrestrial and wetland habitats (120 ac onsite and 96.3 ac offsite) would be affected by the combined impacts from preconstruction, construction, and operation of facilities on Redstone Arsenal Site 12 and associated offsite facilities. The onsite impacts at Redstone Arsenal Site 12 would mainly involve the permanent removal of terrestrial habitat. The offsite impacts would consist principally of the removal of trees within transmission line and pipeline corridors, and the use of vegetation management practices to ensure that the corridors remain clear of trees.

Development and land use activities are likely to continue to contribute to the processes of forest reduction and fragmentation and associated decreases in habitat that have occurred historically in the region. These historical and present trends have resulted in significant impacts to the character and extent of native ecological communities and wildlife populations. In the future, the cumulative effects of development in the geographic area of interest could alter the characteristics of terrestrial ecology by reducing wildlife habitat in localized areas. However, this would not substantially affect the overall availability of wildlife habitat near Redstone Arsenal Site 12 or the general extent of forests or other habitat types in the geographic area of interest. Cumulative impacts on wildlife are expected to be limited by the availability of habitat in the area similar to that on the site. Substantial areas of relatively unfragmented and undisturbed forest habitat have been maintained in the geographic area of interest, particularly on Redstone

Arsenal, minimizing the cumulative impacts of the relatively small areas affected by current and reasonably foreseeable activities.

Cumulative impacts on terrestrial ecological resources were assessed in the context of past, present, and reasonably foreseeable future activities and processes occurring in the geographic area of interest for Redstone Arsenal Site 12. The assessment considered impacts on terrestrial communities from factors such as preconstruction, construction, and operation of the SMR Project in conjunction with other projects or activities that could have cumulative impacts, such as the loss of vegetation and wildlife habitat, and increased habitat fragmentation from continued development. These large-scale processes are ongoing and likely to continue. Based on this analysis, the cumulative impacts on terrestrial ecological resources in the geographic area of interest from past, present, and reasonably foreseeable future actions, including preconstruction, construction, and operation of the SMR facility on Redstone Arsenal Site 12, would range from historically significant to currently noticeable but not destabilizing (MODERATE to LARGE). The future incremental contribution from the SMR Project to the cumulative impacts on terrestrial ecology within the geographic area of interest would be MODERATE due to impacts within Wheeler NWR that would be associated with long-term changes in a sensitive habitat.

Aquatic Ecology Impacts

For the purposes of this cumulative analysis of the impacts on aquatic ecology from preconstruction, construction, and operation of an SMR facility at Redstone Arsenal Site 12, the geographic area of interest is defined as the area of Redstone Arsenal Site 12 and associated linear facilities extending off the site, as well as the middle portion of Wheeler Reservoir. This geographic area of interest is expected to encompass drainages associated with area of Redstone Arsenal Site 12 and associated offsite areas where effects on aquatic ecology from the operation of the SMR facility could occur. It also includes the limited area within Wheeler Reservoir that may be affected by the operation of the SMR facility as well as other facilities or activities capable of having effects that could interact with the SMR facility to cumulatively impact aquatic ecological resources. The potential for the SMR Project to contribute to such impacts is expected to be highest in close proximity to Redstone Arsenal Site 12, in the corridors for associated linear facilities such as transmission lines and pipelines near the site, and in the reach of Wheeler Reservoir surrounding the cooling water intake and discharge for the site. The potential for direct, indirect, and cumulative impacts to aquatic ecological resources is expected to decrease substantially with distance from Redstone Arsenal Site 12 and its intake and discharge.

Development of the SMR Project on Redstone Arsenal Site 12 potentially could have adverse effects on Wheeler Reservoir as a result of preconstruction and construction activities, such as dredging, in-water construction of intake or discharge structures, or sedimentation from stormwater runoff. As discussed in Subsection 9.3.4.2.3, the potential for occurrence of listed or other special status aquatic species on Redstone Arsenal Site 12 is minimal due to the absence of significant aquatic habitats on Redstone Arsenal Site 12 and the lack of recorded

occurrences of federally or state-listed aquatic species on or adjacent to Redstone Arsenal Site 12. By employing BMPs and complying with the requirements of permits, the aquatic impacts associated with construction are likely to be minimal.

Operation of the SMR facility on Redstone Arsenal Site 12 could have direct and indirect impacts on Wheeler Reservoir, as discussed in Subsection 9.3.4.2.2. Table 9.3-6 identifies the past, present, and reasonably foreseeable projects and facilities considered in the cumulative impacts analysis. Of the projects within the geographic area of interest for cumulative impacts on aquatic ecology, those with the greatest potential to contribute to cumulative impacts in conjunction with the SMR facility at Redstone Arsenal Site 12 are Wheeler Dam and Reservoir and the BFN Plant. Historical dam and reservoir projects to regulate the Tennessee River system have greatly altered the natural flow regime of the Tennessee River and its tributaries in the geographic area of interest. When Wheeler Dam created Wheeler Reservoir, it produced significant changes in the aquatic community that historically occurred in this portion of the Tennessee River. These changes have had minor to significant impacts on aquatic organisms and communities. Additional projects could occur in Wheeler Reservoir during the construction of the SMR Project. For example, TVA issued a Finding of No Significant Impact regarding the Limestone County request for permission to install a 30-inch pipeline across Wheeler Reservoir to connect the county to the Decatur water treatment plant. This project would also involve limited in-water construction. (Reference 9.3-115) Potentially, increases in population could increase demands on the reservoir and result in more in-water construction occurring simultaneously. Multiple construction projects within similar time-frames could cause cumulative negative impacts to aquatic ecology in Wheeler Reservoir. However, the use of BMPs and compliance with permits is expected to reduce sedimentation impacts and limit their extent to the immediate area of such projects. Thus, the contribution of construction and operation to cumulative impacts would be mitigated and remain SMALL.

As discussed in Subsection 9.3.4.2.3, operational impacts to aquatic ecology would center on the intake and discharge structures of the SMR Project. Potential chemical and thermal impacts would occur at the discharge, while biological impacts to aquatic organisms from impingement and entrainment would occur at the intake. There are already public municipal and industrial water intakes and discharges in the Wheeler Reservoir watershed, including intakes in Wheeler Reservoir (Reference 9.3-35). The addition of thermal and chemical discharges from the operation of the SMR Project could contribute to impacts on water quality, which could cumulatively impact the aquatic ecology in Wheeler Reservoir in conjunction with other sources of contaminants. However, with the implementation of BMPs, compliance with discharge permits that are set by the permitting agency to prevent cumulative impacts on water quality, and performance of monitoring, water quality would be protective of aquatic life.

Impacts due to impingement and entrainment at intake structures could also result in adverse cumulative impacts to aquatic ecology due to deaths of individual organisms and changes in population and community structure. However, as discussed for the operation of the SMR Project in Subsection 5.3.1.2, NRC has found that the effects of entrainment and impingement of aquatic organisms have not been a problem at nuclear facilities with a closed-cycle, cooling-

tower-based heat dissipation system. In addition, NRC found that the operation of the BFN Plant, an existing nuclear power plant on Wheeler Reservoir approximately 27 river miles downstream of the potential discharge location for the SMR Project on Redstone Arsenal, has impacts on fish and shellfish in Wheeler Reservoir from entrainment, impingement, and thermal effects that are small. Given the size of the reservoir and the distance between these nuclear facilities, their cumulative impact on populations of fish and other aquatic organisms in Wheeler Reservoir would not be noticeable.

Cumulative impacts on aquatic ecological resources were assessed for past, present, and reasonably foreseeable future activities and processes occurring in the geographic area of interest for Redstone Arsenal Site 12. The assessment considered impacts on aquatic communities from factors such as the effects of preconstruction, construction, and operation of the SMR Project, regulation of the Tennessee River by dams, and construction and operation of other commercial and industrial facilities in the watershed. This assessment indicates that cumulative impacts from past and present projects and activities on aquatic resources in the geographic area of interest range from historically significant to currently noticeable but not destabilizing (MODERATE to LARGE). The future incremental contribution from the SMR Project to the cumulative impacts on aquatic ecology within the geographic area of interest would be SMALL.

9.3.4.2.4 Cumulative Socioeconomic Impacts

Cumulative impacts are addressed in this subsection for physical resources (air quality and noise), human health, and socioeconomic resources (population, housing, economy and tax revenues, transportation, visual intrusions, infrastructure, and education). The past, present, and reasonably foreseeable future projects included in the cumulative analysis for Redstone Arsenal Site 12 are identified on Table 9.3-6.

CRN Site and ORR Sites 2 and 8

The cumulative impacts to socioeconomics from preconstruction, construction and operation associated with the CRN Site are provided in Subsections 4.7.5.1.1 and 4.7.5.1.2 (preconstruction and construction) and 5.11.5.1.1 and 5.11.5.1.2 (operations). The geographic area of interest for the physical resource, human health and socioeconomic resource areas were defined as follow:

- Air quality: 5-mi radius during preconstruction and construction and a 10-mi radius during operations.
- Noise: 5-mi radius from the CRN Site.
- Human Health: 50-mi radius around the CRN Site, including parts of Roane, Anderson, Knox, and Loudon Counties along with population centers Kingston, Lenoir City, Oak Ridge, Athens, Maryville/Alcoa, and Knoxville.
- Socioeconomics: Roane, Anderson, Knox, and Loudon counties

The cumulative impacts to noise, human health, economy and tax revenues, and education in the geographic area of interest from past, present, and reasonably foreseeable projects were determined to be SMALL to MODERATE. However, the incremental contribution of preconstruction, construction, and operation to cumulative impacts associated with the SMR Project at the CRN Site would be SMALL. The cumulative impacts and the incremental contribution of the SMR Project to cumulative impacts would be the same for ORR Sites 2 and 8.

The cumulative impacts to visual resources in the geographic area of interest from past, present, and reasonably foreseeable projects was determined to be SMALL to MODERATE. However, the incremental contribution of preconstruction, construction, and operation to cumulative impacts associated with the SMR Project at the CRN Site would also be SMALL to MODERATE. The cumulative impacts and the incremental contribution of the SMR Project to cumulative impacts would be the same for ORR Sites 2 and 8.

The cumulative impacts to air, population, housing, transportation, and infrastructure in the geographic area of interest from past, present, and reasonably foreseeable projects was determined to be MODERATE. However, the incremental contribution of preconstruction, construction, and operation associated with the SMR Project at the CRN Site would also be SMALL. The cumulative impacts and the incremental contribution of the SMR Project to cumulative impacts would be the same for ORR Sites 2 and 8.

Redstone Arsenal Site 12

Air Quality

The geographic area of interest is a 5-mi radius during preconstruction and construction and a 10-mi radius during operations. During preconstruction and construction, cumulative impacts to air quality from past, present, and reasonably foreseeable projects are possible if several construction projects are underway simultaneously. Preconstruction and construction activities associated with the operation of motor vehicles and construction equipment would produce temporary emissions of both gaseous pollutants and particulate matter. Present and reasonably foreseeable projects within the geographic area of interest that would involve motor vehicles and construction equipment include industrial and office parks, such as Redstone Gateway and the Polaris facility and road construction projects. However, with the use of BMPs such as dust suppression and limiting cleared areas on active construction sites, impacts would be mitigated. Because of the temporary and limited nature of preconstruction and construction emissions, and the mitigation measures used to limit onsite construction activity emissions and mobile source emissions, the additional contribution from the SMR Project during preconstruction and construction is expected to be minor.

During SMR Project operation, supporting equipment used, including cooling towers and various fossil fuel combustion sources, is expected to generate minor levels of criteria pollutants and air toxics emissions. Because supporting equipment would be operated infrequently and for limited periods of time, it is expected the SMR Project's modeling impact area would be within 10 mi.

The 10-mi radius from Redstone Arsenal Site 12 includes the cities of Huntsville and Madison and portions of Madison, Morgan, and Limestone Counties. As of 2015, the only county in Alabama that was in nonattainment was Pike County, due to lead (Reference 9.3-116). The permitted levels of emissions from other past, present, and reasonably foreseeable future actions within the geographic area of interest are not known. Major sources are currently operating within regulated permits and Madison, Morgan, and Limestone Counties are in attainment, indicating that the total level of regulated pollutants within the counties are within national ambient air quality standards set by EPA. The effects on air quality from supporting equipment used during SMR Project operation would be minor because it would be used intermittently and emissions would be minimized by using required controls. Accordingly, the additional contribution from operation of the SMR Project to cumulative impacts on air quality within the geographic area of interest would be minor.

Because climate change is global in nature and currently focuses on the policies established by national governing agencies, the project's geographic area of interest needs to be considered in the context of United States policy and national GHG emissions. Further, individual states are developing GHG regulations, thus consideration of GHG emissions under state regulations would in all likelihood also be necessary. Because GHG emissions and associated impacts require a global perspective, small incremental changes from individual projects must be evaluated collectively. This is beyond the scope of an individual project and is therefore addressed by the US under the authority of the EPA at the national scale. Mitigation measures, however, provide individual projects with the ability to minimize GHG emissions. Generally, measures to alleviate emissions of criteria pollutants from fossil fuel-fired equipment would likewise reduce GHG emissions.

Cumulative impacts on air quality were assessed in the context of past, present, and reasonably foreseeable future projects occurring in the geographic area of interest for Redstone Arsenal Site 12. This assessment indicates that the major sources among those projects are operating within regulated permits and Madison, Morgan, and Limestone Counties are in attainment (within national ambient air quality standards) and their impacts on air quality would be minor. State and federal air permitting also ensures cumulative impacts from past, present, and reasonably foreseeable future sources would comply with the Clean Air Act and state air pollution regulations. The SMR Project would be constructed and operated under air permits issued by ADEM and would not be a significant contributor to air quality impacts associated with criteria and other pollutants or GHG emissions. Due to operation-related emissions regulations and construction management BMPs, the future contributions from the SMR Project to the cumulative impacts to air quality from past, present, and reasonably foreseeable future projects are anticipated not to be detectable or so minor that they would not destabilize or noticeably alter air quality within the geographic area of interest and would be minor. Overall, cumulative impacts, when considering GHG emissions are expected to be noticeable and MODERATE. However, the incremental contribution of the SMR project to cumulative impacts on air quality would be SMALL.

Noise

Cumulative impacts on noise were assessed in the context of past, present, and reasonably foreseeable future projects occurring in the geographic area of interest. The geographic area of interest for cumulative impacts to noise is within 5 mi of Redstone Arsenal Site 12. Cumulative noise impacts may occur if several large present or reasonably foreseeable future projects were under construction at the same time in close proximity. Redstone Arsenal master plan addresses the future of the Army resources located on site. Objectives include the continuation of administrative space consolidation, reduction of offsite office space leases, on-post facility revitalization, development plans for the airfield, the city center and the Huntsville Spring Branch, Goss Road development, Martin Road development, and improving transportation infrastructure both onsite and regionally. (Reference 9.3-94) Redstone Arsenal is developing a 468-ac office and mixed use park called Redstone Gateway (Reference 9.3-91). The park will be located near the intersection of I-565 and Highway 255 in the northwest portion of the professional zone in the arsenal (Reference 9.3-92). Due to its large scale and proximity to Redstone Arsenal Site 12, this project would contribute to cumulative impacts to noise during preconstruction, construction, and operation of the SMR Project. The high rate of development in the Redstone Arsenal area would increase the noise impacts as it would place more residences closer to the SMR Project and the other new developments. The contribution of the past, present, and reasonably foreseeable future projects to noise levels within the geographic area of interest are unknown, but considered to be MODERATE.

Based on noise levels associated with construction equipment and the mechanical draft cooling towers (the main source of continuous onsite noise during operation), the contribution from the SMR Project to cumulative impacts on noise would be noticeable during preconstruction and construction and minor during operation. However, given the existing high-level noise environment, it would be a minor component of overall noise in the geographic area of interest. Therefore, the incremental contribution of the SMR Project to cumulative impacts on noise would be SMALL.

Human Health

Cumulative radiological and non-radiological to human health impacts to the public were assessed for past, present, and reasonably foreseeable future projects. The geographic area of interest for cumulative impacts to human health is a 50-mi radius around Redstone Arsenal Site 12 including the Redstone Arsenal, Huntsville, and Decatur.

As described in Section 5.4, the radiological impacts from operation of the CR SMR Project would be SMALL. While potential human health impacts from radiological exposures are dependent upon site-specific meteorological data, water and other exposure pathways, and potential exposed populations, the conditions at Redstone Arsenal Site 12 are not so significantly different from the CRN Site that the resulting dose to the public would be significantly different. Additional sources of man-made radiation within the 50-mi radius around Redstone Arsenal Site 12 include the three nuclear power reactors at the BFN Plant. SMRs at

Redstone Arsenal Site 12 and the combined reactors at BFN Plant site would both have to independently comply with the regulatory dose limits of 100 mrem/yr to members of the public. While the cumulative dose does not have to meet this regulatory limit, the cumulative dose would still be substantially less than the approximately 300 mrem average annual dose to individuals from natural or background radiation in the United States (Reference 9.3-117). Additional radiation source with the 50-mi radius would also include commercial products and medical exposures. These are generally considered part of an individual's background radiation exposure. Therefore, the incremental contribution from SMRs operating at Redstone Arsenal Site 12 to the cumulative radiological health impacts in the geographic area of interest would be substantially less than background dose and would therefore be SMALL.

As described in Sections 4.7 and 5.11, the nonradiological health impacts on the surrounding public from preconstruction, construction, and operational activities at the CRN Site would be SMALL. Compliance with emissions is not site-specific and, therefore, human health impacts for Redstone Arsenal Site 12 would be similar to the impacts for the CRN Site. Impacts were evaluated for cooling system effects on surface water and the atmosphere and transmission line effects on members of the public.

Past, present and foreseeable future projects within the geographic area of interest such as construction and operation of roads, an airport, and industrial facilities would contribute to cumulative health impacts. The specific impacts of those projects are unknown, but would be considered SMALL to MODERATE. However, given that emissions from the SMR Project would be in compliance with regulatory limits, incremental contributions from the SMR Project to non-radiological cumulative health impacts in the geographic area of interest would be SMALL.

Population

Cumulative effects on population are associated with an influx of workers or residents into the area. The geographic area of interest for cumulative impacts to population is Madison, Morgan, and Limestone Counties, Alabama. As described in Subsection 9.3.4.2.4, the in-migrating workforce for the SMR Project along with their families include 2765 people during preconstruction and construction, 620 people during operation, and 3385 people during the overlap period between preconstruction/construction and operation. The past, present, and reasonably foreseeable future projects identified for the geographic area of interest would contribute to cumulative population impacts through the additions of workers and residents. Subsection 9.3.4.1.1 discusses land use and the master plans of several surrounding population centers and the Redstone Arsenal. Overall, the geographic area of interest for population is rapidly developing due to the BRAC program and other large scale industrial and commercial developments. In addition to the increases in utilization of Redstone Arsenal, new companies are moving into the area. For example, Polaris is constructing a facility to build off-road vehicles on 450 ac in Limestone County that will employ up to 2000 workers (Reference 9.3-118).

The cumulative impacts on population in the geographic area of interest from past, present, and reasonably foreseeable future actions would be sufficient to noticeably alter population, and

would be considered MODERATE. As the population in the geographic area of interest is already increasing, the incremental contribution to cumulative impacts on population growth from preconstruction, construction, and operation of the SMR Project would be negligible and would be considered SMALL.

Housing

Cumulative effects on housing are associated with an influx of workers or residents into the area. The geographic area of interest for cumulative impacts to housing is Madison, Morgan, and Limestone Counties, Alabama. As described in Subsection 9.3.4.1.5, the SMR Project would add up to 3300 workers who would require temporary housing and 250 requiring permanent housing. Present and reasonably foreseeable future projects that add workers, including large scale commercial and industrial developments such as the Polaris manufacturing facility (that will employ an estimated 2000 workers) and the BRAC program at Redstone Arsenal, would also result in increased demand for housing in the geographic area of interest. New home construction is already occurring to address this demand.

The cumulative impacts on housing in the geographic area of interest from past, present, and reasonably foreseeable future actions would be sufficient to noticeably increase demand for temporary and permanent housing, and would be considered MODERATE. Based on the relatively small numbers of in-migrating families requiring housing, the incremental contribution to cumulative impacts on housing from preconstruction, construction, and operation of the SMR Project would be negligible, and are considered SMALL.

Economy and Tax Revenues

Subsection 9.3.4.1 discusses potential impacts to the economy of the Redstone Arsenal area if the SMR Project were to be constructed at Site 12. Most of these impacts are due to an increase in population and an increase in employment. The geographic area of interest for cumulative impacts to the economy and tax revenues is Madison, Morgan, and Limestone Counties, Alabama.

Cumulative impacts to the economy were assessed in the context of past, present, and reasonably foreseeable future projects occurring in the geographic area of interest. The impact of past and present projects is already reflected in existing employment levels. The preconstruction and construction workforce of 3300 assumed for the SMR Project accounts for 1 percent of the total workforce within the three counties in the geographic area of interest. Operations workers represent 0.2 percent of the total workforce and the temporary refueling outage workers represent 0.3 percent of the total workforce. During the overlap period between preconstruction/construction and operation, the total workforce of 3666 represents 1.1 percent of the total workforce in the geographic area of interest. Increases in employment would lead to an increase in sales and property tax revenues in the affected counties. This would represent a beneficial impact to the geographic area of interest.

Preconstruction/construction employment and operations employment each account for less than 5 percent of employment within the three counties in the geographic area of interest. The reasonably foreseeable future projects identified in Table 9.3-6 would generate increased area employment noticeably. Therefore, the additional cumulative impact of SMR Project-related employment on the economy of the geographic area of interest would be minor and beneficial.

The increase in TVA tax equivalent payments would be used by cities and towns in the geographic area of interest to hire additional personnel and construct new social infrastructure facilities as needed. Cumulative impacts on the tax revenues were assessed in the context of past, present, and reasonably foreseeable future projects occurring in the geographic area of interest. The impact of past and present projects is already reflected in existing tax revenues. As presented in Subsection 9.3.4.1.5, the TVA tax equivalent payments represent 8.4 percent of total county revenues for Madison County and 28.4 percent for Morgan County. For Limestone County, the total annual tax revenues collected during FY 2013-2014 were $43.1 million. The TVA tax equivalent payment during the same year was $8.4 million, which represents 19.6 percent of total county revenues. For the three counties combined, the TVA tax equivalent payments of $44.2 million represent 13 percent of the total revenues of $333.5 million.

In summary, given the high rate of development and projected population increases in the geographic area of interest, the cumulative impacts to the economy and tax revenue due to the preconstruction, construction, and operation of the SMR Project along with past, present, and reasonably foreseeable future actions would be sufficient to noticeably alter the regional economy and tax revenues and is considered MODERATE, and primarily beneficial. Although the employment increase and amount of sales and property taxes associated with the SMR Project would be noticeable in absolute terms, the impact of preconstruction, construction, and operation would be small based on associated employment representing less than 5 percent of employment in the geographic area of interest. Therefore, the overall incremental contribution to cumulative impacts of the SMR project to economy and tax revenues would be SMALL to MODERATE, and primarily beneficial.

Transportation

The evaluation of cumulative transportation impacts is based on the effect of project-related traffic and traffic associated with past, present, and reasonably foreseeable future projects on the LOS for roadways within the relevant study area. The geographic area of interest for cumulative impacts to transportation is Madison, Morgan, and Limestone Counties, Alabama. Using the volumes and Florida LOS Handbook, I-565 is currently operating at LOS D, US 231 at its highest traffic volumes is operating at LOS D (borderline LOS E), and Rideout Road is operating at LOS C or better (Reference 9.3-71). Based on these LOS results for the surrounding roads and the urban setting, it can be concluded that additional traffic to construct the SMR Project at this Site would create traffic concerns and would require roadway improvements.

The ALDOT has 52 transportation projects in the geographic area of interest projected for fiscal years 2015 through 2019. Of these projects, one is in Limestone County and the rest are in Madison County, generally in or near Huntsville. Projects vary from simple re-grading to bridge replacement and widening and extending existing roads. There will be a new Huntsville bypass and a new interchange at the entrance to Redstone Arsenal off of I-565. The projects are predicted to cost between 301 to 452 billion dollars. (Reference 9.3-119) These projects are likely to impact local traffic conditions while they are under construction. Indirect impacts can occur if delays on major roads cause travelers to use smaller local roads instead. Although impacts to traffic in the geographic area of interest are likely due to the combination of the multiple construction projects, these would be temporary and conditions would improve once the improvements have been completed.

The Redstone Arsenal master plan and associated projects are designed to improve the existing conditions on and around the arsenal and, therefore, are not expected to contribute to potential adverse cumulative impacts to traffic associated with the SMR Project. There may be temporary increases in traffic if construction projects are occurring concurrently, or if road improvements are scheduled during preconstruction and construction of the SMR Project. The planning process would address traffic increases, but if many construction projects are underway simultaneously, coupled with a large increase in local population, the effects would be sufficient to noticeably alter traffic levels in the geographic area of interest and cumulative impacts to traffic would be moderate. However, these impacts would be temporary and the road improvement projects would be expected to result in an overall beneficial impact to traffic resources.

The City of Huntsville has developed a variety of master plans, including a long range transportation plan for the year 2040. This plan serves as a decision guide for the urbanized Huntsville area over the next 25 yr, with an emphasis on the next 3 to 5 yr. The plan addresses future traffic volumes, roadway and intersection capacities, new transportation corridors, alternative transportation modes, pedestrian/bicycle trails, signalization needs, and funding alternatives. The plan includes a projection of a 68,000 household increase by 2040, and an increase of 133,000 jobs. The reason given for this massive growth is the BRAC program. The plan envisions bicycle and pedestrian paths and public transportation improvements, as well as a bypass road which will ring the Huntsville urbanized area. The objective is to relieve future traffic congestion and improve freight capacity in the area. (Reference 9.3-95) As with the Redstone Arsenal master plan, the 2040 transportation plan is geared towards eliminating potential adverse impacts to resources in the area. As this plan is executed over the next 25 years, it would be expected to relieve cumulative impacts due to the SMR Project and the past, present, and reasonably foreseeable future projects. If Redstone Arsenal Site 12 were chosen for the SMR Project, the transportation master plan would be updated to reflect this new development. Preconstruction and construction of the SMR Project in conjunction with ALDOT transportation projects, development in the area, and increased traffic levels associated with the projected increase in population are likely to noticeably affect traffic conditions in the geographic area of interest, resulting in MODERATE cumulative impacts to transportation. The incremental

contribution to cumulative impacts related to operation of the SMR Project at Redstone Arsenal Site 12, which would contribute a small portion of the overall traffic increase in the area, would be SMALL.

Visual Intrusions

Definitions of significance levels of impacts that result from visual intrusions, as per NUREG-1437, Revision 1, are summarized under the visual intrusions discussions in Subsection 9.3.4.1.5. The criteria address a changed sense of place or a diminution in the enjoyment of the physical environment (reflected by complaints from the public), and impacts to socioeconomic institutions and processes. The geographic area of interest for cumulative impacts to visual intrusions includes the 2-mi radius surrounding Redstone Arsenal Site 12.

Depending on the location of the observer and the atmospheric conditions, the visual intrusion due to operation of the SMR Project would range from SMALL (no noticeable alteration of visual aesthetics and no complaints anticipated from the affected public) to MODERATE (noticeable alteration with some complaints anticipated), due primarily to the visual effect of the plume from the cooling towers. The Redstone Arsenal master plan includes projects located near or within the geographic area of interest. They represent present and reasonably foreseeable projects and facilities which are expected to impact visual resources and the cumulative impact would be noticeable. The incremental contribution to cumulative impacts from the SMR Project on visual resources within the geographic area of interest, primarily associated with the industrial appearance of the plume during operations, would be SMALL to MODERATE.

Infrastructure

Cumulative impacts to the local infrastructure, primarily water treatment facilities and wastewater treatment facilities, are possible due to the large amount of construction and development occurring in the geographic area of interest. The geographic area of interest for cumulative impacts to infrastructure includes Madison, Morgan, and Limestone Counties, Alabama.

Subsection 9.3.4.1.5 identifies the impacts on water and wastewater treatment facilities associated with the SMR Project and identifies them as small, based on availability of excess capacity. Although the local water treatment facilities are operating below capacity, with an influx of 68,000 persons to the Huntsville area plus additional developments like the Polaris plant, Redstone Arsenal's new developments, and the SMR Project, the municipal water supply would experience increased demand for potable water. However, with the increased tax revenue and a construction-oriented workforce in the area, potential impacts to infrastructure would be minimized with careful planning and monitoring of conditions. In conjunction with past, present, and reasonably foreseeable future actions, based on the projected increase in population and the multiple proposed construction projects in the geographic area of interest, there would be overtaxing of facilities during peak demand periods and some new capital expenditures would be necessary. This would result in noticeable, but not destabilizing, cumulative impacts and would be considered MODERATE. However, the incremental

contribution from operation of the SMR Project to cumulative impacts on infrastructure in the geographic area of interest would result in little or no change occurring in the communities' ability to respond to the level of demand and no need to add capital facilities or additional personnel, and the impact would be SMALL.

Education

Cumulative impacts to education were evaluated based on the estimated number of school-aged children that would relocate to the geographic area of interest as a result of the SMR Project in conjunction with the with past, present, and reasonably foreseeable future projects. The geographic area of interest for cumulative impacts to education includes Madison, Morgan, and Limestone Counties, Alabama.

Population increases and development activities in the geographic area of interest would result in increased demand for educational services. An influx of 68,000 persons would include a considerable amount of children who would need educational services. Additionally, a demand for skilled workers would increase the demand for training programs and vocational schools. With the increased tax revenues in the local population centers, these demands on the educational systems would likely be mitigated. However, educational systems would have to be able to expand quickly enough to meet sudden increases in population due to the large scale construction projects that are ongoing and planned in the geographic area of interest. Cumulative impacts to educational resources in the geographic area of interest from past, present, and reasonably foreseeable future actions would be noticeable but not destabilizing and considered MODERATE. The incremental contribution to cumulative impacts from the SMR Project, resulting in the addition of an estimated 489 students during preconstruction and construction and 110 students during operation, would be SMALL.

9.3.4.2.5 Environmental Justice Impacts

EO 12898 (59 FR 7629) directs federal executive agencies to consider environmental justice under NEPA. This EO ensures that minority and/or low-income populations do not bear a disproportionate share of adverse health or environmental consequences of a proposed project. TVA's policy is to consider environmental justice in its environmental reviews. (Reference 9.3-75)

CRN Site and ORR Sites 2 and 8

The evaluation of cumulative impacts for environmental justice from preconstruction, construction and operation associated with the CRN Site is provided in Subsections 4.7.5.2 and 5.11.5.2. The geographical area of interest was determined to be a 50-mi radius of the CRN Site. There were no cumulative environmental justice impacts identified in the geographic area of interest from past, present, and reasonably foreseeable projects, and therefore, the impacts would be SMALL. The incremental contribution of preconstruction, construction, and operation associated with the SMR Project at the CRN Site would have no disproportionately high and adverse impacts on minority or low-income populations, and therefore, the impacts would be

SMALL. The cumulative and incremental contribution of the SMR Project to cumulative impacts would be the same for ORR Sites 2 and 8.

Redstone Arsenal Site 12

The geographic area of interest for environmental justice impacts is the 50-mi radius around Redstone Arsenal Site 12. Subsection 9.3.4.1.provides baseline information on minority and low-income populations within the 50-mi region and evaluates the potential environmental justice impacts from preconstruction, construction, and operation of the SMR Project at Redstone Arsenal Site 12. Most of the block groups (54 of 74) with an aggregate minority population fall within Madison County, Alabama, within the boundaries of the City of Huntsville. The identified aggregate minority population closest to Redstone Arsenal Site 12 is located approximately 1.5 mi to the southwest of the site in the Town of Triana in Madison County, Alabama. This is also the closest Black minority population block group. The majority of the low-income population in the geographic area of interest is in the City of Huntsville, in Madison County, Alabama. The closest low-income population is located in Madison County, Alabama, approximately 6.5 mi northeast of Redstone Arsenal Site 12. As described in Subsection 9.3.4.1.6, the potential for disproportional impacts to low-income and minority populations from construction-related and operational activities is small.

The cumulative analysis considers impacts from preconstruction, construction, and operation of the SMR Project at Redstone Arsenal Site 12 along with impacts from past, present, and reasonably foreseeable actions that could cause disproportionately high and adverse impacts on minority and low-income populations. The evaluation of potential health and environmental impacts on minority or low-income communities includes consideration of the cumulative impacts identified for the physical and socioeconomic resources discussed within Subsection 9.3.4.1.5. A discussion of the potential for disproportionate impacts to environmental justice populations resulting from cumulative impacts to these resources is provided below. That evaluation concluded that the cumulative impacts would be SMALL and the incremental contribution of the SMR Project to cumulative environmental justice impacts would be SMALL.

Potential Physical Impacts

Physical impacts under consideration due to SMR Project construction and operation at Redstone Arsenal Site 12 include potential effects on land use, water, and ecology.

As described in Subsection 9.3.4.1.1, the cumulative impacts to land use in the geographic area of interest from past, present, and reasonably foreseeable projects would be noticeable, but not destabilizing, and would be considered MODERATE. Site-specific land use impacts associated with the construction and operation of the SMR Project at Redstone Arsenal Site 12 would be MODERATE due to the need to re-designate the land use at Site 12 from weapons testing to power production. However, based on the cumulative impacts that can be attributed to other past, present, and reasonably foreseeable future projects, the incremental contribution to cumulative land use impacts in the geographic area of interest from the construction and operation of the SMR Project would be minor.

As described in Subsection 9.3.4.1.2, site-specific water use and quality impacts associated with the construction and operation of the SMR Project at Redstone Arsenal Site 12 would be SMALL. Although the geographic area of interest has seen a MODERATE impact due to past, present, and reasonably foreseeable future projects, the incremental contribution to cumulative impacts to water use and water quality in the geographic area of interest from the construction and operation of the SMR Project would be minimal.

As described in Subsection 9.3.4.1.3, cumulative impacts on terrestrial ecological resources from factors such as the loss of vegetation and wildlife habitat, and increased habitat fragmentation from continued development were assessed. Based on this analysis, the cumulative impacts on terrestrial ecological resources in the geographic area of interest from past, present, and reasonably foreseeable future actions, including preconstruction, construction, and operation of the SMR facility on Redstone Arsenal Site 12, would range from historically significant to currently noticeable but not destabilizing. The future incremental contribution from the SMR Project to the cumulative impacts on terrestrial ecology within the geographic area of interest would be noticeable but not destabilizing due to impacts within Wheeler NWR that would be associated with long-term changes in a sensitive habitat.

The assessment of aquatic ecology impacts described in Subsection 9.3.4.1.4 considered impacts on aquatic communities from factors such as the effects of preconstruction, construction, and operation of the SMR Project, regulation of the Tennessee River by dams, and construction and operation of other commercial and industrial facilities in the watershed. This assessment indicates that cumulative impacts from past and present projects and activities on aquatic resources in the geographic area of interest range from historically significant to currently noticeable but not destabilizing (MODERATE to LARGE). The future incremental contribution from the SMR Project to the cumulative impacts on aquatic ecology within the geographic area of interest would be minor.

As described above, the incremental contribution from the SMR Project to cumulative impacts on land use and terrestrial biological resources at Redstone Arsenal Site 12 would be localized and would not adversely affect the closest minority block group in the Town of Triana, Alabama and the closest low-income block groups in the City of Huntsville, Alabama. Considering that a minority population known to have been dependent on fishing for subsistence is located close to Redstone Arsenal Site 12, pathways exist for adverse (i.e., both harmful and significant) and disproportionate impacts to the community due to project-related effects on water quality and aquatic resources. Based on the identification of small incremental contributions to cumulative impacts on those resources from construction and operation of the SMR Facility, minority and low-income populations would not be adversely affected. Accordingly, for physical resources, the potential for disproportionately high and adverse cumulative impacts to minority and low-income populations in the geographic area of interest would be SMALL, and the potential for disproportionately high and adverse incremental contribution to the cumulative impacts for Redstone Arsenal Site 12 to minority and low-income populations would be SMALL.

Potential Socioeconomic Impacts

The socioeconomic resources with the greatest potential to affect minorities and low-income populations are housing and transportation, as well as human health.

As described in Subsection 9.3.4.1.5, the cumulative impacts on population and housing in the geographic area of interest from past, present, and reasonably foreseeable future actions would be sufficient to noticeably alter important attributes of these resources, and would be considered noticeable but not destabilizing. As the population in the geographic area of interest is already increasing, and new home construction is already occurring, the incremental contribution to cumulative impacts on population growth and housing from construction and operation of the SMR Project at Redstone Arsenal Site 12 would not be detectable or so minor that it would not noticeably alter or destabilize any important attribute of those resources. Although increased demand for low-cost housing by construction workers within the geographic area of interest would have the potential to drive up prices, which would disproportionately impact low-income populations, the incremental contribution of the SMR Project to cumulative housing impacts would have a negligible potential for disproportionately high and adverse impacts to low-income populations. In summary, cumulative population and housing impacts to minority and low-income populations would be minimal and the incremental contribution of the SMR project to cumulative impacts on environmental justice populations also would be minimal.

As described in Subsection 9.3.4.1.5, the cumulative impacts on transportation in the geographic area of interest from past, present, and reasonably foreseeable future actions would be sufficient to noticeably affect traffic conditions, and would be considered noticeable but not destabilizing. The incremental contribution to cumulative impacts related to operation of the SMR Project at Redstone Arsenal Site 12, which would contribute a small portion of the overall traffic increase in the area, would be minor. Although there is the potential for adverse impacts to minority and low-income populations from commuting or delivery traffic on access roads to Redstone Arsenal Site 12, the primary roads used for access to the Site do not pass through the minority or low-income block groups. Therefore, cumulative transportation impacts would have a minor potential for disproportionately high and adverse impacts to minority and low-income populations and the incremental contribution of the SMR Project to cumulative transportation impacts on environmental justice populations would be minor.

Subsection 9.3.4.1.5 discusses potential cumulative human health impacts from radiological and non-radiological exposures in the geographic area of interest from past, present, and reasonably foreseeable future actions. The estimated human health impacts from radiological exposures at Redstone Arsenal Site 12 are expected to be minor because of the small, contained nature of the reactors and because of the anticipated use of a closed cooling water system in the Wheeler Reservoir. The cumulative radiological impacts from present and reasonably foreseeable future actions within the area of interest are expected to be within permissible levels in the NRC’s regulation and therefore would be minor. The incremental contribution to cumulative human health impacts from radiological exposures associated with operation of the SMR Project also would be within permissible levels and would be negligible.

Therefore, the cumulative human health impacts from radiological exposures would have a minor potential for disproportionately high and adverse impacts to minority and low-income populations, and the incremental contribution of the SMR Project to cumulative environmental justice impacts would be minimal.

Health impacts from non-radiological hazards during preconstruction, construction, and operation activities at Redstone Arsenal Site 12 include localized impacts from noise, vibrations, and dust. Cumulative impacts to noise, vibration, and dust levels are possible if several construction projects are underway simultaneously. If the development actions identified for the geographic area of interest, including the SMR Project, the additions to Redstone Arsenal, and expanding residential areas, were to proceed at the same time, cumulative noise impacts from past, present, and reasonably foreseeable future actions would be sufficient to alter noticeably, but not to destabilize, noise and vibration levels in the area. With the use of BMPs such as dust suppression and limiting cleared areas on active construction sites, cumulative impacts from dust would range from minor to noticeable. Therefore, the cumulative non-radiological impacts on human health would have a minor potential for disproportionately high and adverse impacts to environmental justice populations. There are residential areas adjacent to the Redstone Arsenal western boundary that are located closer to Redstone Arsenal Site 12 than any identified minority or low-income block groups. Given that human health impacts were determined to be small for the general population and that minority and low-income block groups are located farther from Redstone Arsenal Site 12 than other residents, the incremental contribution of the SMR Project to cumulative human health impacts from non-radiological exposures would have a minor potential for disproportionately high and adverse impacts to minority and low-income populations.

As described in Subsection 9.3.4.1.5, the cumulative impacts on the remaining socioeconomic resources in the geographic area of interest from past, present, and reasonably foreseeable future actions would be minor to noticeable. The incremental contribution from preconstruction, construction, and operation of the SMR Project at Redstone Arsenal Site 12 to cumulative impacts would be minor for air quality, economy, infrastructure, and education, noticeable for tax revenues, and minor to noticeable for visual resources. The incremental contribution to cumulative impacts to air quality would not destabilize or noticeably alter air quality in the area of interest. Construction employment and operations employment each account for less than 5 percent of employment within the Redstone Arsenal geographic area of interest. The incremental contribution to cumulative impacts on infrastructure and education would result in little or no change occurring in the communities' ability to respond to the level of demand and no need to add capital facilities or additional personnel. The incremental contribution to cumulative impact to tax revenues, which would be beneficial, would be sufficient to noticeably alter tax revenues of the geographic area of interest. The incremental contribution to cumulative visual impacts is based on the minor to moderate likelihood of the affected public to complain about the visual intrusions. There is the potential for disproportionate cumulative air quality and visual intrusion impacts to minority or low-income populations based on location. The nearest minority or low-income block group, the Town of Triana, is located approximately 1.5 mi to the southwest

of Redstone Arsenal Site 12. Considering that there are other residential neighborhoods located closer to the Site, adjacent to the western boundary of Redstone Arsenal, the incremental contribution of the SMR Project to cumulative impacts to air quality and visual intrusions would have a minor potential for disproportionately high and adverse impacts to minority and low-income populations. Therefore, the cumulative impacts to air quality, economy, infrastructure, education, tax revenues, and visual resources would have a low potential for disproportionately high and adverse impacts to minority and low-income populations, and the incremental contribution of the SMR Project to cumulative environmental justice impacts would be minimal.

In summary, for socioeconomic resources, the potential for disproportionately high and adverse cumulative impacts to minority and low-income populations within the geographic area of interest would be SMALL, and the potential for disproportionately high and adverse incremental contribution to the cumulative impacts associated with the Redstone Arsenal Site 12 to minority and low-income populations would be SMALL.

9.3.4.2.6 Cumulative Impacts to Historic and Cultural Resources

CRN Site and ORR Sites 2 and 8

The cumulative impacts to historic and cultural resources from preconstruction, construction and operation associated with the CRN Site are provided in Subsections 4.7.5.3 and 5.11.6. The geographic area of interest for the analysis of cumulative impacts to historic properties includes:

- The archaeological resources and historic properties within the CR SMR Project APE are defined in Subsection 2.5.3 as (1) the approximate 1200-ac Clinch River Property, (2) an additional approximate 105 ac northwest of the property near the CRN Site entrance and along Bear Creek Road and Tennessee State Highway (TN) 58, and (3) the Melton Hill Dam including a 0.5 mi radius around the Melton Hill Dam.
- The Historic Architectural APE is 0.50-mi radius surrounding the proposed cleared areas.
- The historic properties (those eligible for listing on the NRHP) within a 10-mi radius of the center of the CRN Site (Figure 2.5.3-2).

The geographic area of interest for archaeological resources is the 1305-ac CR SMR APE. For historic architectural resources the geographic area of interest is the 0.5-mi radius around the CRN Site.

The cumulative impacts to historic and cultural resources in the geographic area of interest from past, present, and reasonably foreseeable projects was determined to be MODERATE. The incremental contribution to cumulative impacts to cultural resources from preconstruction, construction, and operations of the CR SMR Project would range from SMALL to MODERATE. The cumulative impacts and the incremental contribution of the SMR Project to cumulative impacts would be the same for ORR Sites 2 and 8.

Redstone Arsenal Site 12

As discussed in Subsection 9.3.4.1.7, approximately 1000 archaeological sites have been identified at Redstone Arsenal and approximately 418 of these sites are potentially eligible for listing on the NRHP. In addition, four NRHP sites are present within the Redstone Arsenal boundary.

The geographic area of interest for historic and cultural impacts is the 38,000-ac U.S. Army garrison and up to a 0.5-mi radius around Redstone Arsenal Site 12, should that distance exceed the Garrison boundary. Cumulative impacts to historic and cultural resources from past and present activities have occurred at Redstone Arsenal, and are noticeable, but not destabilizing and would be considered MODERATE. The impacts from past activities resulted in the destruction, removal, and/or disturbance, of historic and cultural resources. Cultural resources are nonrenewable and therefore impacts are cumulative in nature. The preconstruction, construction, and operation activities associated with the SMR Project could contribute additional cumulative impacts to some cultural resources within the APE.

Based on the analysis of past and present activities in the area and the proposed project actions, the incremental contribution to cumulative impacts to cultural resources from preconstruction, construction, and operations of the CR SMR Project at Redstone Arsenal Site 12 would be SMALL to MODERATE.

9.3.4.2.7 Postulated Accidents

CRN Site and ORR Sites 2 and 8

The cumulative impacts from postulated accidents for the SMR operation at the CRN Site are provided in Subsection 5.11.7. The geographic area of interest was determined to be the 50-mi radius of the CRN Site. The cumulative impacts associated with postulated accidents in the geographic area of interest from past, present, and reasonably foreseeable projects were determined to be SMALL. The incremental contribution to cumulative impacts associated with operation of the SMR Project at the CRN Site also would be SMALL. The cumulative impacts would be the same for ORR Sites 2 and 8.

Redstone Arsenal Site 12

The geographic area of interest for postulated accidents is the same as the project's geographic area of interest - a 50-mi radius. This takes into consideration existing and proposed nuclear power plants that have the potential for increasing the probability-weighted consequence (i.e., risks) from a severe accident at any location with 50 mi of the alternative site. There are currently two nuclear power plants operating in Alabama – BFN Plant, (Limestone County) and Joseph M. Farley (Houston County), the latter of which is well outside of the 50-mi radius, in southern Alabama. The license for the three reactors at BFN Plant was renewed in 2007. The license for Joseph M. Farley was renewed in 2005. (Reference 9.3-120) As these licenses were renewed relatively recently, it is presumed that the currently operating plants would continue to

operate during the construction and operation of the SMR Project. The BFN facility is located approximately 23 mi northwest of Redstone Arsenal Site 12. TVA has considering completing two permitted reactors and has applied for a combined license to operate an additional two reactors at the Bellefonte site in northern Alabama[1] (Reference 9.3-120) The Bellefonte site is approximately 45 mi northeast of Redstone Arsenal Site 12. The BFN and Bellefonte sites are located within the project's geographic area of interest, a 50-mi radius. If these reactors were operated during the lifetime of SMRs at the Redstone Arsenal, the probability-weighted consequences from a severe accident would increase.

As provided in Section 7.1, the environmental consequences of Design Basis Accidents (DBAs) at the CRN SMR Project site have been determined to be small. The same SMR design and vendor would be selected regardless of the site; therefore consequences of DBAs at Redstone Arsenal Site 12 would also be small. Safety evaluations at the BFN Plant were addressed in the re-licensing process, and safety inspections occur at plants (Reference 9.3-121). In the event that the Bellefonte reactors are completed and taken online, they would also be required to submit safety evaluations to the NRC and be subject to NRC inspections, thereby demonstrating operation within the NRC's safety goals.

The severe accident risk from any nuclear power plant decreases with distance from the plant. However, the combined risk at any location within 50 mi of Redstone Arsenal Site 12 would be bounded by the sum of the risks of the operating plants that have overlapping geographic areas of interest. Consequences of DBAs and severe accidents for the SMR Project at Redstone Arsenal Site 12 and the other nuclear power plants in the geographic area of interest are all considered small. Similarly, the incremental contribution to cumulative impacts associated with postulated accidents in the geographic area of interest from past, present, and reasonably foreseeable projects would also be considered SMALL.

9.3.4.2.8 Fuel Cycle/Transport/Decommissioning

As discussed in Section 5.7, many of the impacts related to the uranium fuel cycle are offsite well beyond a 50-mi geographic area of interest. Offsite activities such as uranium mining and milling, conversion to uranium hexafluoride, enrichment of uranium-235, fabrication of reactor fuel, disposal of spent fuel, and reprocessing of irradiated fuel, occur at locations away from the location of the actual nuclear plant, and not within the 50-mi geographic area of interest for the CRN Site or any of the three alternative locations. The impacts of these parts of the new fuel and waste cycles are the same for the CRN Site and the three alternative sites.

Transportation of radioactive waste and spent fuel occurs both within and outside the 50-mi geographic area of interest, the majority of the distance being outside of the geographic area of

[1] Subsequent to completion of the Siting Report, TVA initiated a public process to evaluate the options for Bellefonte Units 1 and 2 and the units are being sold through a public auction. In addition, the combined license application for Bellefonte Units 3 and 4 was withdrawn. The purchaser, Nuclear Development, LLC, proposes to complete the plant. These changes do not affect the conclusions of Redstone Arsenal Site 12 as an Alternative Site.

interest. Because the CRN Site and the three alternatives are geographically close, with respect to the distances traveled from fuel fabrication locations, to radioactive waste disposal facilities, and to fuel repositories, the impact from transportation outside the 50-mi geographic area of interest are essentially the same for the CRN Site and the three alternative sites. ORR Sites 2 and 8 are within 5 mi of the CRN Site, and would thus have the same routes as those to and from the CRN Site. Comparison of the routes from the CRN Site to Yucca Mountain and Redstone Arsenal to Yucca Mountain showed that the routes were very similar, with a route distance difference of 20 mi. Similarly, new fuel shipping route distance from Richland, WA to the ORR sites is about 2 percent greater than the distance to Redstone Arsenal. The low-level radioactive waste shipment route from the ORR sites to Waste Control Specialists in Andrews, TX is 14 percent greater than routes from Redstone Arsenal.

The impacts from the transportation of radioactive wastes and spent fuel are site-specific and dependent on the location of the actual nuclear plant. These impacts are based on the likelihood of an accident, which is dependent on regional population and traffic density.

CRN Site and ORR Site 2 and 8

For the CRN Site, details of the incident-free transportation analysis are provided in Subsection 5.7.2.2 with the impacts based on the normalized number of truck shipments per year, transportation distance, and route. Details of transportation accident analyses are provided in Section 7.4 with impacts also based on the normalized number of shipments per year, transportation distance and route. Both analyses indicated that the impacts are SMALL when compared to the reference reactor. Because ORR Sites 2 and 8 are located on ORR within 5 mi of the CRN Site the analyses provided in Subsection 5.7.2.2 and Section 7.4 are considered applicable to ORR Sites 2 and 8.

The other nuclear facilities within the 50-mi geographic area of interest of the CRN Site are the ORNL, Y-12 Complex, and ETTP sites as well as the Watts Bar and Sequoyah nuclear power plants. Cumulative impacts associated with transportation of fuel and waste by truck to and from the CRN Site include impacts from radioactive waste shipments from ORNL, ETTP, and Y-12 Complex along with fuel and waste shipments to and from the Watts Bar and Sequoyah nuclear power plants. Much of the waste from DOE operations at ORNL, ETTP, and Y-12 Complex is disposed of on the ORR and, therefore, does not contribute to the cumulative impacts within the 50-mi area of interest. However, some waste does leave the site for the Nevada Nuclear Security Site located west of Las Vegas, Nevada and the Waste Isolation Pilot Plant located near Carlsbad, New Mexico (Reference 9.3-122). Shipments from the ORR to these and other sites must be in full compliance with U.S. Department of Transportation regulations that minimize the risk to the public. Like the commercial nuclear power plant related shipments associated with the CRN Site described in Section 7.4, the impacts from truck shipments to and from the Watts Bar and Sequoyah nuclear power plants would be comparable to the minimal impacts from the reference reactor in 10 CFR 51.52. Therefore, when impacts from the DOE and commercial nuclear power related shipments within the 50-mi geographic area of interest

are combined with the impacts associated with the SMR Project, the total impact would also be SMALL.

While major reactor decommissioning activities within the geographic area of interest could overlap with the operation of the SMRs at the CRN Site or the ORR Sites 2 and 8, and have a noticeable impact on some resources, the likelihood of major decommissioning activities from multiple reactor sites in the geographic area of interest occurring at the same time is small. Therefore the cumulative impacts from transporting radioactive waste from major reactor decommissioning activities with the geographic area of interest is would be SMALL and the incremental contribution of the SMR Project at the CRN Site to the cumulative impacts would also be SMALL.

The two alternate ORR sites are located on ORR within 5 mi of the CRN Site. Based on the proximity of the two ORR alternative sites to the CRN Site and a nearly identical 50-mi geographic area of interest, it was concluded that the cumulative evaluation conducted for the CRN Site in the previous paragraphs is representative of the other ORR sites. Therefore, the cumulative impacts of the fuel cycle, transportation, and decommissioning would be SMALL and the incremental contribution of the SMR Project to the cumulative impacts would also be SMALL for each alternative ORR site.

Redstone Arsenal Site 12

Waste transportation in the Huntsville, Alabama area could be riskier due to the larger population (higher traffic density) in the area. Based on the WebTRAGIS analysis preformed for Section 7.4, the only route differences from the ORR sites and Redstone Arsenal Site 12 to Yucca Mountain were the initial routes in Tennessee and Alabama. The analysis indicated that the population densities in Alabama and Tennessee from Redstone were “Medium” of “High” over 37 percent of the route and “Low” over the remaining portion of the route. For the route from the ORR sites, 39 percent of the route had a “Medium” of “High” population density with remaining being “Low.” Therefore, the overall population differences along the transportation routes to and from the alternative sites are small. Similarly, the impacts of incidents involving the transportation of radioactive materials from the alternative sites would be very similar to those from the CRN site and would be considered SMALL.

The other nuclear facilities within 50 mi of Redstone Arsenal Site 12 include the BFN Plant. Cumulative impacts associated with truck transportation of fuel and waste from the Redstone Arsenal Site 12 includes impacts from waste shipments from the BFN Plant. Like the commercial nuclear power plant related shipments associated with the CRN Site described in Section 7.4, the impacts from truck shipments to and from the BFN Plant would be comparable to the minimal impacts from the reference reactor in 10 CFR 51.52. Therefore, when impacts from commercial nuclear power plant waste shipments within the 50-mi geographic area of interest are combined with the impacts associated with the SMR Project at Redstone Arsenal Site 12, the total impact would also be SMALL.

Like the analysis provided for the ORR sites, the likelihood of major decommissioning activities from multiple reactor sites in the geographic area of interest around Redstone Arsenal Site 12 occurring at the same time is small. Therefore the cumulative impacts from transporting radioactive waste from major reactor decommissioning activities with the Redstone Arsenal Site 12 geographic area of interest is would be SMALL and the incremental contribution of the SMR Project at the CRN Site to the cumulative impacts would also be SMALL.

9.3.5 Conclusions

TVA evaluated the environmental and socioeconomic resource areas that would be impacted by the preconstruction, construction, and operation of the SMR Project at the CRN Site and three Alternative Sites to determine if one or more of the Alternative Sites would be obviously superior to the CRN Site. As part of this process, TVA assessed the Alternative Sites to determine if any of the sites would be environmentally preferable to the CRN Site and then considered business reasons for selection of the preferred site.

There do not appear to be any inherent characteristics that would individually or cumulatively preempt building the SMR Project at the CRN Site or any of the Alternative Sites. The incremental contribution to the cumulative impacts associated with building and operating the SMR Project at the CRN Site or at any one of the Alternative Sites are the same for the majority of the resource categories considered from the larger geographic area of interest. These resource areas include land use, water use and quality, aquatic ecology, air quality, noise, human health, population, housing, transportation, visual intrusion, infrastructure, education, environmental justice, historic and cultural resources, postulated accidents, and fuel cycle/transport/ decommissioning. Therefore, none of these resource categories are discussed further in determining whether an Alternate Site is environmentally preferable to the CRN Site.

In the case of terrestrial ecology and economy and tax revenue, the impact conclusions differ between the ORR Sites and Redstone Arsenal Site 12.

For the terrestrial ecology at Redstone Arsenal Site 12, the incremental contribution from the SMR Project to the cumulative impacts within the geographic area of interest would be MODERATE due to impacts associated with long-term changes in a sensitive habitat within the Wheeler NWR. For terrestrial ecology, the incremental contribution from the SMR Project at the CRN Site and ORR Sites 2 and 8 to the cumulative impacts within the geographic area of interest would be SMALL.

For economy and tax revenue, the contribution of the SMR Project to the overall geographic area of interest would be beneficial at each of the four sites. At Redstone Arsenal Site 12, the State of Alabama contributes 83 percent of the tax equivalent payments associated with TVA projects directly to the local governments affected by the projects. Due to the difference in tax structure in Tennessee; the State retains the majority of the tax equivalent payments for the State General Fund and contributes a significantly lower amount of the tax equivalent payments to the affected counties. Although the impacts associated with tax equivalent payments would

be beneficial to all four sites, the difference in tax structure makes the construction and operation of the SMR Project in Alabama more beneficial to a county than the same project in Tennessee. Since TVA's tax equivalent payment is based on a standard rate structure, TVA determined that the difference in the distribution of tax equivalent payments by individual states to counties was not an evaluation factor that should be considered in determining an environmentally preferable site.

TVA determined, based on a detailed environmental review of the four sites, none of the sites were environmentally preferable. Therefore, the CRN Site was selected as the preferred site for the following business reasons:

- The CRN Site is currently managed by TVA and is designated in TVA's land use plan for TVA Project Operations, which includes power production. There are no cost or schedule impacts associated with land transfer or land use re-designation.
- The CRN Site was previously considered to be a suitable location for the Clinch River Breeder Reactor Project (CRBRP). As part of the CRBRP, TVA has already collected historical environmental data and conducted site-related research which reduces the environmental acceptance risk compared to the Alternative Sites.
- The CRN Site is significantly larger than the Alternative Sites, allowing for greater flexibility for selecting a location within the site for the placement of two or more SMRs and ancillary facilities that avoids or minimizes environmental impacts, particularly impacts to natural areas and terrestrial ecology.
- A large portion of the CRN Site was cleared and grubbed for CRBRP activities; in addition some infrastructure was installed for the CRBRP and is still in place at the CRN Site and can be utilized for the SMR Project. Although the Alternative Sites are part of federal installations and may contain limited infrastructure and structures, each of the three is a greenfield site which would require significant clearing.

Because none of the Alternative Sites was determined to be environmentally preferable to the proposed CRN Site, TVA concluded that none of the Alternative Sites are obviously superior to the CRN Site. Tables 9.3-1 and 9.3-7 provide a summary of the impact evaluations for each of the Alternative Sites.

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Table 9.3-1
Summary of Preconstruction, Construction, and Operation Impact Evaluations for Environmental and Socioeconomic Criteria

	CRN Site (ORR 3)	ORR 2	ORR 8	Redstone 12
Land Use	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE
Water Use and Quality				
Surface Water Use	SMALL	SMALL	SMALL	SMALL
Surface Water Hydrology	SMALL	SMALL	SMALL	SMALL
Onsite Surface Water and Wetlands	SMALL	SMALL	SMALL	SMALL
Surface Water Quality	SMALL	SMALL	SMALL	SMALL
Groundwater	SMALL	SMALL	SMALL	SMALL
Terrestrial Ecology	SMALL	MODERATE	MODERATE	MODERATE
Aquatic Ecology	SMALL	SMALL	SMALL	SMALL
Socioeconomics				
Air Quality	SMALL	SMALL	SMALL	SMALL
Noise	SMALL	SMALL	SMALL	SMALL to MODERATE
Human Health	SMALL	SMALL	SMALL	SMALL
Population	SMALL	SMALL	SMALL	SMALL
Housing	SMALL	SMALL	SMALL	SMALL
Economy and Tax Revenue	SMALL[1]	SMALL[1]	SMALL[1]	SMALL to LARGE[1]
Transportation	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Visual Intrusions	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE
Infrastructure	SMALL	SMALL	SMALL	SMALL
Education	SMALL	SMALL	SMALL	SMALL
Environmental Justice	SMALL	SMALL	SMALL	SMALL
Historic and Cultural Resources	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Waste Management	SMALL	SMALL	SMALL	SMALL
Postulated Accidents	SMALL	SMALL	SMALL	SMALL

[1] Denotes a beneficial impact

Table 9.3-2
ORR Site 2 Land Use/Land Cover

Class	Total Available Land (ac)	Percent of Land Coverage (%)	Disturbed Land Area							
			Proposed Road[1] (ac)	Percent of Land Use (%)	SMR Project Facilities (ac)	Percent of Land Use (%)	Pipeline to Discharge[2] (ac)	Percent of Land Use (%)	Pipeline to Intake[2] (ac)	Percent of Land Use (%)
Length (ft)	NA		675.7		NA		3092.2		2890.8	
Area (ac)	**547.0**		1.6		120.2		3.5		3.3	
Barren Land (Rock/Sand/Clay)	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Deciduous Forest	447.8	81.9	1.4	90.3	115.4	95.3	2.5	71.4	1.5	44.7
Developed, High Intensity	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Developed, Low Intensity	6.6	1.2	0.1	8.1	0.0	0.0	0.1	4.0	0.6	18.1
Developed, Medium Intensity	7.7	1.4	0.0	1.7	1.7	1.4	0.0	0.0	0.0	0.0
Developed, Open Space	1.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	13.2
Evergreen Forest	23.3	4.3	0.0	0.0	3.1	3.3	0.0	0.0	0.0	0.0
Grassland/Herbaceous	4.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mixed Forest	8.1	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.2	5.4
Open Water	4.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pasture/Hay	13.6	2.5	0.0	0.0	0.0	0.0	0.9	24.6	0.6	18.5
Shrub/Scrub	7.8	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Woody Wetlands	21.8	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**547.0**	**100.0**	**1.6**	**100.0**	**120.2**	**100.0**	**3.6**	**100.0**	**3.3**	**100.0**

Notes:
[1] Assumed ROW width of 100 ft.
[2] Assumed ROW width of 50 ft.
NA – not applicable

Table 9.3-3
ORR Site 8 Land Use/Land Cover

Class	Total Available Land (ac)	Percent of Land Coverage (%)	Disturbed Land Area							
			Proposed Road[1] (ac)	Percent of Land Use (%)	SMR Project Facilities (ac)	Percent of Land Use (%)	Pipeline to Discharge[2] (ac)	Percent of Land Use (%)	Pipeline to Intake[2] (ac)	Percent of Land Use (%)
Length (ft)	NA		8331.0		NA		4218.1		1265.4	
Area (ac)	423.9		18.9		120.3		4.8		1.5	
Barren Land (Rock/Sand/Clay)	3.7	0.9	0.0	0.0	1.8	1.5	0.1	2.3	0.0	0.0
Deciduous Forest	365.3	86.2	16.3	86.1	100.9	83.9	4.1	84.7	1.4	99.6
Developed, High Intensity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Developed, Low Intensity	1.4	0.3	0.3	1.4	0.0	0.0	0.2	3.5	0.0	0.0
Developed, Medium Intensity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Developed, Open Space	0.6	0.1	0.2	1.3	0.0	0.0	0.0	0.0	0.0	0.0
Evergreen Forest	12.6	3.0	0.9	4.5	3.3	2.7	0.0	0.0	0.0	0.0
Grassland/Herbaceous	12.7	3.0	0.0	0.0	5.9	4.9	0.0	0.1	0.0	0.0
Mixed Forest	17.4	4.1	1.0	5.3	8.5	7.0	0.0	0.2	0.0	0.0
Open Water	5.1	1.2	0.0	0.0	0.0	0.0	0.2	4.1	0.0	0.4
Shrub/Scrub	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pasture/Hay	4.5	1.1	0.0	0.0	0.0	0.0	0.2	5.1	0.0	0.0
Woody Wetlands	0.6	0.1	0.3	1.5	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**423.9**	**100.0**	**18.9**	**100.0**	**120.3**	**100.0**	**4.8**	**100.0**	**1.5**	**100.0**

Notes:
[1] Assumed ROW width of 100 ft.
[2] Assumed ROW width of 50 ft.
NA – not applicable

Table 9.3-4 (Sheet 1 of 2)
Redstone Arsenal 12 Land Use/Land Cover

Class	Total Available Land (ac)	Percent of Land Coverage (%)	Disturbed Land Area					
			Proposed Road[1] (ac)	Percent of Land Use (%)	SMR Project Facilities (ac)	Percent of Land Use (%)	Proposed Pipeline to Discharge[2] (ac)	Percent of Land Use (%)
Length (ft)	NA		740.6		NA		16032.0	
Area (ac)	129.8		1.7		120.2		18.4	
Class								
Barren Land (Rock/Sand/Clay)	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6
Cultivated Crops	25.2	19.4	0.0	0.0	24.9	20.7	0.0	0.0
Deciduous Forest	20.4	15.7	0.0	0.0	16.2	13.4	9.5	51.4
Developed, Low Intensity	0.0	0.0	0.1	6.5	0.0	0.0	0.0	0.0
Developed, Medium Intensity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Developed, Open Space	10.0	7.7	0.3	18.0	9.4	7.8	0.2	1.2
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Evergreen Forest	0.8	0.6	0.0	0.0	0.8	0.7	1.2	6.4
Grassland/Herbaceous	0.8	0.7	0.0	0.0	0.7	0.6	0.0	0.0
Mixed Forest	5.1	3.9	0.0	0.0	4.3	3.6	2.1	11.2
Open Water	0.0	0.0	0.0	0.0	0.0	0.0	1.1	5.7
Pasture/Hay	37.1	28.6	1.0	61.1	34.0	28.3	0.0	0.0
Shrub/Scrub	28.4	21.8	0.2	14.3	28.1	23.3	2.8	15.0
Woody Wetlands	2.1	1.6	0.0	0.0	1.9	1.6	1.5	8.3
TOTAL	**129.8**	**100.0**	**1.7**	**100.0**	**120.2**	**100.0**	**18.4**	**100.0**

Table 9.3-4 (Sheet 2 of 2)
Redstone Arsenal 12 Land Use/Land Cover

Class	Total Available Land (ac)	Disturbed Land Area			
		Proposed Pipeline to Intake[2] (ac)	Percent of Land Use (%)	Proposed Transmission Line[1] (ac)	Percent of Land Use (%)
Length (ft)	NA	8762.7		28828.2	
Area (ac)	129.8	10.1		66.1	
Class					
Barren Land (Rock/Sand/Clay)	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	25.2	0.0	0.0	3.4	5.2
Deciduous Forest	20.4	2.8	28.3	3.2	4.8
Developed, Low Intensity	0.0	1.2	11.6	10.2	15.5
Developed, Medium Intensity	0.0	0.0	0.0	0.1	0.2
Developed, Open Space	10.0	2.1	20.7	5.3	8.0
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0
Evergreen Forest	0.8	1.4	14.0	10.9	16.6
Grassland/Herbaceous	0.8	0.0	0.0	1.2	1.8
Mixed Forest	5.1	0.6	6.1	3.9	6.0
Open Water	0.0	0.1	1.4	5.4	8.2
Pasture/Hay	37.1	0.8	8.1	11.5	17.5
Shrub/Scrub	28.4	0.7	7.4	5.8	8.8
Woody Wetlands	2.1	0.2	2.3	5.0	7.6
TOTAL	**129.8**	**10.1**	**100.0**	**66.1**	**100.0**

Notes:
[1] Assumed ROW width of 100 ft.
[2] Assumed ROW width of 50 ft.
NA – not applicable

Table 9.3-5 (Sheet 1 of 2)
Minority and Low-Income Populations within Redstone Arsenal Site 12 50-Mile Radius[1]

STATE/ County	Total Number of Block Groups	Black	American Indian or Native Alaskan	Asian	Native Hawaiian or Other Pacific Islander	Some Other Race	Multiracial[2]	Aggregate[3]	Hispanic	Low-Income[4]
		Minority or Low-Income Block Groups								
ALABAMA										
Blount	30	0	0	0	0	0	0	0	0	0
Colbert	9	0	0	0	0	0	0	0	0	0
Cullman	62	0	0	0	0	0	0	0	0	1
DeKalb	22	0	0	0	0	2	0	1	0	0
Etowah	11	0	0	0	0	0	0	0	0	0
Franklin	4	0	0	0	0	1	0	0	0	0
Jackson	33	1	0	0	0	0	0	1	0	0
Lauderdale	19	0	0	0	0	0	0	0	0	0
Lawrence	31	4	0	0	0	0	0	3	0	0
Limestone	43	1	0	0	0	0	0	1	0	0
Madison	191	43	0	0	0	3	0	54	0	5
Marshall	65	0	0	0	0	5	0	1	0	2
Morgan	75	4	0	0	0	3	0	10	0	2
Walker	2	0	0	0	0	0	0	0	0	0
Winston	11	0	0	0	0	0	0	0	0	0

Table 9.3-5 (Sheet 2 of 2)
Minority and Low-Income Populations within Redstone Arsenal Site 12 50-mi Radius[1]

STATE/ County	Total Number of Block Groups	Black	American Indian or Native Alaskan	Asian	Native Hawaiian or Other Pacific Islander	Some Other Race	Multiracial[2]	Aggregate[3]	Hispanic	Low-Income[4]
		Minority or Low-Income Block Groups								
TENNESSEE										
Franklin	10	0	0	0	0	0	0	0	0	0
Giles	18	1	0	0	0	0	0	1	0	1
Lawrence	8	0	0	0	0	0	0	0	0	0
Lincoln	24	2	0	0	0	0	0	2	0	2
Marshall	3	0	0	0	0	0	0	0	0	0
Moore	3	0	0	0	0	0	0	0	0	0
50-mi Region Total	**674**	**56**	**0**	**0**	**0**	**14**	**0**	**74**	**0**	**13**
	State Population	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
ALABAMA	4,779,736	26.2%	0.6%	1.1%	0.1%	2.0%	1.5%	33.0%	3.9%	18.6%
TENNESSEE	6,346,105	16.7%	0.3%	1.4%	0.1%	2.2%	1.7%	24.4%	4.6%	17.3%

[1] Block groups where minorities and low-income populations exceed 50 percent or exceed the state average by 20 percentage points or more.
[2] Persons who identified themselves as a member of two or more races.
[3] Everyone except persons who identified themselves as White, Not Hispanic or Latino.
[4] Based on poverty status of individuals in family households and in non-family households.

Table 9.3-6 (Sheet 1 of 3)
Summary of Past, Present and Reasonably Foreseeable Future Projects Considered in the Cumulative Analysis of Redstone Arsenal

Project Name	Summary of Project	Relative Location (from center of Redstone Arsenal Site 12)	Status
Superfund Triana Plume	Inactive non National Priorities List (NPL) site.	Approximately 3 mi SW Zierot Road	Inactive non-NPL site.
Superfund U.S. Army / NASA Redstone Arsenal	Active NPL site. Soil, sediment, surface water, groundwater. Arsenic, mercury, polycyclic aromatic hydrocarbon, principal component analysis, and TCE.	Approximately 3 mi NE	Active NPL site.
Superfund Triana Tennessee River	Steps have been taken to clean up contaminated soil, sediment, surface water resulting from waste handling practices from former business at the site	Approximately 3 mi SW	Final NPL site.
Redstone Arsenal	US Army Garrison Ballistics, chemical weapons, and missile research.	Approximately 4 mi NE	Operational since 1941.
Marshall Space Flight Center	NASA center for propulsion analysis and development.	Approximately 3 mi NE	Operational since 1960.
Guntersville Dam	Hydroelectric generation on Tennessee River. Impounds Guntersville Reservoir (67,900 ac).	Approximately 23 mi SE (near New Hope, Marshall County)	Operational since 1939. 140,400 kilowatt (kW) generating capacity.
Wheeler Dam and hydroelectric facility	Hydroelectric generation on Tennessee River. Impounds Reservoir (67,070 ac).	Approximately 40 mi NW	Operational since 1936. 411,800 kW generating capacity.
Bellefonte Nuclear Power Plant	Units 1 and 2 permitted reactors; partially complete. Units 3 and 4 (AP1000) 2007 combined license application.	Approximately 45 mi NE (Jackson County)	Built 1980. Withdrawn.
Brown's Ferry Nuclear Power Plant	Units 1, 2, and 3 (boiling water reactors).	Approximately 24 mi NW (Limestone County)	Operational since 1974. License renewed 2006.
Sequoyah Nuclear Power Plant	Units 1 and 2 (pressurized water reactors).	Approximately 100 mi NE (Soddy-Daisy, TN)	Operational since 1980. License renewed 2015.
Watts Bar Nuclear Reactor	Unit 1 operational (pressurized water reactor). Unit 2 construction completion date: 09/30/2016.	Approximately 131 mi NE (Spring City, Tennessee)	Operational since 1996.
Joseph M. Farley Nuclear Power Plant	Two unit pressurized water reactors.	Approximately 251 mi SE Columbia, Alabama	Operational since 1974. License renewed 2005.
Redstone Gateway	468 acre mixed use and office park.	Approximately 6 mi NE Intersection of I-565 and Highway 255	Under development.
City of Huntsville	Urbanization plans incorporate projected growth of 68,000 homes by 2040 from Redstone activities.	Approximately 10 mi NE	Current.

Table 9.3-6 (Sheet 2 of 3)
Summary of Past, Present and Reasonably Foreseeable Future Projects Considered in the Cumulative Analysis of Redstone Arsenal

Project Name	Summary of Project	Relative Location (from center of Redstone Arsenal Site 12)	Status
City of Madison	12 percent anticipated growth in technology employment over next 5 yr.	Approximately 6 mi NW	Current.
City of Arab	Revitalization and expansion of downtown.	Approximately 25 mi SE	Planned.
City of Hartselle	Small town.	Approximately 18 mi SW	Current.
City of Decatur	Highly planned, tightly zoned growth and development.	Approximately 15 mi W	Current.
Decatur Education and Technology Business Park	Planned establishment to help cement development of Decatur Downtown Commons.	Approximately 15 mi W	Planned development by 2019.
Decatur Railroad Depot	Restoration and enhancement.	Approximately 16 mi W	Planned development.
Decatur Depot - Renovation	Expansion of jail.	Approximately 16 mi W	Current.
Decatur - Alabama Center for the Arts	Phase 2 construction.	Approximately 16 mi W	Current.
City of Athens	Highly detailed development plan emphasizing infill and redevelopment of exiting areas.	Approximately 19 mi NW	Current.
Wheeler Reservoir / Tennessee River System	Much of water supply for City of Huntsville and Madison County.	Approximately 30 mi NW	45 mgd to customers.
Various surface water treatment facilities	Facilities located within 6 county area.	Within approximately 60 mi	Current.
Huntsville – South Parkway Treatment Plant	Tennessee River plant for Huntsville Utilities.	Approximately 9 mi SE Whitesburg Bridge	Operational since 1964 35 mgd.
Huntsville – Southwest Treatment Plant	Huntsville Utilities.	Approximately 5 mi SW (Triana Highway)	Operational since 1988. 35 mgd.
North Limestone Treatment Facility	Surface water pumped from Elk River.	Approximately 30 mi NW (5 mi north of Elkmont)	2788 mgd (2724 mgd flow through).
Decatur Utilities	Surface water pumped from Wheeler Reservoir.	Approximately 16 mi SW	119 mgd.
Arab Water Works	Surface water pumped from Brown's Creek Embayment, Lake Guntersville, Marshall County.	Approximately 25 mi SE	1065 mgd (1044 mgd flow through).
Huntsville - Southeast Water Treatment Plant	Tennessee River plant under construction for Huntsville Utilities.	Approximately 21 mi SE (East of New Hope, Marshall County)	Construction initiated 2015. Operational by 2018. 96 mgd peak.
Fort Payne-Tuscumbia groundwater aquifer	Local groundwater source. The aquifer is rather large, including areas north of the Tennessee River from North Alabama into Middle Tennessee and including south Kentucky.	Approximately 37 mi NW (from approximated center point of aquifer)	Supplies water for most of Morgan County.

Table 9.3-6 (Sheet 3 of 3)
Summary of Past, Present and Reasonably Foreseeable Future Projects Considered in the Cumulative Analysis of Redstone Arsenal

Project Name	Summary of Project	Relative Location (from center of Redstone Arsenal Site 12)	Status
Lincoln and Dallas Well Treatment Plant	Huntsville Utilities.	Approximately 11 mi NE	Operational since 1992.
Hampton Cove Well Treatment Plant	Huntsville Utilities.	Approximately 13 mi E	Operational since 1996.
Williams Well	Huntsville Utilities.	Approximately 1 mi NW	Operational since 1971.
Madison County – anticipated development	Madison County anticipates between 38 and 50% will be developed by 2020.	Approximately 6 mi NW	Current.
Limestone County – proposed connection to Decatur Water Treatment Plant	30 inch pipeline across Wheeler Reservoir supplying water to Limestone County.	Approximately 30 mi NW	Seeking FONSI status to allow construction.
Polaris Facility	450 acre production facility for all terrain vehicles.	Approximately 8 mi NW Off I-565 Greenbrier Road (Huntsville, Lincoln County)	Under construction. Estimated completion: Spring 2016.
Connector I-565 and I-65 – Greenbrier Parkway	Limited access road from Athens to Greenbrier. (8.3 mi) Eventual connection to Huntsville-Browns ferry Road south of Athens.	Approximately 9 mi NW	Estimated completion: 2016.
Madison - 1500 ac Industrial Megasite	Sewell Farm. Pre-certified as TVA Megasite for industrial development.	Approximately 9 mi NW (North of Old Highway 20 intersection with Greenbrier Road in Lincoln County)	Pre-certified for large-scale manufacturing. Seeking TVA Megasite certification in 2015.
Huntsville International Airport (HSV)	Commercial international airport.	Approximately 4 mi NW	Established 1967.
Huntsville – Jetplex Industrial Park and Jetplex South Park	1470 ac adjacent to HSV (Jetplex Supplier Park).	Approximately 3 mi NW	1400 ac available for development.
Huntsville – Cummings Research Park	3843 ac. Second largest research and development park in the United States with industrial and educational use. More than 300 companies, 30,000 employees, and 11,000 students.	Approximately 7 mi NE	Established 1962. Continued development.

Notes:
NE - Northeast NW – Northwest SE – Southeast SW – Southwest W – West

Table 9.3-7 (Sheet 1 of 2)
Summary of Potential Cumulative Impacts of Construction and Operation to Environmental and Socioeconomic Criteria by Site

	CRN Site and ORR Sites 2 and 8		Redstone 12	
	Cumulative Impacts	**Incremental Contribution of the SMR Project to Cumulative Impacts**	**Cumulative Impacts**	**Incremental Contribution of the SMR Project to Cumulative Impacts**
Land Use	MODERATE	SMALL[1]	MODERATE	SMALL[1]
Water Use				
Surface Water Use	SMALL	SMALL	SMALL	SMALL
Groundwater Use	MODERATE	SMALL	SMALL	SMALL
Surface Water Quality	SMALL	SMALL	MODERATE	SMALL
Groundwater Quality	MODERATE	SMALL	MODERATE	SMALL
Terrestrial Ecology	SMALL to MODERATE	SMALL	MODERATE to LARGE	MODERATE
Aquatic Ecology	SMALL to LARGE	SMALL	MODERATE to LARGE	SMALL
Socioeconomics				
Air Quality	MODERATE	SMALL	MODERATE	SMALL
Noise	SMALL to MODERATE	SMALL	MODERATE	SMALL
Human Health	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL
Population	MODERATE	SMALL	MODERATE	SMALL
Housing	MODERATE	SMALL	MODERATE	SMALL
Economy and Tax Revenues	SMALL to MODERATE [2]	SMALL[2]	MODERATE[2]	SMALL to MODERATE[2,3]
Transportation	MODERATE	SMALL	MODERATE	SMALL
Visual Intrusion	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Infrastructure	MODERATE	SMALL	MODERATE	SMALL
Education	SMALL to MODERATE	SMALL	MODERATE	SMALL
Environmental Justice	SMALL	SMALL	SMALL	SMALL
Historic and Cultural Resources	MODERATE	SMALL to MODERATE	MODERATE	SMALL to MODERATE
Postulated Accidents	SMALL	SMALL	SMALL	SMALL

Table 9.3-7 (Sheet 2 of 2)
Summary of Potential Cumulative Impacts of Construction and Operation to Environmental and Socioeconomic Criteria by Site

	CRN Site and ORR Sites 2 and 8		Redstone 12	
	Cumulative Impacts	**Incremental Contribution of the SMR Project to Cumulative Impacts**	**Cumulative Impacts**	**Incremental Contribution of the SMR Project to Cumulative Impacts**
Fuel Cycle/Transport/ Decommissioning	SMALL	SMALL	SMALL	SMALL

[1] Although the direct and indirect impacts to land use presented in Table 9.3-1 are SMALL-MODERATE for ORR Site 8 and MODERATE for Redstone Arsenal Site 12, this impact determination was based on the requirement for land use designation changes on the specific installation. From a cumulative perspective, the land use re-designation for the small area associated with the SMR Project represents a negligible or SMALL addition to the overall impacts to the land use in the Cumulative Geographic Area of Interest.

[2] Denotes a beneficial impact

[3] Defining environmentally preferable as the avoidance of detrimental impacts, Redstone Arsenal Site 12 is not environmentally preferable to the CRN Site. Although the economic benefits appear to be greater when associated with the long-term operation of the SMR Project at Redstone Arsenal Site 12, the economic impacts of the SMR Project would be beneficial at each of the evaluated sites.

Table 9.3-8 (Sheet 1 of 3)
Public Water Supply Systems in the Redstone Arsenal Region

Water System Name	County(s) Served	City(s) Served	Population Served	Primary Water Source Type	PWS Activity	Water System ID
Gurley Water System	Madison	Gurley	1113	Surface water purchased	Active	AL0000904
Harvest-Monrovia Water System	Madison	Harvest	32109	Groundwater under influence of surface water	Active	AL0000878
Huntsville Utilities	Madison	Huntsville	219168	Surface water	Active	AL0000882
Madison County Water Department	Madison	Huntsville	85947	Surface water purchased	Active	AL0000888
Madison Water Works & Sewer	Madison	Madison	39051	Surface water	Active	AL0000885
New Hope Water System	Madison	New Hope	5544	Surface water purchased	Active	AL0000893
Owens Crossroads Water Authority	Madison	Not Reported	7161	Groundwater	Active	AL0000897
Triana Water Works	Madison	Triana	1002	Surface water purchased	Active	AL0000905
US Army Aviation & Missile Command	Madison	Redstone Arsenal	28500	Surface water	Active	AL0000899
Ardmore Water System	Limestone	Ardmore	3600	Groundwater	Active	AL0001420
Athens Utilities	Limestone	Athens	27534	Surface water	Active	AL0000824
Elkmont Water Works	Limestone	Elkmont	795	Surface water purchased	Active	AL0000828
Limestone County Water System	Limestone	Athens	58500	Surface water	Active	AL0000833

Table 9.3-8 (Sheet 2 of 3)
Public Water Supply Systems in the Redstone Arsenal Region

Water System Name	County(s) Served	City(s) Served	Population Served	Primary Water Source Type	PWS Activity	Water System ID
Swan Creek Community (Bsi, Llc)	Limestone	Tanner	720	Groundwater	Active	AL0000831
Decatur (Municipal Utilities Board Of)	Morgan	Decatur	77100	Surface water	Active	AL0001084
Falkville Water Works	Morgan	Falkville	1680	Surface water purchased	Active	AL0001085
Hartselle Utility Board	Morgan	Hartselle	20631	Surface water purchased	Active	AL0001086
Ne Morgan Co Water And Sewer Authority	Morgan	Somerville	22038	Surface water purchased	Active	AL0001088
Trinity Water Works System	Morgan	Trinity	2646	Surface water purchased	Active	AL0001091
West Morgan-East Lawrence Water Authority	Morgan	Decatur	26130	Surface water	Active	AL0001092
Bridgeport Utilities Board	Jackson	Bridgeport	6000	Surface water	Active	AL0000713
Cumberland Mountain Water	Jackson	Scottsboro	5280	Surface water purchased	Active	AL0000717
Dekalb-Jackson Water Supply District	Jackson	Not Reported	14937	Surface water	Active	AL0001796
Jackson County Water Authority	Jackson	Scottsboro	6750	Surface water purchased	Active	AL0001748
Pisgah Water Works	Jackson	Pisgah	1407	Groundwater	Active	AL0000726
Scottsboro Water Works	Jackson	Scottsboro	21879	Surface water	Active	AL0000729

Table 9.3-8 (Sheet 3 of 3)
Public Water Supply Systems in the Redstone Arsenal Region

Water System Name	County(s) Served	City(s) Served	Population Served	Primary Water Source Type	PWS Activity	Water System ID
Section-Dutton Water System	Jackson	Rainsville	32949	Surface water	Active	AL0000728
Stevenson (Util. Board Of The Town Of)	Jackson	Stevenson	3969	Groundwater	Active	AL0000732
Albertville Utilities Board	Marshall	Albertville	29991	Surface water	Active	AL0000933
Arab Water Works Board	Marshall	Arab	34800	Surface water	Active	AL0000934
Asbury Water System	Marshall	Albertville	7170	Surface water purchased	Active	AL0000935
Boaz Water & Sewer Board	Marshall	Boaz	29196	Surface water purchased	Active	AL0000936
Guntersville Water Works & Sewer Board	Marshall	Guntersville	12612	Surface water	Active	AL0000943
North Marshall Utilities	Marshall	Grant	12369	Surface water	Active	AL0000945
Swearengin Water System	Marshall	Grant	2136	Surface water purchased	Active	AL0000949
Union Grove Utility Board	Marshall	Union Grove	2814	Surface water purchased	Active	AL0000951

Source: (Reference 9.3-124)

Table 9.3-9
Total Freshwater Withdrawals and Consumption by County, 2005

County	Withdrawals (mgd)			Return Flows (mgd)	Consumption (mgd) Net Water Demand
	Groundwater	Surface Water	Total		
Blount	0.17	0.04	0.21	0.00	0.21
Colbert	3.54	1359.60	1363.14	1350.67	12.47
Cullman	0.40	0.07	0.47	0.00	0.47
DeKalb	2.65	2.00	4.65	0.00	4.65
Etowah	0.24	0.05	0.29	0.00	0.29
Franklin	2.07	4.66	6.73	3.71	3.02
Jackson	1.97	1496.26	1498.23	1489.64	8.59
Lauderdale	3.64	13.50	17.14	9.68	7.46
Lawrence	1.21	65.70	66.91	53.50	13.41
Limestone	6.01	2006.00	2012.01	1993.62	18.39
Madison	28.94	43.45	72.39	37.21	35.18
Marion	0.13	3.20	3.33	0.12	3.21
Marshall	4.01	22.33	26.34	10.46	15.88
Morgan	2.41	122.29	124.70	112.68	12.02
Winston	0.15	0.01	0.16	0.00	0.16
Total	57.54	5139.16	5196.70	5061.29	135.73

Source: (Reference 9.3-125)

Table 9.3-10
Surface Water Withdrawals and Consumption by County, 2005

County	Surface Water Withdrawals (mgd)						
	Public Supply	Irrigation	Livestock	Industrial	Mining	Thermoelectric	Total
Blount	0.00	0.02	0.02	0.00	0.00	0.00	0.04
Colbert	8.27	1.40	0.17	55.57	0.05	1294.14	1359.60
Cullman	0.00	0.01	0.06	0.00	0.00	0.00	0.07
DeKalb	0.47	0.88	0.65	0.00	0.00	0.00	2.00
Etowah	0.00	0.04	0.01	0.00	0.00	0.00	0.05
Franklin	3.88	0.20	0.40	0.00	0.18	0.00	4.66
Jackson	10.08	0.67	0.40	8.78	0.03	1476.30	1496.26
Lauderdale	12.79	0.43	0.28	0.00	0.00	0.00	13.50
Lawrence	6.91	1.18	0.36	57.18	0.07	0.00	65.70
Limestone	8.85	6.16	0.25	0.00	0.50	1990.24	2006.00
Madison	38.85	3.30	0.19	0.89	0.22	0.00	43.45
Marion	3.17	0.01	0.02	0.00	0.00	0.00	3.20
Marshall	21.16	0.57	0.51	0.00	0.09	0.00	22.33
Morgan	30.42	0.74	0.40	89.36	0.17	1.20	122.29
Winston	0.00	0.00	0.01	0.00	0.00	0.00	0.01
Total	144.85	15.61	3.73	211.78	1.31	4761.88	5139.16

Source: (Reference 9.3-125)

Table 9.3-11
Groundwater Withdrawals and Consumption by County, 2005

County	Groundwater Withdrawals (mgd)						
	Public Supply	Residential	Irrigation	Livestock	Industrial	Mining	Total
Blount	0.00	0.10	0.01	0.02	0.00	0.04	0.17
Colbert	1.29	0.31	0.94	0.13	0.87	0.00	3.54
Cullman	0.00	0.28	0.06	0.06	0.00	0.00	0.40
DeKalb	0.70	0.87	0.50	0.58	0.00	0.00	2.65
Etowah	0.00	0.23	0.00	0.01	0.00	0.00	0.24
Franklin	0.82	0.31	0.25	0.30	0.00	0.39	2.07
Jackson	0.63	0.91	0.04	0.32	0.00	0.07	1.97
Lauderdale	1.40	1.30	0.74	0.20	0.00	0.00	3.64
Lawrence	0.00	0.47	0.31	0.27	0.00	0.16	1.21
Limestone	2.67	1.05	2.10	0.19	0.00	0.00	6.01
Madison	25.59	1.12	1.61	0.14	0.00	0.48	28.94
Marion	0.00	0.11	0.00	0.02	0.00	0.00	0.13
Marshall	2.98	0.29	0.00	0.51	0.04	0.19	4.01
Morgan	0.00	0.30	0.12	0.33	1.29	0.37	2.41
Winston	0.00	0.14	0.00	0.01	0.00	0.00	0.15
Total	36.08	7.78	6.68	3.09	2.20	1.70	57.54

Source: (Reference 9.3-125)

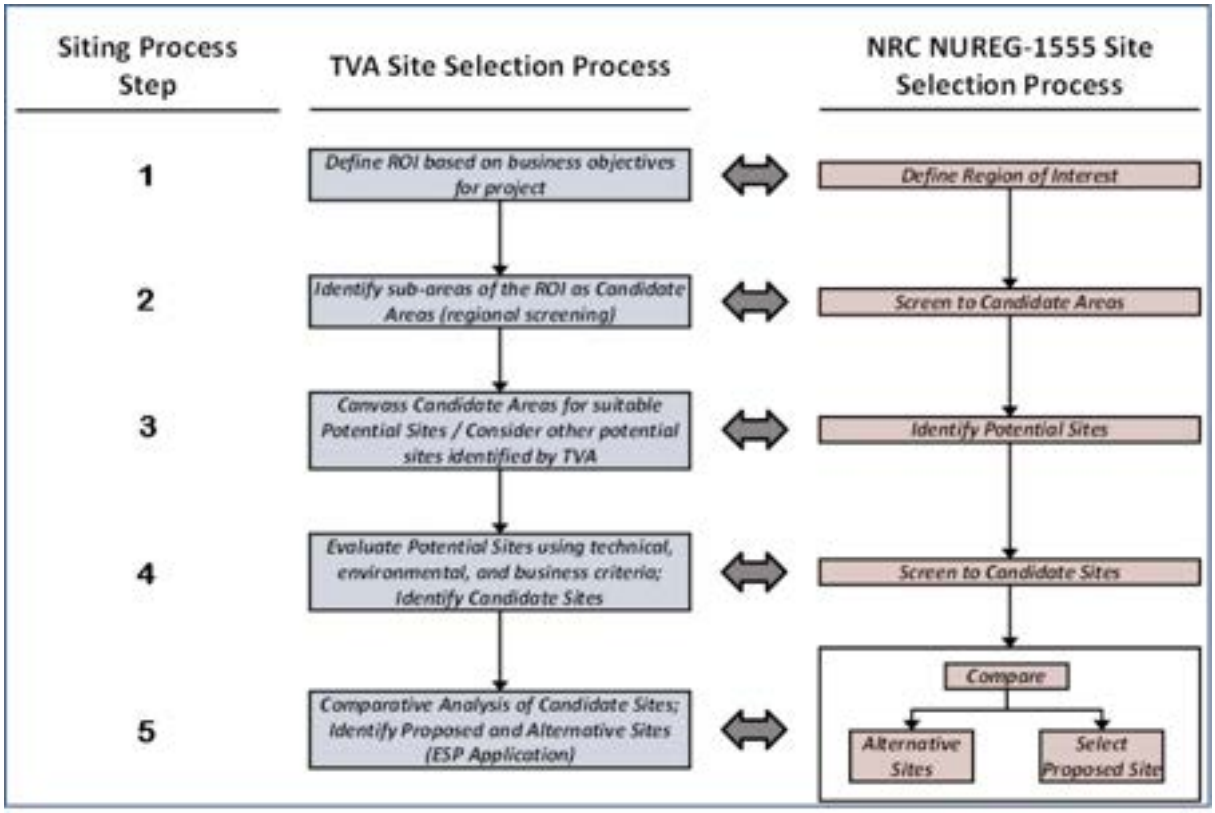

Figure 9.3-1. Proposed and Alternative Candidate Site Screening Methodology

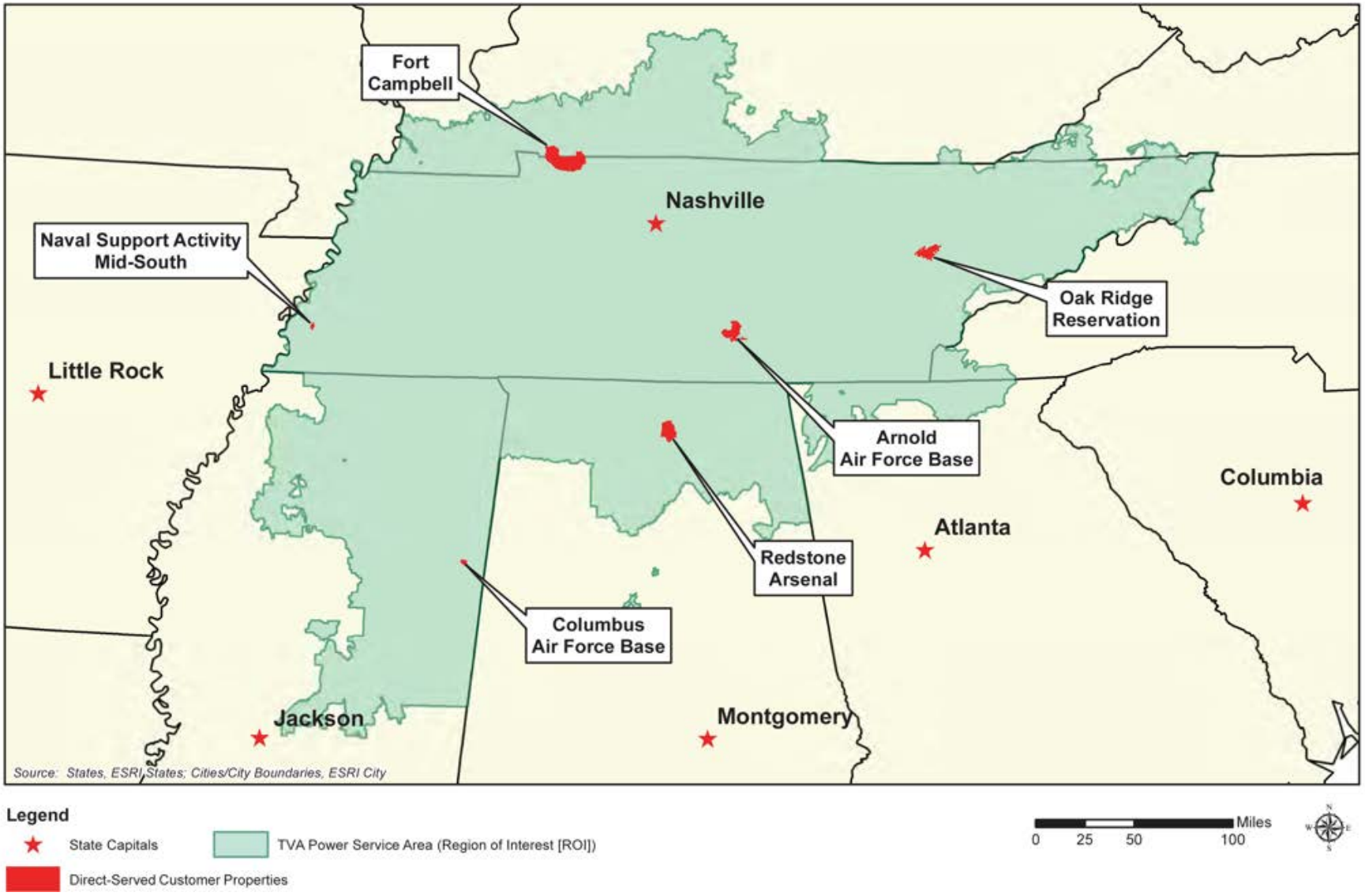

Figure 9.3-2. TVA Service Area and Direct Serve Federal Customers

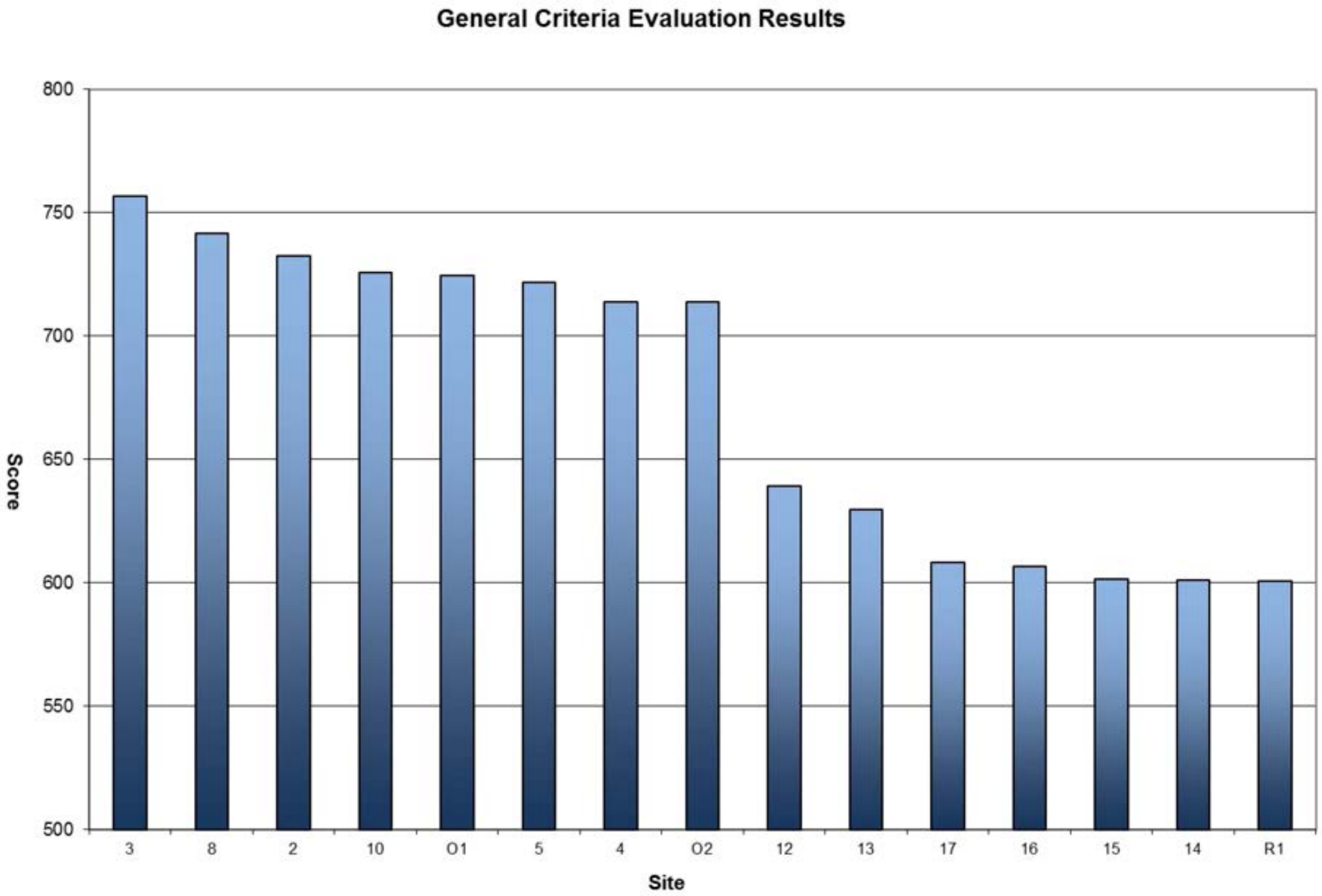

Figure 9.3-3. General Site Criteria Evaluation Results

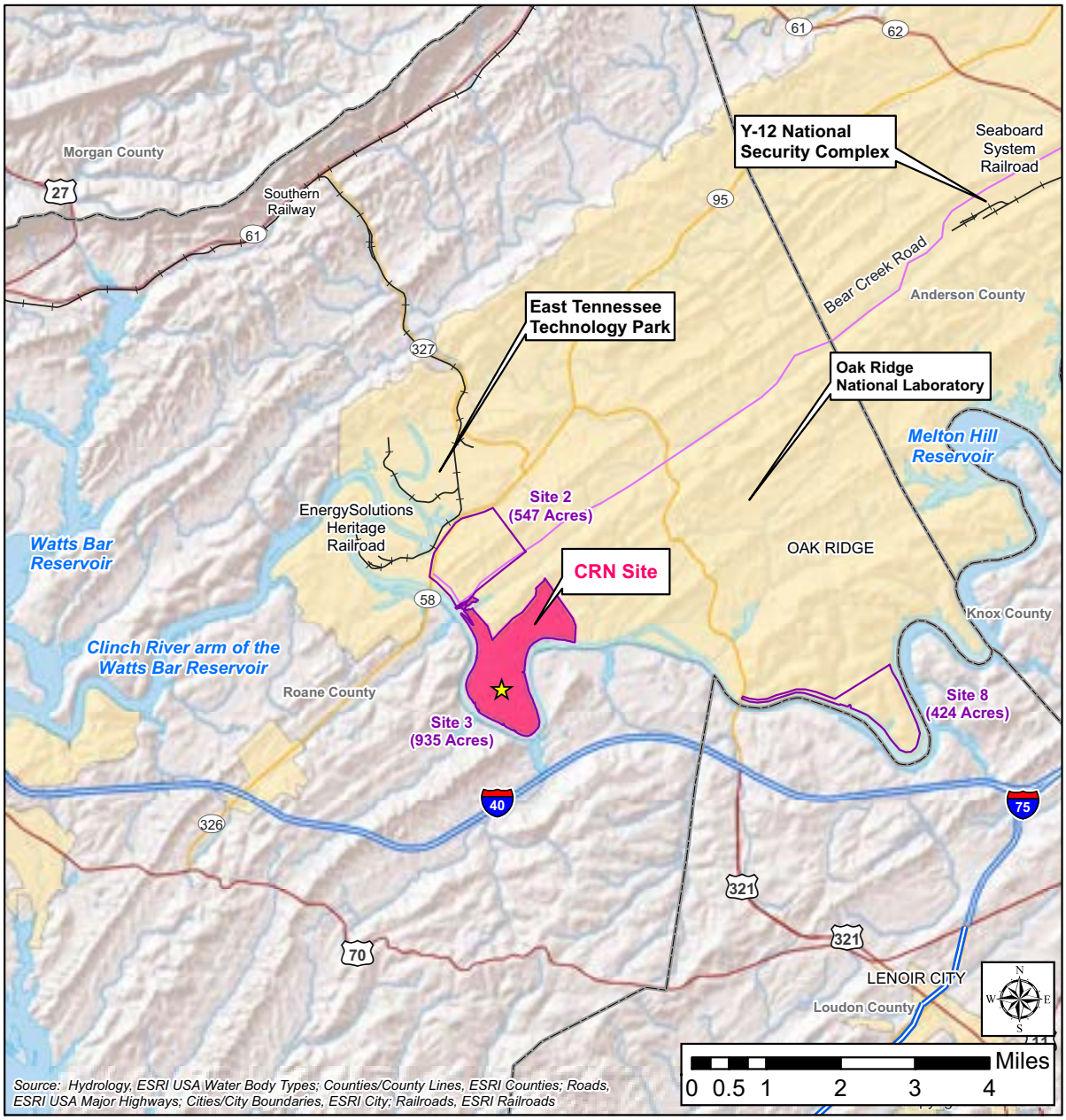

Figure 9.3-4. ORR Candidate Sites

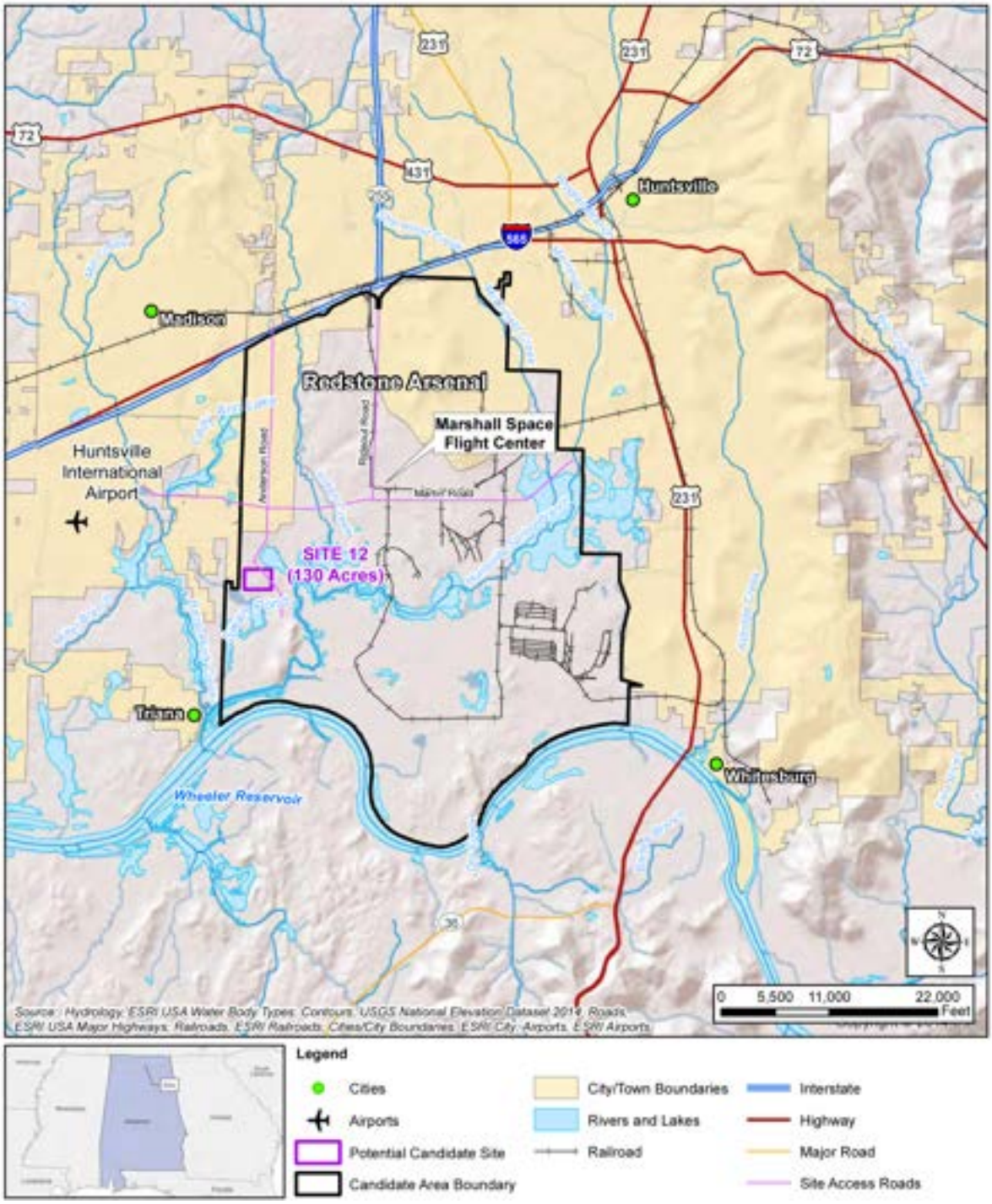

Figure 9.3-5. Redstone Arsenal Candidate Sites

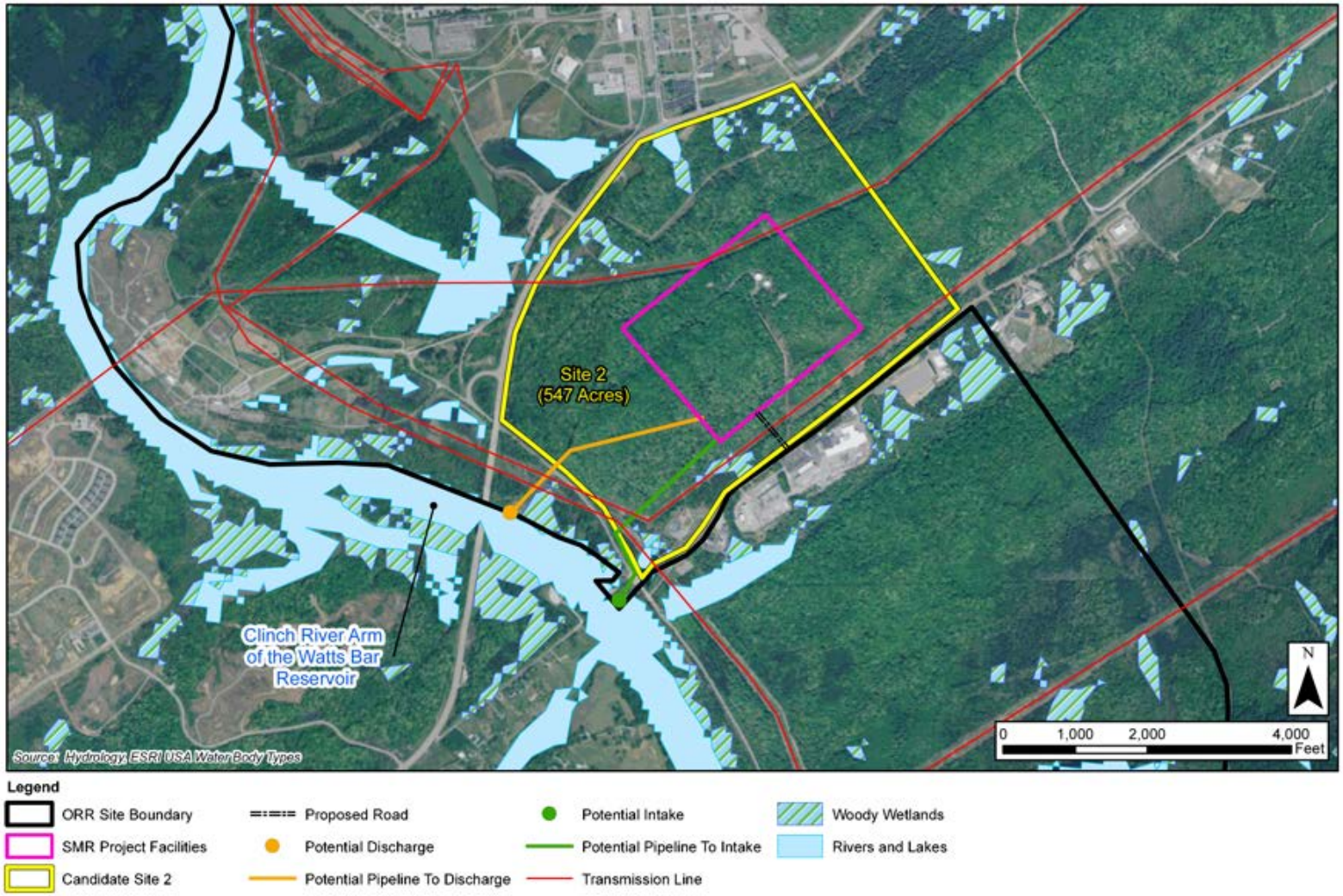

Figure 9.3-6. ORR Site 2 - Potential Layout

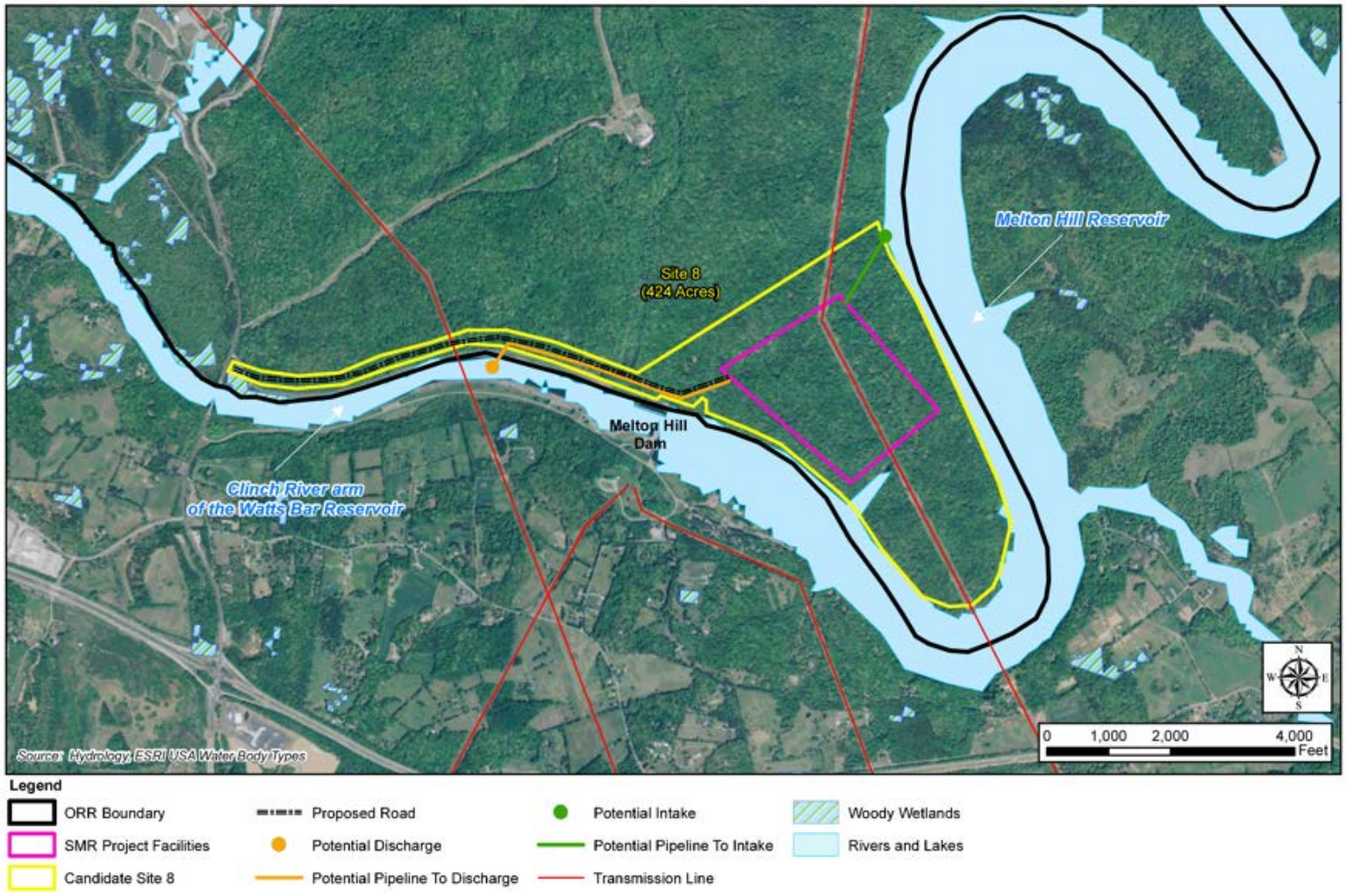

Figure 9.3-7. ORR Site 8 - Potential Layout

Figure 9.3-8. Redstone Arsenal Site 12 - Potential Layout

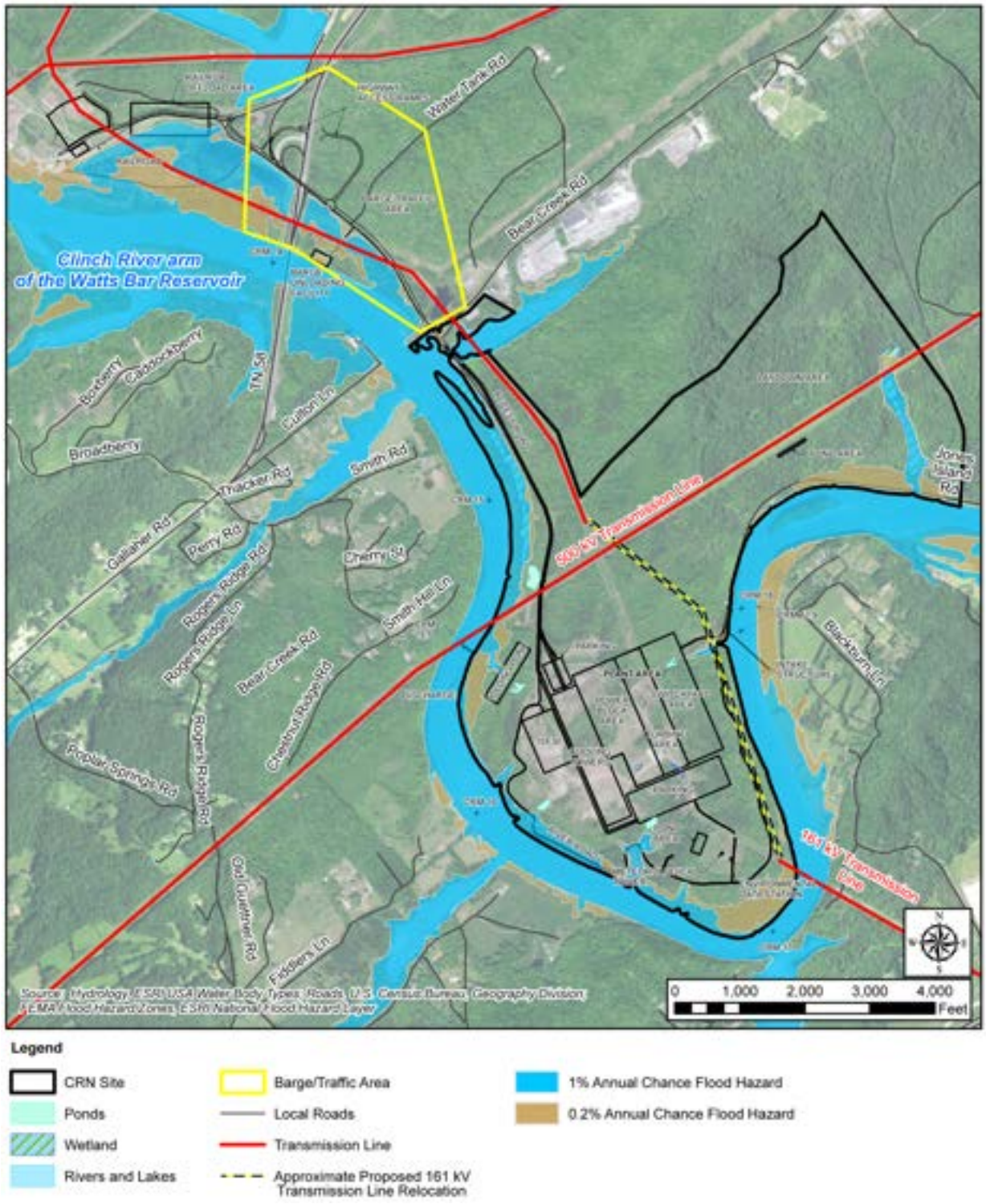

Figure 9.3-9. ORR Site 3 (CRN Site) Flood Hazard Map

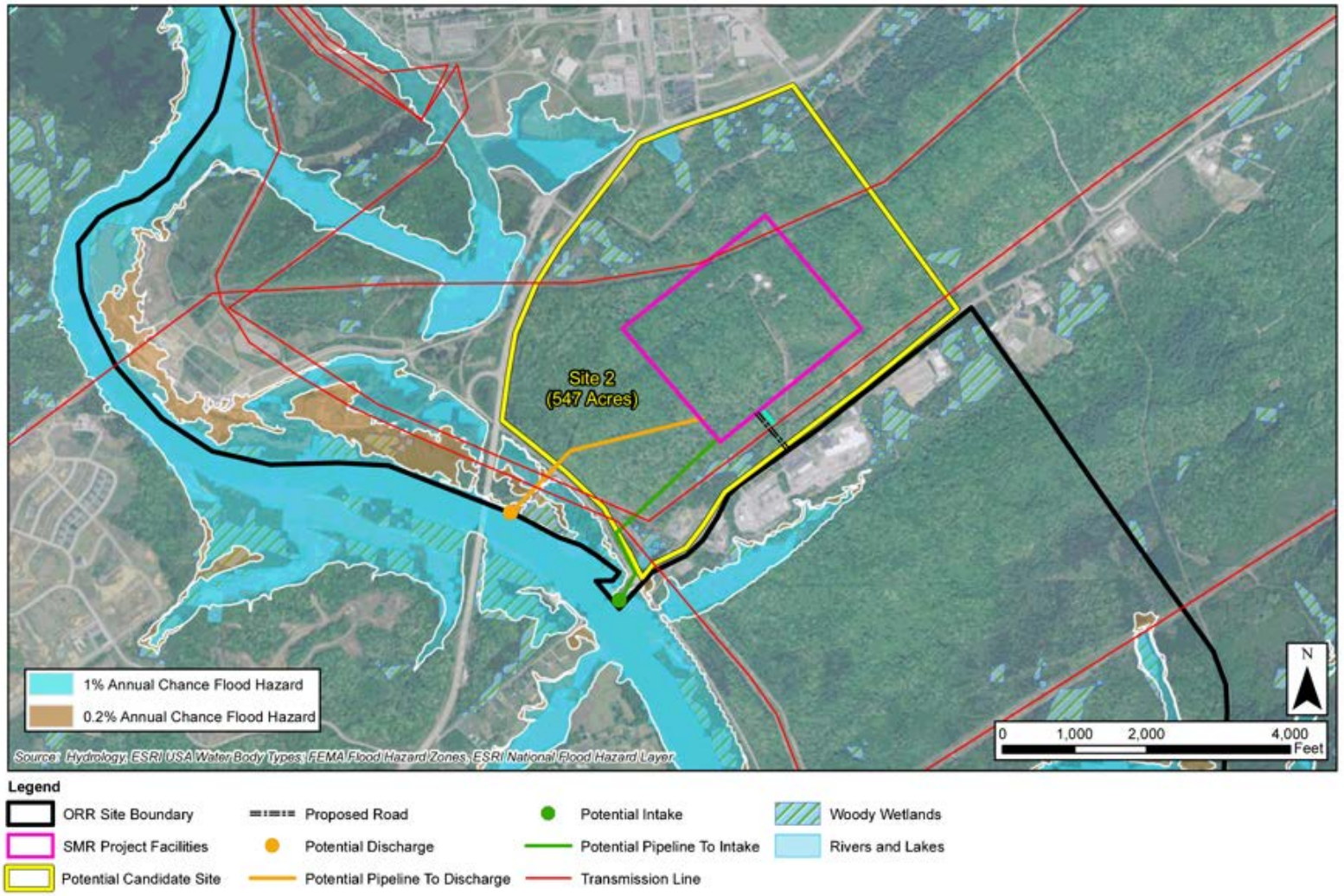

Figure 9.3-10. ORR Site 2 Flood Hazard Map

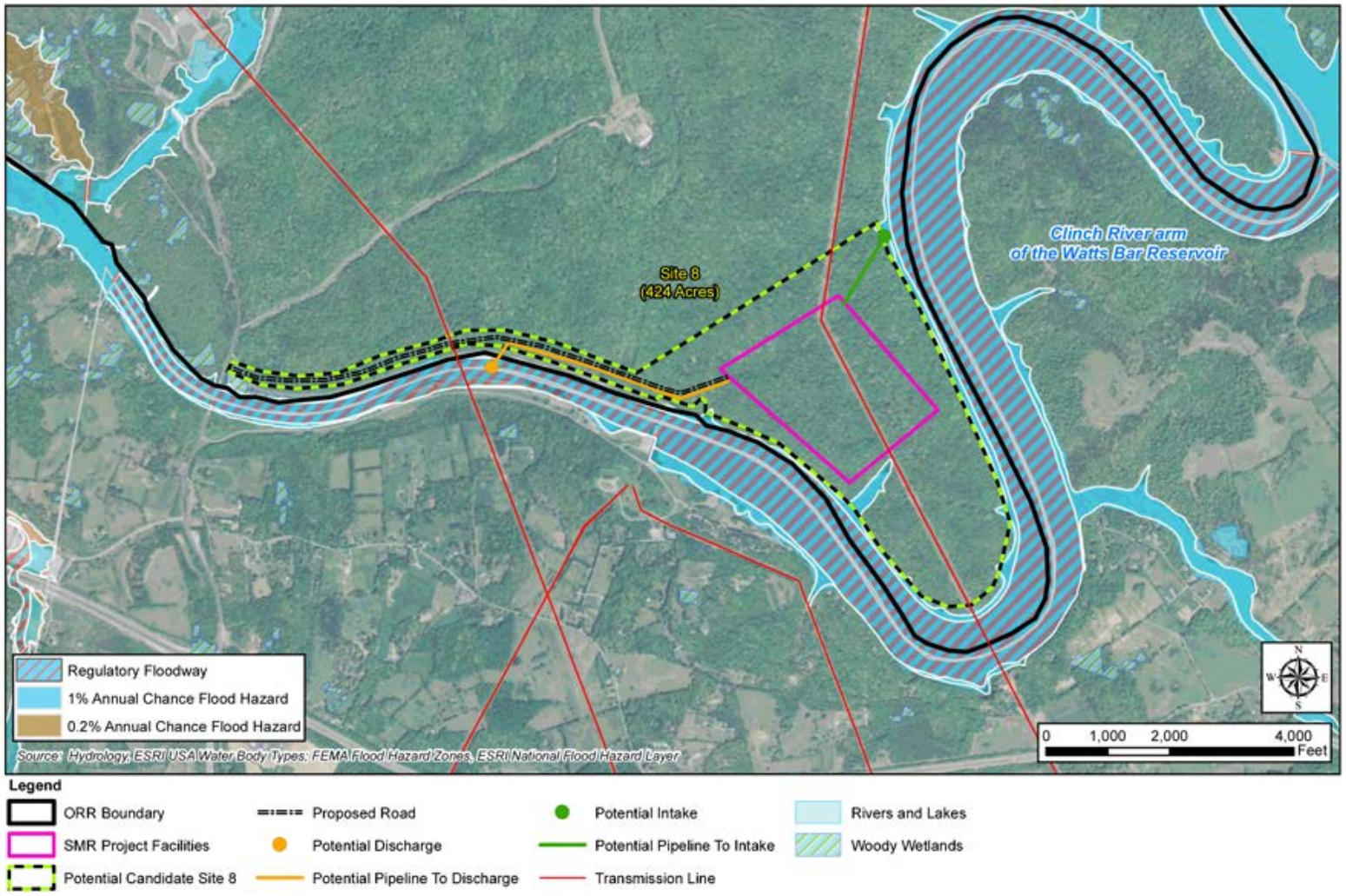

Figure 9.3-11. ORR Site 8 Flood Hazard Map

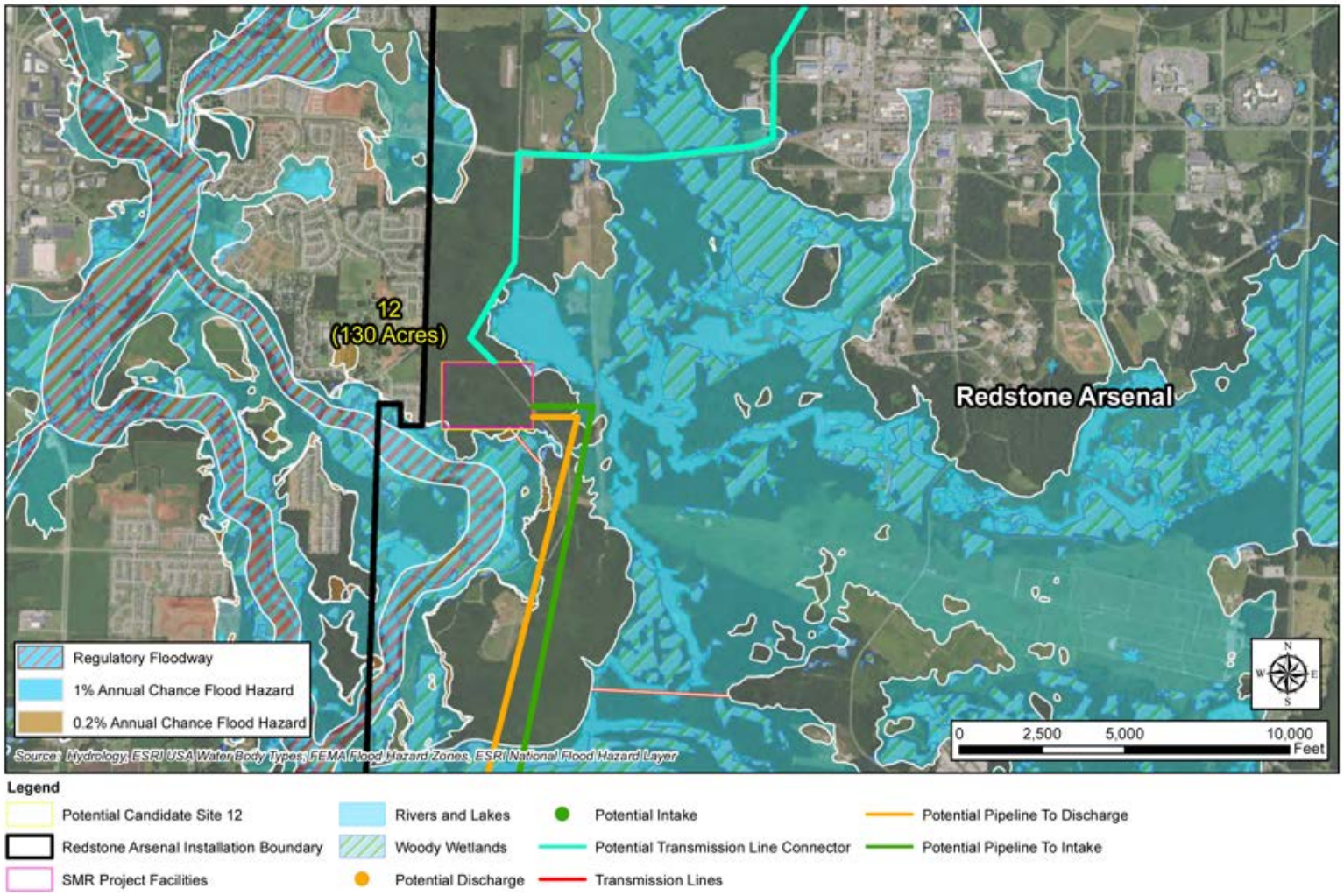

Figure 9.3-12. Redstone Arsenal Site 12 Flood Hazard Map

Figure 9.3-13. Minority Population Block Groups within 50 Miles of the Redstone Arsenal Candidate Site

Figure 9.3-14. Low-Income Population Block Groups within 50 Miles of the Redstone Arsenal Candidate Site

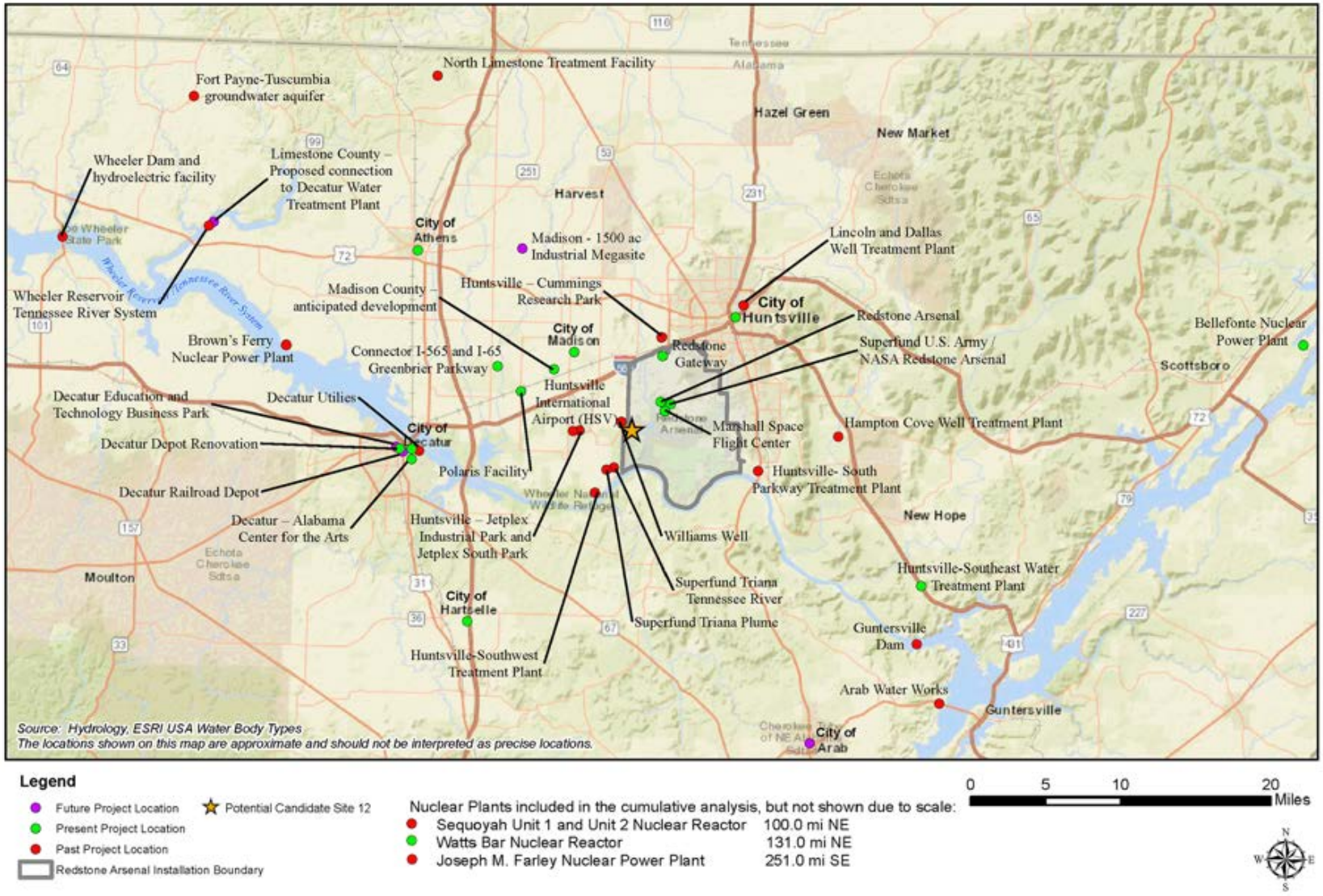

Figure 9.3-15. Redstone Arsenal Past, Present and Reasonably Foreseeable Future Projects

9.4 ALTERNATIVE PLANT SYSTEMS

This section discusses alternative plant systems for the proposed Clinch River (CR) Small Modular Reactor (SMR) Project. This information is provided to enable a comparison of the environmental impacts of the proposed system to that of the select alternatives. Because a final reactor selection has not been made, a Plant Parameter Envelope (PPE) approach to defining the various plant systems has been utilized. The proposed heat dissipation and circulating water systems for the new facility were initially presented in Chapter 3. Subsection 9.4.1 presents alternatives to the facility heat dissipation system, and Subsection 9.4.2 presents alternatives to the circulating water system.

9.4.1 Heat Dissipation Systems

There are multiple heat dissipation system alternatives, each having varying energy transfer mechanisms and, therefore, varying potential environmental impacts. The following subsections describe the proposed heat dissipation system and evaluate comparable alternatives based on guidance provided in NUREG-1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan*.

9.4.1.1 Proposed Heat Dissipation System

The purpose of a heat dissipation system is to dissipate heat energy to the environment. To meet cooling requirements of the proposed SMR units at the Clinch River Nuclear (CRN) Site and at the same time to provide environmental protection for the waters of Clinch River arm of the Watts Bar Reservoir, a closed system consisting of a mechanical draft cooling tower was selected as the preferred primary method of heat dissipation.

In this closed loop tower system, the main circulating water pumps circulate water through the condenser and to the towers where the heat is transferred to the air. Air flow through the cooling tower is conducted by large fans. Water returning from the towers flows back to the circulating water pumps via gravity. For the proposed heat dissipation system, makeup water is the only intake from and blowdown is the only discharge to the Clinch River arm of the Watts Bar Reservoir. Expected atmospheric effects from the operation of a mechanical draft cooling tower would include fogging and/or icing.

9.4.1.2 Screening of Alternatives to the Proposed Heat Dissipation System

The various heat dissipation system alternatives can be classified as one of two types of systems: once-through cooling system or closed-cycle cooling system. Based on the guidance provided in NUREG-1555, the following classes of heat dissipation systems were considered:

- Once-through systems
- Closed-cycle systems
  - Natural draft cooling towers

- Dry cooling towers
- Wet-dry cooling towers (hybrid towers)
- Cooling ponds
- Spray ponds

Once-through cooling systems involve the use of a large quantity of water which is withdrawn from a nearby water body, circulated through the condenser in order to absorb heat, and then discharged back into the initial water body. The water requirements for a once-through system are approximately 25,000 to 60,000 gallons of water per megawatt-hour (MWH) of electricity produced (Reference 9.4-1).

Closed-cycle cooling systems utilize comparatively much less water because the water performing the cooling is recirculated through the main condenser and the only additional water required is makeup water to account for expected system losses such as evaporation, blowdown, and/or drift. Examples of closed-cycle cooling systems include cooling towers (wet, dry, and wet-dry hybrid), cooling ponds, and spray ponds.

In the following subsections, these alternative systems are evaluated for use in the CR SMR Project. Because some of these alternatives were not feasible and/or environmentally desirable, detailed costs, operation and maintenance comparisons are not provided.

9.4.1.2.1 Once-Through Cooling Systems

In a once-through cooling system, water would be withdrawn at the intake pumping station from the Clinch River arm of the Watts Bar Reservoir and circulated through the condenser. The heated water would be discharged back into the Clinch River arm of the Watts Bar Reservoir. Even though once-through systems have characteristic advantages such as utilizing less land and minimal visual impacts, U.S. Environmental Protection Agency (EPA) regulations (Title 40 of the Code of Federal Regulations [40 CFR] 125) governing cooling water intake structures under Section 316(b) of the Clean Water Act (CWA) effectively prohibit newly constructed steam electric generating plants from using once-through cooling systems. Based on this regulation, once-through cooling was eliminated from further consideration.

9.4.1.2.2 Closed-Cycle Cooling Systems

The following subsections describe the alternative closed-cycle cooling systems considered in this ER.

Natural Draft Cooling Towers

Natural draft towers are essentially large chimneys designed to move air up through the structure by convection without the use of fans. As hot water is pumped into a natural draft cooling tower, it is distributed through packing or fill material inside the tower. The fill material

provides an interface for evaporation of the water and heating of the air to take place. As the water is being distributed, the exposed, lower portion of the tower allows ambient air to pass over the cold water basin at the bottom of the tower. This passing of ambient air over the cold water basin at the bottom of the tower and the evaporation/air heating taking place at the top of the tower create a temperature and density differential which results in a natural draft as less dense warmer air rises to the top. As this differential is being produced, the hyperbolic shape of the cooling tower itself facilitates the upward flow of air.

Natural draft cooling towers have very high construction costs but low operating cost, auxiliary power requirements, and noise impact because there is no mechanical equipment needed to move the air. Therefore, they can be very practical and cost-effective for locations with access to very large water volumes where consistent cooling is required over an extended time period. Potential environmental impacts resulting from the operation of natural draft cooling towers include cloud development and plume shadowing. Ground level fogging and icing are generally not a problem with larger natural draft cooling towers.

Because the Clinch River arm of the Watts Bar Reservoir provides an adequate water source, a natural draft cooling tower could be appropriate for consideration at the CRN Site. However, natural draft cooling towers require tall stacks to generate the airflow necessary for cooling. According to NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Rev. 1*, natural draft towers are typically higher than 500 ft tall and mechanical draft towers are typically 100 ft tall. Due to the increased visual impact and the comparatively high construction cost, a natural draft tower is not preferable to a mechanical draft cooling tower.

Dry Cooling Towers

Dry cooling towers utilize conduction and/or convection to dissipate heat to the atmosphere. The condenser coolant is enclosed within a piping network that has no direct air-to-water interface. The heat transfer process is based on the thermal transport properties of the piping material and the dry bulb temperature of the air. Either natural or mechanical draft techniques can be used to move the air. Because there are no evaporative or drift losses in this type of system, water loss for dry cooling towers is typically lower than for wet cooling towers, but some makeup water is required. Also many of the problems associated with wet cooling systems, such as blowdown disposal, water availability, fogging and/or icing, are not applicable. Dry towers do have inherent technical obstacles, such as high turbine backpressure and possible freezing in cooling coils during periods of light load and startup.

In 2001, the EPA determined that dry cooling was not the best available technology for minimizing adverse environmental impacts. This was based on high capital, operating, and maintenance costs for dry cooling, and the detrimental effects of dry cooling causes on electricity production caused by the reduction of the energy efficiency of steam turbines. EPA did recognize that dry cooling may be an appropriate technology for some facilities (such as those with limited cooling water availability or sensitive biological resources), and therefore did

not restrict the use of dry cooling technology. (Reference 9.4-2) Because the CRN Site has adequate water, dry cooling towers are not preferable to mechanical draft towers for this plant.

Wet / Dry Cooling Towers (Hybrid Towers)

A wet/dry cooling tower, also referred to as a hybrid cooling tower, is composed of a wet section and a dry section. Hybrid cooling towers combine the high efficiency of the wet cooling tower with the reduced visible plume of the dry cooling tower. The hybrid tower generally functions as a wet cooling tower, but when the ambient temperature is low, the cooling tower may be operated as a dry cooling tower without water consumption or plume production. A dry section installed in the upper part of the tower heats wet air coming from the lower wet zone, thereby reducing or eliminating the visible water vapor plumes typically associated with wet cooling towers.

In a hybrid cooling tower, fans are located in the wet section as well as the dry section of the tower, and the hyperbolic shell produces a natural draft effect that reduces power consumption. Power consumption is also reduced by the application of two-speed motors (Reference 9.4-3). This design has the highest associated capital costs. Water consumption for a hybrid tower is based on the water use of the wet section and, in general, the water usage of a hybrid tower is one-third to one-half of that for a wet cooling tower. The cost increase for the hybrid systems versus the wet cooling systems does not overcome water use savings (Reference 9.4-4).

The advantages of the hybrid system are that it conserves water where water is limited and/or expensive, provides for plume abatement, and results in reduced evaporation, blowdown, and makeup water. However, the dry cooling portion of the hybrid tower is not as efficient as the wet cooling process because it requires the movement of a large amount of air through the heat exchangers to achieve the necessary cooling. This results in less net electrical power for distribution. Because water availability is not a primary issue at the CRN Site a hybrid cooling tower is not a preferred heat dissipation technique for use at the CRN Site.

Cooling Ponds

A cooling pond is a shallow reservoir with a large surface area used for removing heat from process water. Cooling ponds can be used to reduce the heat load to natural bodies of water from power plant discharge without the construction and operation costs associated with cooling towers. The natural body of water is not relied on for heat dissipation but is used as a source of makeup water to replace water lost to evaporation and as a receiving stream for blowdown from the cooling pond.

A cooling pond is typically used at locations where land is relatively inexpensive, cooling water is scarce or expensive, and/or where there are strict thermal loading restrictions. Impacts resulting from the discharge of heated water into a cooling pond include thermal impacts such as altered stratification and atmospheric impacts such as steam fogging and/or icing. Once

cooled, water in the cooling pond can be reused, thereby reducing the overall quantity of water utilized.

Based on the anticipated production of 800 megawatts electrical (MWe) at the CRN Site (Table 3.1-2, item 16.6) and the general rule of thumb of 1.5 acres (ac) of cooling pond surface area per MWe of nuclear production, a cooling pond for the CR SMR Project would require approximately 1200 ac (Reference 9.4-5). Because the area of the CRN Site is only 935 ac, the use of a cooling pond as an independent technology is not feasible.

The facility design includes a small-scale holding pond located on the western side of the CRN Site as described in Subsection 3.4.2.2. While discharge flow mixing in the holding pond does reduce water temperature and moderate flow rates in the discharge, the pond is not intended to serve as a primary means of heat dissipation.

Spray Ponds

The spray pond cooling technology utilizes a series of spray nozzles located in a relatively long and narrow pond. Water from the condenser is sprayed into the air, where it is cooled by evaporation, and then allowed to fall into the pond where it is drawn into the intake structure to be pumped back to the condenser. Water lost in spray ponds through the evaporation process requires makeup from a nearby source. Spray ponds require considerably less land use to dissipate the same amount of heat versus conventional cooling ponds. In general, land use as a function of plant output at power plants utilizing spray ponds is approximately 1 ac per 15 MWe generated; therefore, approximately 53 ac would be required at the CRN Site for a spray pond (Reference 9.4-6).

The evaporative heat transfer associated with spray ponds is less efficient than that for a mechanical or natural draft cooling tower. The comparatively lower airflow associated with a spray pond results in an increase in the amount of land area required for the spray pond to dissipate the same amount of heat when compared to a wet cooling tower. This increased land use compared to a cooling tower results in increased negative effects to terrestrial and aquatic ecosystems. Therefore, a spray pond heat dissipation system is not preferable to the proposed mechanical draft cooling tower for the CRN Site. The use of a smaller scale spray cooling system as a mechanism for moderating temperatures in blowdown from cooling towers is included in the discharge alternatives presented in Subsection 9.4.2.2.2.

9.4.2 Circulating Water Systems

This subsection presents a discussion of alternatives to the following components of the Circulating Water System (CWS): intake systems, discharge systems, water supply and water treatment processes. This review only considers those alternatives that are applicable to the CRN Site, and are compatible with the proposed heat dissipation system discussed in Section 3.4 and Subsection 9.4.1.

9.4.2.1 Proposed Circulating Water System

This subsection summarizes the components of the CWS proposed for the facility.

9.4.2.1.1 Intake System

The proposed water intake is described in Subsection 3.4.2.1. The approximate location of the intake is shown in Figure 3.4-1. The proposed intake structure is located on the eastern side of the CRN Site, at approximately Clinch River Mile (CRM) 17.9. Figure 3.4-2 shows the general configuration of the intake structure with respect to the shoreline, and Figure 3.4-3 provides a more detailed conceptual depiction of the intake channels, trash racks, flow baffles, and pumps. A cross-sectional view of the intake is shown in Figure 3.4-4.

The intake structure is designed to meet the bounding makeup water requirements of the heat dissipation system by drawing water directly from the Clinch River arm of the Watts Bar Reservoir. As shown on Figure 3.4-2, the intake structure is constructed on the shoreline with the front face located at the existing river bank. This is a common intake to all power units that accommodates pumps, trash racks, and appropriate water screen technology. The design of the intake structure will comply with the CWA 316(b) regulations. The maximum water velocity at the intake, trash flow rack and water screens will be less than 0.5 ft per second, as required by the CWA, Section 316(b) Phase I requirements specified in 40 CFR 125.84.

9.4.2.1.2 Discharge

The proposed discharge is described in Subsection 3.4.2.3. A detailed, conceptual layout of the discharge is shown in Figure 3.4-5. The blowdown from the CWS is transported from the mechanical draft cooling tower to the discharge through a pipeline. The blowdown passes through an instrumentation vault for measurement of flow and temperature, and then continues through the approach conduits to two diffuser conduits.

As shown on Figure 3.3-1, between the mechanical draft cooling tower and the discharge, the blowdown passes through a holding pond, where it mixes before it continues through another pipeline to the discharge. Although discharge flow mixing in the holding pond acts to reduce water temperature and moderate flow rates in the blowdown; the use of the holding pond is not intended for purposes of heat removal from the facility discharge or for management of discharge flow rates in the hydrothermal analysis.

To maintain acceptable thermal limits for the discharge, a bypass provides a continuous flow of approximately 400 cubic ft per second (cfs) within the Clinch River arm of the Watts Bar Reservoir at Melton Hill Dam.

The facility’s discharges will be regulated by the Tennessee Department of Environment and Conservation (TDEC) through a National Pollutant Discharge Elimination System (NPDES) permit. The NPDES permit will include discharge limits established to protect receiving waters, and monitoring to ensure compliance with those limits. Temperatures and chemical

concentrations for all discharges will be in compliance with the terms and conditions of the NPDES permit.

9.4.2.1.3 Water Supply

The proposed water supply for operation of the CWS is described in Subsections 3.3.1 and 3.4.1.4. The proposed water source is the Clinch River arm of the Watts Bar Reservoir.

A water-use diagram for the conceptual facility is provided in Figure 3.3-1. The diagram shows the average and maximum flow rates for the intake from and discharge to the reservoir, the rates for consumptive uses, and the relationships between the various water flow systems. The intake withdraws an average of approximately 18,400 gallons per minute (gpm), and a maximum of approximately 30,700 gpm. The mechanical draft cooling tower consumes some of this water through evaporation and drift. The average and maximum drift rate is 8 gpm, and the expected and maximum evaporation rate is 12,800 gpm.

9.4.2.1.4 Water Treatment

The proposed treatment of the water supply for operation of the CWS is described in Subsection 3.3.2. Biocides and other chemicals are used to treat cooling and process water. Specific anti-fouling methods are to be defined in the combined license application (COLA), after an SMR design has been selected. The quantities and concentrations of chemicals to be used are to be in accordance with a Biocide/Corrosion Treatment Plan (B/CTP), submitted as part of the NPDES permit application to the TDEC.

9.4.2.2 Alternatives to the Proposed Circulating Water System

The purpose of this subsection is to identify and analyze reasonable alternatives to the proposed CWS. The analysis of each alternative system considers various factors during construction and operation, for comparison with those of the proposed system. These factors are covered in separate sections: intake system, discharge system, water supply, and water treatment system.

9.4.2.2.1 Intake System

9.4.2.2.1.1 Intake Location

The CRN Site is located on a peninsula on the north shore of the Clinch River arm of Watts Bar Reservoir (Figure 2.1-2), between approximately Clinch River Mile (CRM) 14.5 and CRM 19 (Reference 9.4-7; Reference 9.4-8). As discussed in Subsection 3.3.1, the proposed location of the intake structure is at approximately CRM 17.9, which is near the upstream edge of the CRN Site. Potential alternative intake locations evaluated include Melton Hill Reservoir, a location between Melton Hill Reservoir and CRM 17.9, a location on the CRN Site between CRM 17.9 and CRM 14.5, and a location on the Clinch River arm of Watts Bar Reservoir downstream of CRM 14.5.

As shown in Figure 2.1-3, the cooling towers are not situated directly on the Clinch River arm of the Watts Bar Reservoir, or on any other surface water source. To supply make-up water to the cooling towers, the water must be conveyed from its source to the cooling towers through either a water supply pipeline or canal. Either a pipeline or canal would require ground disturbance during construction, resulting in impacts to terrestrial and aquatic ecology, as well as water quality, air emissions, and land use impacts. The longer the distance, the greater these impacts would be. Therefore, the optimal intake location would minimize the length of the required pipeline or canal.

As shown in Figure 4.1-1, the cooling towers are located within the area which would be permanently cleared for the plant. This permanent clearance area comes closest to bordering the reservoir on the eastern, upstream side of the peninsula, between approximately CRM 17.5 and 17.9. In the remainder of the CRN Site, there is a buffer of land which will not be disturbed between the reservoir and the permanently cleared area. The optimal intake location would minimize the amount of temporary ground disturbance and land use outside of the permanent clearance area.

As discussed in Subsection 5.3.2.1, one objective of the hydrothermal analysis was to verify that the intake for the CR SMR Project is located far enough upstream to minimize the potential for blowdown being recirculated into the intake. To achieve this, the optimal intake location would be as far upstream of the discharge as feasible.

The proposed intake location would result in a 2498 ft long pipeline, and would not require any additional ground disturbance or land use outside of the permanent clearance area for the plant. An intake at other locations within the CRN Site would require a pipeline length of 6558 to 7147 ft. Although an intake on the western side of the CRN Site would result in shorter pipeline than the proposed intake location, it would not accomplish the objective of being located as far upstream of the discharge as possible, and could potentially result in recirculation of heated water. Also, an intake on the western side of the CRN Site would require a pipeline or canal to be constructed outside of the permanent clearance area. An intake outside of the CRN Site would require a pipeline or canal with a minimum length of 6558 ft. An intake directly on the north side of Melton Hill Reservoir would require a pipeline or canal with a minimum length of 27,575 ft, and a pipeline or canal with a length of 24,824 ft would be required to reach an intake on the south side of Melton Hill Reservoir.

The proposed intake location minimizes construction impacts, and minimizes disturbance outside of the permanent disturbance area, while still meeting the objective of avoiding recirculation of heated water. Most of the alternative intake locations would result in a greater level of construction impacts, as well as disturbance outside of the permanent disturbance area. An intake location on the western side of the CRN Site would result in a reduction in construction impacts, but would require disturbance outside of the permanent disturbance area, and would not meet the objective of being located as far upstream of the discharge as feasible. Therefore, the alternative intake locations are not environmentally preferable to the proposed intake location, and were not evaluated further.

9.4.2.2.1.2 Intake Pipe or Canal

As shown in Figure 3.4-2, the proposed intake structure is located directly on the shoreline, at surface water level. Alternative intake structures, including an intake pipe and intake canal, were considered.

An intake pipe would consist of a pipe extending out into the reservoir, and would withdraw water from the center of the reservoir instead of the shore. The type of inlet and size of the pipe could be selected and adjusted to manage the intake to keep cap entrance velocities below 0.5 feet per second (fps), as required by the Clean Water Act Section 316(b) Phase I requirements specified in 40 CFR 125.84. The inlet type and orientation could be adjusted to avoid creation of a vortex in order to minimize entrainment of aquatic biota and detritus. An intake canal would consist of a channel excavated into the riverbank. An intake canal places the intake pumps a distance inland from the reservoir, allowing intake velocities to be managed to comply with 316(b) requirements. The proposed shoreline intake structure is designed to keep flow velocities below 0.5 fps, complying with 316(b) requirements.

As discussed in Subsection 4.2.1.1.2, there is legacy contamination within sediments in the reservoir, and TVA is party to an Interagency Agreement requiring coordination with other agencies for activities which could result in the disturbance, re-suspension, removal, and/or disposal of contaminated sediments in the reservoir. Installation of an intake pipe requires disturbance of sediments within the reservoir, resulting in water quality and aquatic ecology impacts associated with construction. Installation of a shoreline intake or an intake canal requires disturbance of sediments along the shoreline.

The three alternatives differ with respect to impacts associated with construction and with respect to land use during operations. Installation of an intake pipe would require dredging of a trench in the reservoir, placing crushed stone bedding underneath the pipe, backfilling the trench with sand or gravel, and then protecting the pipe with riprap. Installation of an intake canal would require excavation from the shoreline into the plant, which would result in water quality, terrestrial ecology, and air quality impacts during construction, and would require land use during operations. The proposed shoreline intake would minimize the need for excavation onshore, thus minimizing water quality, terrestrial ecology, and air quality impacts during construction, and minimizing land use needs during operations. Therefore, neither an intake pipe nor an intake canal alternative are environmentally preferable to the proposed shoreline intake, and were not evaluated further.

9.4.2.2.1.3 Radial Collector Wells

Radial collector wells, also known as Ranney wells, are a mechanism for withdrawing surface water by laterally projecting well screens through alluvial sediments adjacent to and underneath a surface water body. These wells protect aquatic life by withdrawing water at extremely low velocities through many feet of porous material. The system requires no excavation in the waterway, so there are no direct construction impacts to the reservoir. The withdrawn water is

generally free of turbidity, reducing the need for water treatment; and the visual impact of the system is minimal, compared to a conventional shoreline intake system. However, the quantity of water that can be obtained from a radial collector well depends on the characteristics of the aquifer in which it is located. (Reference 9.4-9)

The highest yielding collector wells are constructed in coarse-grained outwash and alluvium deposits where the fines (clay, silt, fine sand) have been winnowed out, the saturated thicknesses of the unconsolidated formation are a minimum of 60 to 70 ft thick, and the well is located in close proximity to a surface water source that is rapidly hydraulically connected to the unconsolidated aquifer. The land requirement for such a well (one well) would be a parcel approximately 430 ft x 430 ft (184,900 ft^2 [4.25 ac]). Typical spacing for collector wells is 1500 ft (Reference 9.4-9). Yields from collector wells constructed in ideal conditions would range from 10 to 15 million gallons per day (mgd). As discussed in Subsection 5.2.2.1.1, the expected water needs for plant operations range from an average of 26 mgd to a maximum of 44 mgd. If ideal conditions were present at the CRN Site, three to four wells would be required to meet the water needs for plant operations.

As discussed in Subsection 2.3.1.2.1.3.5, there are alluvial and river terrace deposits along the Clinch River arm of the Watts Bar Reservoir on the CRN Site, but these sediments are primarily silty clay with thin intercalated layers of quartzose gravel. With finer-grained sediments, well screens need to be installed with smaller slot sizes to stop the formation from entering and clogging the well. Smaller slot sizes result in lower productivity from each well. As discussed in Subsection 2.3.1.2.1.3.5, the thickness of the unconsolidated sand and clay alluvial deposits along the shoreline is approximately 32 ft. This is substantially thinner than the 60 to 70 ft needed for highly productive radial wells. A more comparable example of production from an aquifer of similar thickness, provided in Table V-1 of the American Society of Civil Engineers Design of Water Intake Structures for Fish Protection, is a range of 1 to 5 mgd for wells with a saturated thickness of 20 to 40 ft (Reference 9.4-9).

As shown on Figure 2.6-4, the alluvial aquifer at the CRN Site is limited to a narrow strip less than 500 to 1000 ft wide along the eastern, southern, and western edges of the CRN Site. Of these, the alluvial aquifer located on the western edge of the site is located adjacent to and downstream of the proposed discharge, so an intake at the location would potentially withdraw heated water, and would therefore not be technically feasible. The total area of alluvium on the eastern and southern edges of the site comprise a total of 26.2 ac.

Because the sediment type, thickness, and areal extent of the alluvial aquifer at the CRN Site fall short of the ideal conditions for Ranney wells, yields in the range of 10 to 15 mgd are not technically feasible. Assuming a production rate close to 5 mgd, approximately nine Ranney wells would be required. At 4.25 ac per well, an alluvial aquifer system of more than 38 ac in size (9 wells X 4.25 ac per well = 38.25 ac) would be required. Because only approximately 26 ac of alluvial aquifer are available on the site, Ranney wells are not technically feasible, and were not analyzed in detail.

9.4.2.2.2 Discharge

Potential alternatives for managing the SMR blowdown were developed, and cursory analyses of the alternatives were performed in sufficient detail to recommend a preferred alternative for the discharge. The analyses included: (1) developing order-of-magnitude estimates for the capital cost of the alternatives, (2) summarizing any impacts that the alternatives may have on hydroelectric power production at Melton Hill Dam (as well as any other notable operating and maintenance (O&M) impacts), and (3) examining the hydrothermal performance of the alternatives in terms of the likelihood of satisfying the regulatory guidance for the mixing zone and regulatory requirements for instream water temperature. The alternatives developed for the discharge are summarized in Table 9.4.2-1.

Alternative 0, the base case, included routing the blowdown directly to the reservoir without any changes in the existing release characteristics at Melton Hill Dam. Other than specific design details related to the intake and discharge structures, this alternative was basically the same as the proposed blowdown system for the former Clinch River Breeder Reactor Project (CRBRP). Hydrothermal analyses reported for the CRBRP suggested that in today's regulatory climate, this alternative would not likely gain acceptance because of the type of mixing zone required and the potential impacts on reservoir temperature.

For Alternative 1 and Alternative 2, a new low level outlet structure (bypass) would be added at Melton Hill Dam to provide a continuous release of 400 cfs of water. The SMR blowdown would still be routed directly to the reservoir. The bypass would ensure sufficient flow is provided at all times to dilute the plant thermal discharge, even during extreme winter conditions with SMR discharges over 30 degrees Fahrenheit (°F) warmer than the reservoir. For Alternative 1, the bypass would be equipped with a valve to control the discharge. For Alternative 2, the bypass would be equipped with a small hydroelectric generating unit to recapture some of the hydroelectric value forfeited by the Alternative 1 bypass. The proposed modification to releases from Melton Hill Dam via the bypass is within the current Tennessee Valley Authority (TVA) reservoir operation policy for minimum daily average flow of 400 cfs at this location and thus would not require a change in operating policy. In the initial analysis, the recommended amount of flow for the bypass was 200 cfs. A revised analysis was also performed which recommended a bypass of 400 cfs. Although Alternative 1 and Alternative 2 required modifications at Melton Hill Dam, these modifications operationally could be provided within the current TVA policy for managing flows in the Clinch River arm of the Watts Bar Reservoir (e.g., 200 cfs falls within the minimum daily average flow currently specified for Melton Hill Dam, which is 400 cfs). In terms of hydrothermal impacts at the location of the SMR discharge, Alternatives 1 and 2 would be identical.

For Alternative 3, the SMR blowdown would be routed directly to the reservoir; however, the plant withdrawal from and discharge to the reservoir would be reduced by increasing the design cycles of concentration (COC) for the CWS. In this alternative, there would be no modifications at Melton Hill Dam. The COC represents the ratio of the concentration of dissolved solids in the plant discharge to the same for the plant withdrawal. The water in the reservoir below Melton

Hill Dam is low in dissolved solids, so much so that it may be possible to increase the COC of the CWS loop by a factor of two. In turn, this would decrease the plant discharge by about 50 percent. A lower plant discharge would perhaps reduce the impact of the blowdown in the reservoir during long periods of idle operation at Melton Hill Dam. Alternative 3A also would include an increase in the COC by a factor of two, but in addition would contain an oriented spray cooling system (OSCS) to further cool the blowdown before discharging it to the reservoir.

For Alternatives 4 and 5, a holding pond would be provided on the CRN Site to store the blowdown during periods of idle operation at Melton Hill Dam. The blowdown in the pond would be emptied to the reservoir as a batch release during subsequent periods when Melton Hill Dam is releasing water to the reservoir. In the most extreme cases, this release would need to be accomplished in about 1.5 hours (hr). Alternative 5 differs from Alternative 4 in that it would also include an OSCS to further cool the blowdown. Alternative 5A is basically Alternative 5 without a holding pond. In this manner, Alternative 5A is the same as Alternative 0 with the addition of an OSCS to further cool the blowdown (again, without any changes in the existing release characteristics at Melton Hill Dam).

Order-of-magnitude estimates for the capital cost of the alternatives are summarized in Table 9.4.2-2. Also shown are some notable O&M impacts. The physical components needed for the various alternatives are placed in one of two categories: onsite and offsite. Onsite components include equipment located on or immediately adjacent to the CRN Site, and offsite components include equipment situated beyond the immediate area of the CRN Site. Offsite components were included only in Alternatives 1 and 2, which include modifications at Melton Hill Dam. Based solely on capital cost, and if all of the options to Alternative 0 were viable in terms of hydrothermal impacts in the reservoir, the results of Table 9.4.2-2 suggest Alternative 3 would be the best option for the SMR discharge. In fact, even if Alternative 0 was viable, the capital costs suggest that it would be better to abandon Alternative 0 in favor of Alternative 3. The cost of a small hydro unit at Melton Hill Dam causes Alternative 2 to have the highest capital cost. Alternatives 1 and 2 also have notable impacts on hydroelectric operations, creating losses in energy production and capacity at Melton Hill Dam. Other notable O&M impacts include the likely need for additional water treatment to help control the soluble mineral content of CWS flow for Alternatives 3 and 3A. Also, O&M expenses are required for operating the oriented spray cooling systems included in Alternatives 3A, 5, and 5A.

For all of the alternatives, it is anticipated that the best technology to mix the plant discharge in the reservoir would be the use of a bottom-mounted/submerged multiport diffuser. As an integral part of the hydrothermal analyses, cursory diffuser designs were developed for each alternative included in Table 9.4.2-1. For Alternatives 4 and 5, the design would require a diffuser with a discharge capacity of 281 cfs. For this flow, the size and arrangement of the diffuser conduits could not be reasonably accommodated within the regulatory guidelines for mixing zones. Other potential challenges exist concerning impacts on navigation and recreation, and the overall sensibility/perception of flushing a large volume of water to the reservoir in a short period of time. For these reasons, these alternatives were not considered any further.

In the same manner as Alternative 0, Alternatives 3, 3A, and 5A would each include a continuous discharge of SMR blowdown directly to the reservoir in extreme events with no release from Melton Hill Dam. In these types of events, the magnitude of the temperature impacts would be influenced primarily by the temperature of the facility discharge. For extreme events in the winter, the temperature of the facility blowdown for Alternative 3 would be the same as Alternative 0, and Alternatives 3A and 5A would be nearly the same as Alternative 0. For Alternative 3 it would be the same: 31°F warmer than the ambient water temperature. For Alternatives 3A and 5A, in the winter the OSCS would reduce the discharge temperature only slightly, from 31°F to 29°F above the ambient water temperature. In this manner, the results of the Alternative 0 simulation suggest that extreme operating conditions for Alternatives 3, 3A, and 5A could potentially challenge regulatory requirements for the facility thermal discharge. There is also a concern associated with restricting plant operational flexibility with high COC in Alternatives 3 and 3A. For these reasons, Alternatives 0, 3, 3A, and 5A were not considered any further.

Because Alternatives 4 and 5 were previously excluded, only Alternatives 1 and 2 remained. For these alternatives, Fluent simulations were conducted for both extreme winter and extreme summer conditions. The simulations included unsteady events wherein for the first hour, the flow in the reservoir was provided solely by hydroelectric operation at Melton Hill Dam. For the next 46 hr, hydroelectric operation was idled and the bypass was initiated with a release of 200 cfs in the initial analysis, and 400 cfs in the revised analysis. In the final (48th) hour of the simulation, hydroelectric operation was resumed as in the first hour (without the bypass). For both cases (i.e., winter and summer), the results predict temperatures that are considered favorable for obtaining acceptance for all pertinent regulatory guidelines and requirements. That is, it is anticipated that a mixing zone of acceptable size and shape can be successfully defined, and the impact on reservoir temperature appears to fall within the limits for temperature change, temperature rate of change, and reservoir water temperature.

Provided in Table 9.4.2-3 is an assessment summary of the alternatives based on the hydrothermal analyses. Alternatives 0, 3, 3A, and 5A (those with no modifications to the dam) were expected to experience challenges with the size of the discharge mixing zone and/or the ability to satisfy regulatory requirements for water temperature, particularly for extreme events in the winter. Alternatives 4 and 5, which rely on a holding pond to store blowdown during no release events from Melton Hill Dam, were also expected to experience challenges related to the size of the mixing zone, and perhaps also adverse impacts related to navigation and recreation during flushing of the holding pond. For these reasons, none of these alternatives were preferred. In contrast, model simulations of extreme events for Alternatives 1 and 2, which included a continuous minimum flow at Melton Hill Dam, suggested that these alternatives could likely satisfy regulatory requirements for both the size of the mixing zone and reservoir temperature without adversely impacting navigation, recreation, or other uses of the reservoir. For these reasons, from the standpoint of hydrothermal impacts, Alternatives 1 and 2 were recommended as preferred among the alternatives considered. Additional studies (e.g., studies

detailing the exact features of the bypass and related costs and benefits) would be required to select one of these two alternatives as the best suited.

The discharge location evaluated in the thermal analysis of Alternatives 1 and 2 is at approximately CRM 15.5. A preliminary location at CRM 15.9 was initially evaluated, and was determined to not be favorable for dissipating waste heat in the reservoir. This was because a submerged island within the reservoir was identified at that location by the bathymetric surveys, and it was determined that this feature would encumber mixing of the plant effluent and produce a shore-hugging thermal plume. As a result, the thermal analysis identified a location further downstream, near CRM 15.5, which takes advantage of turbulence created by the submerged island to enhance mixing. It also locates the discharge further from semi-stagnant tributary embayments (such as Poplar Springs Creek), and increases the distance between the plant water intake and discharge.

9.4.2.2.3 Water Supply

CWS makeup water is to be withdrawn from the Clinch River Arm of the Watts Bar Reservoir. Reservoir water use is discussed in Section 3.3, and is summarized in Subsection 9.4.2.1.3. As discussed in Subsection 5.2.2.1.1, the expected water needs for plant operations range from an average of 26 mgd to a maximum of 44 mgd. The sufficiency of the water supply for facility operation and the impact of water use from the reservoir are analyzed in Section 5.2. Alternative water supply sources, including groundwater, the City of Oak Ridge water supply system, and wastewater flows, were considered.

9.4.2.2.3.1 Groundwater

Section 2.3 discusses regional groundwater use and site-specific groundwater occurrence. As discussed in Subsection 2.3.2.2.1, groundwater resources in the region are very limited. The total withdrawal of groundwater in the geographic area of interest, which is the five-County region surrounding the CRN Site, is 3.5 mgd. This is less than 10 percent of the operational water needs of the plant.

Section 2.3 summarizes local and regional groundwater production. Subsection 2.3.2.2.1 describes wells and springs within a 2-mile (mi) radius of the site, and reports that nearly all wells were domestic wells with flow rates less than 10 gpm. As discussed in Subsection 2.3.1.2.1.2, individual well yields from wells completed in the principal aquifers range from about 11 to 350 gpm (0.016 to 0.504 mgd). If site conditions permitted groundwater production in the upper end of this regional range, a minimum of 88 such wells would be required to meet the water needs of plant operations. However, the reported data from wells within a 2-mi radius of the site suggest productivity would be at the lower end of the range. Productivity in the lower end of the range is also supported by results from the aquifer pump test conducted on the CRN Site, as discussed in Subsection 2.3.1.2.2.4.1. The test well was pumped at a constant rate of 14.5 gpm for 72 hours. If productivity in the range of 14.5 gpm can be expected, then more than 2700 wells would be required. The yield of individual wells may be improved through the use of

radial collector well technology. However, given that the water needs for plant operations are up to more than 10 times the entire volume of groundwater production in the five county study area surrounding the CRN Site, providing a water supply for plant operations from groundwater resources, even using radial collector well technology, is not technically feasible.

9.4.2.2.3.2 City of Oak Ridge

Use of the City of Oak Ridge water supply system as the plant water supply was evaluated. The capacity of the City of Oak Ridge water supply system is 28 mgd, of which 10.2 mgd was withdrawn in 2005 (Reference 9.4-10). Based on average water supply requirements of 26 mgd, and maximum water supply requirements of 44 mgd, for plant operations, the City of Oak Ridge system does not have the capacity to supply plant operations. Therefore, the City of Oak Ridge is not a technically feasible alternative for the plant water supply.

9.4.2.2.3.3 Recycled Wastewater

Use of recycled wastewater flows in the local area was evaluated. Table 2.3.2-2 shows the wastewater returns in the surface water study area in 2010. The total return of public water supply in the seven-county area is 80.47 mgd. However, the majority of this return, more than 58 mgd, is located in Knox County. The closest of these return sources is approximately 14 mi east of the CRN Site. The total amount of return within Roane County is 3.0 mgd, substantially less than the 44 mgd needed to support plant operations. Outside of Roane County, the closest wastewater return is the Oak Ridge Wastewater Treatment Plant in Anderson County. The Oak Ridge plant returns 4.53 mgd, or approximately 10 percent of the water needs for operations, and is located approximately 7 mi from the CRN Site. Other wastewater sources would be located further from the CRN Site. Overall, the largest single wastewater source in the seven-County area is the Knoxville-Kuwahee Wastewater Treatment Plant, which returns approximately 29 mgd, and is located more than 21 mi east of the CRN Site.

Because there is no single source of wastewater with the capacity to support plant operations, multiple sources would need to be accessed. Each of these would require construction of a pipeline, ranging from 7 to more than 20 mi in length. The construction of each of these pipelines would have its own impacts, including land use, terrestrial ecology, water quality, and air quality impacts. Given these constraints, the use of wastewater is not environmentally preferable to the proposed water source, and no further evaluation of this option was considered.

9.4.2.3 Water Treatment

Concentration of dissolved salts in makeup water resulting from evaporative water losses require the discharge of a certain percentage of the mineral-rich stream (blowdown) and its replacement with fresh water (makeup). Nuclear power plants are required to obtain an NPDES permit to discharge effluents. These permits are renewed every five years by the state's water quality permitting agency (in this case, TDEC). The periodic NPDES permit renewals provide

the opportunity to require modification of power plant discharges or to alter discharge monitoring in response to water quality concerns. Effects of cooling tower discharges are considered to be of small significance when water quality criteria (e.g., NPDES permits) are met. In considering the effects of closed-cycle cooling systems on water quality, the U.S. Nuclear Regulatory Commission (NRC) evaluated the same issues that were evaluated for open-cycle systems. Based on review of literature and operational monitoring reports, consultations with utilities and regulatory agencies, and comments on the draft Generic Environmental Impact Statement for License Renewal of Nuclear Plants, discharge of cooling tower effluents has not been a problem at existing nuclear plants.

As discussed in Subsection 9.4.2.1.4, specific anti-fouling methods are to be defined at COLA, when a final SMR design is selected. The quantities and concentrations of chemicals to be used are to be in accordance with a B/CTP, submitted as part of the NPDES permit application to the TDEC. Therefore, no alternative water treatment methods have been evaluated.

9.4.3 Transmission Systems

As indicated in the Interim Staff Guidance Combined License and Early Site Permit No. 026 (COL/ESP-ISG-026), *Environmental Issues Associated with New Reactors*, issued October 2014, alternative transmission line routing is no longer evaluated because transmission lines are not NRC authorized construction.

9.4.4 References

Reference 9.4-1. Macknick, J, Newmark, R, Heath, G, and Hallett K C, "Operational water consumption and withdrawl factors for electricity generating technologies," December 20, 2012.

Reference 9.4-2. U.S. Environmental Protection Agency, National Pollutant Discharge Elimination System: Regs Addressing Cooling Water Intake Structures, Website: http://www.gpo.gov/fdsys/pkg/FR-2001-12-18/pdf/01-28968.pdf, December 18, 2001.

Reference 9.4-3. Cooling Technologies, "Hybrid Cooling Towers - Cooling Towers without visible plume," 2013.

Reference 9.4-4. U.S. Environmental Protection Agency, "Technical Development Document for the Final Regulations Addressing Cooling Water Intake Structures for New Facilities," EPA-821-R-01-036, November 9, 2001.

Reference 9.4-5. Edinger, J.E. and Buchak, E. M., "Surface Heat Exchange and Hydrothermal Analysis, Transport Processes in the Oceans 7: 214, 1977.

Reference 9.4-6. Exelon Generation, "Victoria County Station Environmental Report Chapter 9," May 30, 2012.

Reference 9.4-7. Tennessee Valley Authority, "Final Environmental Impact Statement Watts Bar Reservoir Land Management Plan Loudon, Meigs, Rhea, and Roane Counties, Tennessee," February, 2009.

Reference 9.4-8. Watts Bar - Clinch Watershed Team, Final Watts Bar Reservoir Land Management Plan, Panel 4; Alternative B "Preferred", January 23, 2009.

Reference 9.4-9. American Society of Civil Engineers, Design of Water Intake Structures for Fish Protection, 1982.

Reference 9.4-10. U.S. Geological Survey, Public Water-Supply Systems and Associated Water Use in Tennessee, Website: http://pubs.usgs.gov/of/2010/1226/pdf/ofr2010-1226.pdf, 2005.

Table 9.4.2-1
Discharge Alternatives Evaluated to Attenuate Impact of SMR Blowdown

Alternative	Description
0	Blowdown directly to reservoir with existing release characteristics at Melton Hill Dam (base case)
1	Blowdown directly to reservoir + provide minimum continuous bypass release at Melton Hill Dam via new low level outlet conduit with control valve. Bypass release was 200 cfs in initial analysis and 400 cfs in the revised analysis.
2	Blowdown directly to reservoir + provide minimum continuous bypass release at Melton Hill Dam via new small hydro unit. Bypass release was 200 cfs in initial analysis and 400 cfs in the revised analysis.
3	Blowdown directly to reservoir + reduce blowdown 50% by doubling cooling system COC
3A	Blowdown directly to reservoir + reduce blowdown 50% by doubling cooling system COC + OSCS to further cool blowdown
4	Store blowdown to holding pond when Melton Hill Dam idle, and empty holding pond as a batch release when Melton Hill Dam operation resumes
5	Store blowdown to holding pond when Melton Hill Dam idle, and empty holding pond as a batch release when Melton Hill Dam operation resumes + OSCS to further cool blowdown
5A	Blowdown directly to reservoir (no holding pond) + OSCS to further cool blowdown

Table 9.4.2-2
Order-of-Magnitude Capital Costs and Notable O&M Impacts for Alternative Systems

Alternative	Approx Capital Cost ($ million)			Notable O&M Impacts[1] (Compared to Base Case)
	Onsite	Offsite	Total	
0	2.4	none	2.4	NA
1	2.4	5 - 10	7.4 - 12.4	• Loss of 8760 MWH on-peak hydro energy/year at Melton Hill Dam • Loss of 45.0± MWe hydro capacity at Melton Hill Dam
2	2.4	14 - 20	16.4 - 22.4	• Loss of 600 MWH on-peak hydro energy/year at Melton Hill Dam • Loss of 43.2± MWe hydro capacity at Melton Hill Dam
3	1.4	none	1.4	• Water treatment likely also needed to help control soluble mineral content of CWS flow
3A	4.4	none	4.4	• Water treatment likely also needed to help control soluble mineral content of CWS flow • Energy (35 hp pump)+labor, materials & equipment for routine control/upkeep of OSCS
4	9.3	none	9.3	NA
5	12.9	none	12.9	• Energy (50 hp pump)+labor, materials & equipment for routine control/upkeep of OSCS
5A	7.5	none	7.5	• Energy (50 hp pump)+labor, materials & equipment for routine control/upkeep of OSCS

[1] Excluding any SMR derates and shutdowns to satisfy regulatory guidelines and requirements.

Note:
NA = Not Applicable

Table 9.4.2-3
Assessment Summary of Discharge Alternatives

Alternative	Hydrothermal Assessment Summary	
0	Per Fluent simulations, this alternative cannot ensure compliance with regulatory guidance for size of mixing zone and requirements for water temperature, at least for extreme winter events with long periods of idle hydro operation at Melton Hill Dam.	Not preferred
1	Per Fluent simulations, this alternative is considered favorable for obtaining regulatory acceptance for the size of mixing zone and requirements for water temperature, for both extreme winter events and extreme summer events containing long periods of idle hydro operation at Melton Hill Dam.	**Preferred**
2	Per Fluent simulations, this alternative is considered favorable for obtaining regulatory acceptance for the size of mixing zone and requirements for water temperature, for both extreme winter events and extreme summer events containing long periods of idle hydro operation at Melton Hill Dam.	**Preferred**
3	Per Fluent simulations for Alternative 0, challenges expected relative to the ability of this alternative to ensure compliance with regulatory guidance for size of mixing zone and requirements for water temperature, at least for extreme winter events involving long periods of idle hydro operation at Melton Hill Dam. Concern also exists in restricting plant operational flexibility with a high COC.	Not preferred
3A	Per Fluent simulations for Alternative 0, challenges expected relative to the ability of this alternative to ensure compliance with regulatory guidance for size of mixing zone and requirements for water temperature, at least for extreme winter events involving long periods of idle hydro operation at Melton Hill Dam. OSCS does not provide significant additional cooling for extreme winter events. Concern also exists in restricting plant operational flexibility with a high COC.	Not preferred
4	This alternative likely cannot ensure compliance with regulatory guidance for size of mixing zone. Potential issues also exist for navigation and recreation during flushing of the holding pond. Overall operational and public perceptions of flushing a large volume of water to the reservoir in a short period of time is likely to be poor.	Not preferred
5	This alternative likely cannot ensure compliance with regulatory guidance for size of mixing zone. Potential issues also exist for navigation and recreation during flushing of the holding pond. Overall operational and public perceptions of flushing a large volume of water to the reservoir in a short period of time is likely to be poor. OSCS does not provide significant additional cooling for extreme winter events.	Not preferred
5A	Per Fluent simulations for Alternative 0, challenges expected for this alternative relative to the ability of this alternative to ensure compliance with regulatory guidance for size of mixing zone and requirements for water temperature, at least for extreme winter events involving long periods of idle hydro operation at Melton Hill Dam. OSCS does not provide significant additional cooling for extreme winter events.	Not preferred