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

CNL-16-190

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

Clinch River Nuclear Site
NRC Project No. 785

Subject: Submittal of Supplemental Information Related to Site Selection in Support of the Early Site Permit Application for Clinch River Nuclear Site

References:

1. Letter from TVA to NRC, CNL-16-081, "Application for Early Site Permit for Clinch River Nuclear Site," dated May 12, 2016
2. Letter from TVA to NRC, CNL-16-103, "Submittal of Calculation Input and Output Files in Support of Early Site Permit Application for Clinch River Nuclear Site," dated June 23, 2016
3. Letter from TVA to NRC, CNL-16-112, "Submittal of Siting Study in Support of Early Site Permit Application for Clinch River Site," dated July 6, 2016
4. Letter from TVA to NRC, CNL-16-134, "Schedule for Submittal of Supplemental Information in Support of Early Site Permit Application for Clinch River Nuclear Site," dated August 11, 2016
5. NRC Presentation to TVA, "Discussions Related to TVA's Planned Submittal of Information to its Supplement May 12, 2016 Early Site Permit Application," public meeting held on September 15, 2016 (ML16252A182)

By letter dated May 12, 2016 (Reference 1), Tennessee Valley Authority (TVA) submitted an application for an early site permit for the Clinch River Nuclear (CRN) Site in Oak Ridge, TN. By letter dated June 23, 2016 (Reference 2), TVA provided RADTRAN input and output data used to estimate the radiological doses and dose risks to populations and transportation workers resulting from incident-free transportation and to the general population from accident scenarios. By letter dated July 6, 2016 (Reference 3), TVA submitted the "Small Modular Reactor Final Siting Study," Revision 1. Subsequent to the submittal of this

application, and consistent with interactions with Nuclear Regulatory Commission (NRC) staff, TVA identified certain aspects of the application that it intended to supplement. By letter dated August 11, 2016 (Reference 4), TVA provided a plan for submitting the identified supplemental information. At a public meeting on September 15, 2016, the NRC staff presented to TVA (Reference 5), items requiring supplemental information and clarification.

This letter provides a revised CRN Site Small Modular Reactor Siting Study (renamed TVA Site Selection Report); changes to the CRN Early Site Permit Application (ESPA), Part 3, Environmental Report (ER) Section 9.3, "Alternative Sites," and supporting information related to the revised TVA Site Selection Report and ER Section 9.3.

Enclosure 1 provides information to address NRC Supplemental Items AltSit 1, AltSit 2, AltSit 3, AltSit 4, AltSit 5, and AltSit 6 presented during the September public meeting. Enclosure 1 contains two attachments. Attachment 1 contains the TVA Site Selection Report, Revision 2. Attachment 2 contains the updated CRN ESPA Part 3, ER, Section 9.3 (replacing the existing Section 9.3 in its entirety) resulting from this supplemental information and additional supplemental information contained in Enclosure 3.

Enclosure 2 provides information to clarify the potential candidate sites outside of the candidate area boundaries, clarifies the screening criteria for candidate areas, and provides additional information on the basis of the impact to aquatic species.

Enclosure 3 provides additional supplemental information supporting CRN ESPA, Part 3, ER, Subsection 4.4.2.1, "Population and Housing," Subsection 5.8.2, "Social and Economic Impacts of Station Operation," and Section 9.3, "Alternative Sites." Attachments 1 and 2 to this enclosure contain markups to Subsections 4.4.2.1 and 5.8.2, respectively.

The changes to the ER described above will be incorporated in a future revision of the ESPA.

There are no new regulatory commitments associated with this submittal. If any additional information is needed, please contact Dan Stout at (423) 751-7642.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 15th day of December 2016.

Respectfully,

J. W. Shea
Vice President, Nuclear Licensing

Enclosures

cc: See Page 3

Enclosures:
1. Response to NRC Supplemental Items AltSit 1, AltSit 2, AltSit 3, AltSit 4, AltSit 5, and AltSit 6
2. Supplemental Information Supporting the Tennessee Valley Authority Site Selection Report, Revision 2
3. Supplemental Information Supporting CRN Early Site Permit Application, Part 3, Environmental Report Section 9.3, "Alternative Sites"

cc (Enclosures):

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cc (without Enclosures):

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ENCLOSURE 1

Response to NRC Supplemental Items AltSit 1, AltSit 2, AltSit 3, AltSit 4, AltSit 5 and AltSit 6

ENCLOSURE 1

By letter dated May 12, 2016 (Reference 1), Tennessee Valley Authority (TVA) submitted an application for an early site permit for the Clinch River Nuclear (CRN) Site in Oak Ridge, TN. By letter dated July 6, 2016 (Reference 2), TVA submitted the "Small Modular Reactor Final Siting Study," Revision 1. Subsequent to the submittal of the application, and consistent with interactions with Nuclear Regulatory Commission (NRC) staff, TVA identified certain aspects of the application that it intends to supplement. By letter dated August 11, 2016 (Reference 3), TVA provided a plan for submitting the identified supplemental information. At a public meeting on September 15, 2016, the NRC staff presented to TVA (Reference 4), items requiring supplemental information and clarification.

This enclosure provides supplemental information addressing NRC Supplemental Items AltSit 1, AltSit 2, AltSit 3, AltSit 4, AltSit 5, and AltSit 6 presented during the September public meeting (Reference 4). This enclosure also provides the proposed changes to the TVA Site Selection Report in Attachment 1 and changes to the CRN Early Site Permit Application (ESPA), Part 3, Environmental Report (ER) Section 9.3, "Alternative Sites," in Attachment 2. Changes to the ER will be incorporated in a future revision of the ESPA.

CRN-Site Selection Supplemental Information

1. *SI AltSit 1*

   The screening process summarized in the ER and described in somewhat more detail in the Siting Study, progresses from the Region of Interest (ROI) through the assessment of Candidate Areas and Preliminary Potential Sites and declares that both exclusionary and avoidance criteria were applied. However, the ER and the Siting Study do not sufficiently define the actual criteria that were applied. Each exclusionary and avoidance criterion applied at each step of the screening process from ROI to candidate sites must be defined so that the screening results can be independently assessed such that the staff is able reach a conclusion on the reasonableness of the applicant's site selection process. To the maximum extent possible screening criteria should be objective and not subjective.

   TVA Response

   The text of the TVA "Small Modular Reactor Final Siting Study" has been revised and renamed, "TVA Site Selection Report." The TVA Site Selection Report revision provides clarity in defining the screening process and explains how screening criteria are applied. Exclusionary criteria have been defined and applied to eliminate those areas that are either unsuitable or are significantly less suitable than other potential siting areas. The regional screening process includes safety and security considerations, including proximity to federal direct-served customers, distance to viable water sources, and other related physical features that provide insights into site suitability on an areal basis within the ROI. The exclusionary criteria applied to the regional screening of the ROI are listed in Table 3.1, "Regional Screening Criteria," of the revised TVA Site Selection Report. These screening criteria are consistent with the exclusionary criteria identified in Chapter 3.0 of the *Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Power Generation Facilities* (Siting Guide), June 2015.

   ER Subsection 9.3.1, "The Site Comparison Process," renamed, "Identification of Candidate Areas," Subsection 9.3.2, "General Description of the Preliminary Candidate Areas" renamed, "Identification of Potential Sites," and Subsection 9.3.3, "Candidate

Area Evaluation Process," renamed, "Evaluation of Potential Sites and Identification of Candidate Sites," has been revised to provide a summary of those changes in the TVA Site Selection Report. ER Subsection 9.3.5.1, "Generic Issues for Alternative Sites," and ER Subsection 9.3.6.1, "Safety Criteria," are being deleted.

The revised TVA Site Selection Report, Table 3.1 and associated conforming changes, are contained in Attachment 1. The revised ER Subsections 9.3.1 through 9.3.3 and conforming changes are contained in Attachment 2.

2. *SI AltSit 1a.*

Exclusionary criterion that was derived from two of TVA's project objectives to narrow the ROI to areas in "close proximity" to TVA's six federal customers as preliminary Candidate areas should be defined. Include in this response how TVA has defined "close proximity." Clarify if and where more than one exclusionary criterion was applied during this step in the screening process.

TVA Response

The TVA Site Selection Report has been revised to define the use of "close proximity" as an exclusionary criterion. The TVA Site Selection Report, Appendix A, Section A-1, "Proximity to Customers," states, "Within the ROI, TVA established an exclusionary criterion based on the project objectives associated with (1) assisting federal facilities with meeting carbon reduction objectives, and (2) supplying 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. Areas which allow TVA to accomplish the project objectives are those which are in close proximity (defined as adjacent to and within 0.5 mile) to TVA's six federal direct-served customers. Areas across water bodies from federal customer property (i.e., areas where physical access restrictions for transmission connections to customer property are not practical) were excluded."

The regional screening process applies the exclusionary criteria listed in TVA Site Selection Report, Table 3.1, "Regional Screening Criteria." These criteria include evaluations of (1) federal direct-served customers, (2) seismology/geology, (3) population density and (4) cooling water availability.

3. *SI AltSit 1b.*

The screening criteria that were derived from the ER Section 9.3.1 listed criteria for assessing "preliminary candidate area suitability" should be clearly defined:

- *Sufficient acreage available to incrementally construct two or more SMRs*
- *Proximity to a Federal installation*
- *Proximity to a water source*
- *Proximity to transmission lines*
- *Proximity to existing transportation infrastructure*

These same criteria are not listed in the Siting Study for the evaluation of Candidate Areas. Clarify how, or if, they were applied in the siting study. If they were not applied,

the screening criteria which were used to assess preliminary candidate area suitability should be clarified.

TVA Response

ER Subsection 9.3.1, "The Site Comparison Process," is being revised to eliminate the existing screening criteria associated with the preliminary candidate area suitability evaluation. The revised ER Subsection 9.3.1, now titled, "Identification of Candidate Areas," provides the exclusionary criteria used to eliminate those areas that are either unsuitable or significantly less suitable than other potential siting areas. These criteria are consistent with the exclusionary criteria identified in the Siting Guide.

Section 3.1, "Regional Screening Process," of the TVA Site Selection Report outlines the regional screening process, identifies the direct-served customers, describes the "mapping" process and applies the exclusionary criteria. Table 3.1, "Regional Screening Criteria," of the TVA Site Selection Report, lists the exclusionary criteria. Included in Table 3.1, are details associated with mapping, mapping criteria, effects on candidate area identification and associated data sources. Section 3.2, "Regional Screening Results," of the TVA Site Selection Report, describes the results of applying the process to the ROI, and Section 3.3, "Candidate Area," provides results of the identification of candidate areas.

4. *SI AltSit 1c.*

Define in detail the avoidance screening criteria that were derived from the safety conditions listed in ER Section 9.3.3 for Candidate Area evaluation and clarify how and why these differ from those listed previously in ER section 9.3.1 for the evaluation of Candidate Areas. Listed safety considerations included:

- *Geology/Seismology*
- *Atmospheric Dispersion*
- *Exclusion Area and Low-Population Zone*
- *Population*
- *Emergency Planning*
- *Security Plans*
- *Hydrology*
- *Industrial, Military, and Transportation Facilities*

TVA Response

The text of ER Subsection 9.3.1, "The Site Comparison Process," and text of ER Subsection 9.3.3, "Candidate Area Evaluation Process," are being revised to eliminate the avoidance screening criteria used for the candidate area evaluation process. The avoidance screening criteria derived from the safety conditions, as presented in ER Subsection 9.3.3, are being eliminated. The new ER Subsection 9.3.1, now titled, "Identification of Candidate Areas," provides the exclusionary criteria used to eliminate those areas that are either unsuitable or significantly less suitable than other potential siting areas. These criteria are consistent with the exclusionary criteria identified in the Siting Guide. ER Subsection 9.3.1 refers to Section 3.1, "Regional Screening Process," of the TVA Site Selection Report for the specific details of application of the screening

criteria to the ROI.

5. *SI AltSit 1d.*

Please provide the basis for the scoring of each of the Candidate Areas that resulted from the application of the one to three scaling of each of the criterion provided in the Siting Study Table 3.2-1. As written, the text of the Siting Study Section 3.0 speaks to the characteristics of each Candidate Area without providing the logic between such features and TVA's scoring values. Clarify how the application of scaled avoidance criterion resulted in the elimination of two of the six Candidate Areas. Also clarify the term "exclusionary criteria." The ER texts states that exclusionary criteria such as seismic exceedance were applied, although no such "exclusionary criterion" is listed.

TVA Response

The SMR Final Siting Study, Revision 1, Section 2.2, "Candidate Area Evaluation Process," identified six preliminary Candidate Areas. The six Candidate Areas were evaluated against avoidance screening criteria based on the eight safety considerations provided in NRC Draft Regulatory Guidance DG-41, "General Site Suitability Criteria for Nuclear Power Stations." The preliminary Candidate Areas were evaluated against the avoidance screening criteria, resulting in the elimination of two of the six candidate areas.

The revised regional screening process, based on the Siting Guide, evaluates six potential customer locations and eliminates sites that do not meet one or more of the exclusionary criteria defined in TVA Site Selection Report, Section 3.1, "Regional Screening Process." The regional screening process eliminated four of the six customer locations from further consideration, because they did not meet one or more of the established exclusionary screening criteria.

The text associated with the numerical scoring criteria and the tabular results reflected in Siting Study Table 3.2-1 have been deleted. The revised screening process description is provided in Section 3.1, "Regional Screening Process," of the TVA Site Selection Report. Section 3.1 outlines the regional screening process, identifies the direct-served customers, describes the mapping process and applies the exclusionary criteria. The exclusionary criterion used for the screening process are: (1) federal direct-served customers, (2) seismology/geology, (3) population density, and (4) cooling water availability. The information defined for each of the exclusionary criteria was mapped and displayed on separate maps of the ROI.

The candidate areas determined to remain eligible based on the screening process were reviewed to verify that the areas remaining provide: (1) adequate land area for a reasonable number of potential sites, (2) reasonable diversity in potential sites, in terms of alternative settings within the ROI, and (3) potential sites that are capable of satisfying TVA's business objectives for the project.

The results of the regional screening process are provided in TVA Site Selection Report, Table 3-2, "Regional Screening Results." The regional screening process eliminated four of the six customer locations from further consideration, because they did not meet one or more of the established exclusionary screening criteria. The two remaining candidate areas for consideration are Oak Ridge Reservation and Redstone Arsenal.

6. *SI AltSit 1e.*

Define the ER section 9.3.3.1 exclusionary and avoidance criteria that were applied in a two-step process to identify Preliminary Potential Sites within the four Candidate Areas. The specific ER criteria are listed as:

- *Availability of land*
- *Proximity to a water source*
- *Proximity to sensitive resources such as wetlands and historic sites*
- *Proximity to transmission lines*
- *Proximity to existing transportation infrastructure, and*
- *Obvious topographic concerns*

Additionally Section 4.0 the Siting Study lists a second set of undefined criteria that were applied to Preliminary Potential sites. These include:

- *Presence of wetlands*
- *Known historic sites*
- *Land cover*
- *Existing land uses*

Please define these criteria.

TVA Response

The text of ER Subsection 9.3.3.1, "Process for Identification of Potential Sites," contains exclusionary and avoidance criteria that were applied in a two-step process identifying preliminary potential sites. ER Subsection 9.3.3.1 is being revised to remove the process for evaluating preliminary potential sites. In addition, the TVA Site Selection Report, has been revised to eliminate any criteria associated the preliminary potential site evaluations. The revised ER Subsection 9.3.3, now titled, "Evaluation of Potential Sites and Identification of Candidate Sites," refers to the general siting criteria as provided in the Siting Guide.

TVA Site Selection Report, Section 4.1, "Potential Site Identification Process," has been revised to address the two independent processes for potential site identification. The first evaluation process, "Customer-Identified Sites of Interest," Subsection 4.1.1, discusses Redstone Arsenal (RSA) and Oak Ridge Reservation (ORR) candidate areas where TVA identified potential sites that contain as a minimum, (1) a contiguous area of 120 acres for the SMR site, preferably in a square configuration, and capable of accommodating a reactor block with sides of 0.4 miles in length; (2) are consistent with TVA's objectives for the project, as described in Section 9.3; and (3) are consistent with land use plans and other requirements associated with existing missions and activities. TVA also identified potential sites that are TVA-owned property adjacent to the candidate areas. TVA consulted RSA and ORR for their independent review of the selected sites. RSA and ORR provided input on sites that should be and should not be considered.

The second phase of the potential site identification process is addressed in Subsection 4.1.2, "Candidate Area Canvassing," of the TVA Site Selection Report. RSA and ORR were canvassed to identify additional potential sites. These potential sites allowed for more comprehensive characterization of siting tradeoffs within the ROI, as well as providing further assurance that the process identified the best sites from an environmental perspective that could reasonably be identified within the ROI. Identification of potential sites through canvassing was conducted as a qualitative process, applying best judgment regarding which land areas could be favorable for nuclear power plant development. The canvassing process utilized satellite imagery of the areas and topographic maps to identify areas for potential sites and to clarify and optimize locations identified from satellite imagery.

7. *SI AltSit 1f.*

Provide sufficient information for each Preliminary Potential Site that was eliminated so that the rational provided in Siting Study Table 4.0-1 for elimination of Preliminary Potential Sites can be independently confirmed. The Siting Study merely lists the undefined screening criteria and provides a table of results without identifying the characteristics of each site for each criterion. For example, since no sites were eliminated for the presence of wetlands or historic sites, does such imply that there are no such features present? Additionally, ORR site 1, and Redstone 16, 17, 18, and 19, and Columbus 24 were eliminated based on potential problems that might result from flooding. But no flooding criterion is listed in the ER or the Siting Study for the evaluation of Preliminary Potential Sites and mapping of flood zones for these sites is not provided.

TVA Response

The Potential Site screening process has been updated in the TVA Site Selection Report. The Site Selection Report no longer has a separate step to eliminate identified potential sites. The TVA Site Selection Report, Section 5.1, "Evaluation of Potential Sites," discusses the overall process for the evaluation of the 15 potential sites. The process includes developing criterion ratings for each site, developing a weighting factor that reflects the overall importance of each criterion, and developing a composite site suitability rating.

Each potential site was assigned a rating for each general siting criterion. The general site criteria, as described in Appendix C, "Technical Basis for General Site Criteria Evaluations," of the TVA Site Selection Report were derived from the Siting Guide. Appendix C provides a description of each criterion, the objective of the site suitability criterion being measured, the evaluation approach, a discussion of the data collected for each site and the ratings /rational used in determining the result of the evaluation.

Weight factors reflecting the relative importance of each criterion were developed by a multi-disciplinary committee in the areas of nuclear power plant site suitability. This committee was composed of subject matter experts in geology/geotechnical/seismic, hydrology, ecology & wetlands, land use/zoning, transmission, socioeconomics, engineering, and public/institutional relations.

The composite suitability rating reflects the overall suitability of each site. The composite suitability ratings were developed by multiplying criterion ratings by the criterion weight factors and summing the overall criteria scoring for each site.

The composite rating for the potential site evaluations are shown in Table 5-1, "General Site Criteria Evaluation Results," of the TVA Site Selection Report.

8. *SI AltSit 2.*

The process for evaluation of Potential Sites includes for most criteria multiple bulleted "sub-criteria" which assess various aspects of the sites. Please explain why these sub-criteria were combined rather than scored separately. Also please explain how a site was scored if the scoring for the multiple sub-criteria had differing scoring values. Taking Hydrology as an example –a site could have no flood issues (score of 5), insufficient water (score of 1), but water of outstanding quality (score of 4 or 5). In such a case, what would be the score for Hydrology? Please also address why each sub-criterion element was not characterized and scored for each Potential Site. For example, distance from viable water is a sub-criterion of Hydrology, less than 1 mi to greater than 3 mi, however some Potential Site descriptions do not characterize or score the distance from the water sources.

Additionally, some sub-criteria use qualitative terms such as small, moderate, or large, or marginally adequate vs adequate, instead of quantitative terms such a less than 1 mi or greater than 3 mi. Please provide the basis for such distinctions for evaluating the sites. For example, is a large potential for flooding 1 in 100 years, and moderate 1 in 500 years and a small potential 1 in 1000 years?

TVA Response

TVA has revised the preliminary potential site evaluation scoring process. The previous scoring process of combining "bulleted" or "sub criteria" has been eliminated. The site evaluation criteria, as identified in the Siting Guide, have been scored separately. Each potential site was assigned a rating for each general siting criterion. The general site criteria are described in Appendix C, "Technical Basis for General Site Criteria Evaluations," of the TVA Site Selection Report. Appendix C, provides a description of each criterion, the objective of the site suitability criterion being measured, the evaluation approach, a discussion of the data collected for each site and the ratings /rational used in determining the result of the evaluation. The composite rating for the potential site evaluations are shown in Table 5-1, "General Site Criteria Evaluation Results," of the TVA Site Selection Report.

9. *SI AltSit 3.*

Some "scored" criteria used in evaluating the Potential Sites had been used previously as exclusionary criteria in identifying the Preliminary Potential Sites. For example:

- *In the Siting Study Table 4.0-1, sites were eliminated for having less than 120 available acres, yet such a condition in a Potential Site is scored a "1" under Land Use for "insufficient total area available for siting the project". Please clarify why, if the exclusionary criterion of 120 acres was applied universally during the screening of Preliminary Potential Sites, there could be any Potential Sites without sufficient area for the project?*

TVA Response to SI AltSit 4a.

ER Section 9.3 is being revised to provide additional quantitative information supporting the alternative sites impact evaluations regarding Environmental Criteria, Land Use, Water Use, Terrestrial Ecology and Socioeconomics. Specifically, the following ER subsections are being revised to reflect the incorporation of additional quantitative information:

The text of ER Subsection 9.3.5.2, "Environmental Criteria," and Subsection 9.3.5.2.1, "Land Use," are being revised and renumbered to 9.3.4.1 and 9.3.4.1.1, respectively. ER Subsection 9.3.4.1 is being revised to include more detailed figures (Figures 9.3-23 through 9.3-25 are being renumbered to Figures 9.3-6 through 9.3-8) to show the proposed power block, transmission lines, and intake and discharge locations for the three Alternative Sites.

Land use, land coverage and the associated acreages impacted during the preconstruction and construction of the proposed power block, transmission lines, and intake and discharge locations have been incorporated in ER Subsection 9.3.4.1.1. New Tables 9.3-2 through 9.3-4 show the total land use/land cover on each of these alternative sites and the land use/land cover that would be affected by the specific site features including roads (where new roads are required), pipelines, and transmission lines (where transmission lines occur offsite). The text of this subsection is also being revised to incorporate total land use acreages.

ER Subsection 9.3.5.2.2, "Water Use and Quality," renumbered to 9.3.4.1.2, is being revised to incorporate the land cover information provided in Tables 9.3-2 through 9.3-4. Quantitative data is being provided to support the associated impact conclusions.

ER Subsection 9.3.5.2.3, "Terrestrial Ecology," renumbered to 9.3.4.1.3, is being revised to incorporate the land cover classifications and the associated acreages impacted during the preconstruction and construction of the proposed power block, transmission lines, and intake and discharge locations. New Tables 9.3-2 through 9.3-4 show the total land use/land cover (including streams and open waters) on each of these sites and the land use/land cover that would be affected by the specific site features including roads (where new roads are required), pipelines, and transmission lines (where transmission lines occur offsite).

ER Subsection 9.3.5.2.4, "Aquatic Ecology," renumbered to 9.3.4.1.4, is being revised to discuss the impacts on aquatic ecology from preconstruction and construction which 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.

Socioeconomics provided in ER Subsection 9.3.5.2.5, renumbered to 9.3.4.1.5 is being revised to add quantitative information regarding economy and tax revenues.

11. *SI AltSit 4b.*

The introductory text for cumulative impacts indicates that the cumulative impacts for CRN and the two ORR alternative sites would all be the same because they're located

- *Also in the Siting Study Table 4.0-1, Preliminary Potential Sites were eliminated because of flooding concerns. However, such a condition is only a score of 1 for screening the Potential Sites. Why, if an exclusionary criterion of flooding potential was applied universally during the screening of Preliminary Potential Sites, could there be any Potential Sites with flooding potential?*

TVA Response

The TVA Site Selection Report has been revised to eliminate the preliminary potential site evaluation and provide a revised description of the process used to perform Candidate Area exclusionary evaluations. The revised evaluation process ensures that conflicts between the Candidate Areas exclusionary evaluations and Potential Site identification scoring evaluations are eliminated.

The regional screening process, as described in Section 3.1 of the TVA Site Selection Report, uses exclusionary criteria to eliminate those areas that are either unsuitable or are significantly less suitable than other potential siting areas. The regional screening process considers safety and security, including proximity to federal direct-served customers, distance to viable water sources, and other related physical features that provide insights into site suitability within the ROI. The regional screening process applies the exclusionary criteria listed in Table 3.1, "Regional Screening Criteria," of the revised TVA Site Selection Report.

The TVA Site Selection Report, Section 5.1, "Evaluation of Potential Sites," discusses the overall process for the evaluation of the 15 potential sites. The process includes developing criteria ratings for each site, developing a weighting factor that reflects the overall importance of each criterion, and developing a composite site suitability rating. Each potential site was assigned a criterion rating for each general siting criterion. The general site criteria, as described in Appendix C, "Technical Basis for General Site Criteria Evaluations," of the TVA Site Selection Report were derived from the EPRI Siting Guide. Appendix C, provides a description of each criterion, the objective of the site suitability being measured, the evaluation approach, a discussion of the data collected for each site and the ratings /rational used in determining the result of the evaluation. The composite rating for the potential site evaluations are shown in Table 5-1, "General Site Criteria Evaluation Results," of the TVA Site Selection Report.

10. *SI AltSit 4a.*

The cumulative impacts evaluations for the alternative sites in the ER are presented based on an almost exclusively qualitative basis. Very little data is used to back up the assertions and conclusions. For example, there is no quantitative information provided that summarizes and compares the environmental impacts (wetlands, floodplains, streams, sensitive land uses) of the candidate sites. There should be quantification (using reconnaissance level information) of impacts to resources such as aquatic ecology (i.e., streams, open waters) based on conceptual site boundaries, plant footprints (e.g., amount of dredging required for water intake/discharge facilities and barge docking facilities). As another example, there should be quantification of land use and terrestrial impacts that includes corridors for linear facilities (access roads, rail spur, water pipeline routes, transmission line corridor to nearest substation). Please provide a quantitative cumulative impact information commensurate with the level of knowledge and analyses for an alternative site.

close together. But Table 9.3-2 indicates that the impacts of the project at the ORR 2 and 8 sites to, for example, Terrestrial Ecology are MODERATE, while the cumulative impacts are shown as SMALL. First, such a result doesn't make sense as a whole. The cumulative impacts cannot be less than the project's incremental impacts. There are similar issues related to cumulative impacts for land use, water use and quality, and aquatic, and historic and cultural. Second, there doesn't appear to be a basis to say all of these sites will have the same cumulative impacts. Please justify any assumptions regarding the equivalency of the cumulative impacts across the sites.

TVA Response to SI AltSit 4b.

ER Subsection 9.3.5.3, "Cumulative Impacts," is being renumbered to 9.3.4.2. The introductory text to cumulative impacts states, "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 associated with these sites would also be the same for each of the three ORR sites." The basis for this assumption was that ORR Site 2 is adjacent to the CRN Site and ORR Site 8 is less than 3 miles from the CRN Site. Because the past, present, and future projects within the geographic area of interest are the same for all three sites, the cumulative impacts (not including the incremental contribution of the SMR Project) of those projects would also be the same. Furthermore, because most of the resource areas evaluated would have similar impacts for ORR Sites 2 and 8 as for the CRN Site, the SMR Project's incremental contribution to cumulative impacts would be the same.

However, project specific impacts from preconstruction, construction, and operation for land use and terrestrial ecology at ORR Sites 2 and/or 8 could result in an impact evaluation that is different from the impacts for the CRN Site. In addition, based on the physical location of the CRN Site and ORR Sites 2 and 8, site-specific surface water use impacts could also vary. TVA evaluated the incremental contribution of the SMR Project to cumulative impacts for land use, water use, and terrestrial resources at ORR Sites 2 and 8, and concluded that although there are some site differences, the differences are not substantial enough to alter the overall incremental contribution to cumulative impacts for the larger geographic area of interest.

The introduction to ER Subsection 9.3.4.2, "Cumulative Impacts," is being revised to clarify that the specific differences between the ORR sites are not significant enough to alter the overall impact to the geographical area of interest. In addition, the basis for this conclusion and the supporting information is being included in the revised ER Subsections 9.3.4.2.1, "Cumulative Land Use Impacts," 9.3.4.2.2, "Cumulative Water Use Impacts," and 9.3.4.2.3, "Cumulative Ecological Impacts." ER Table 9.3-6, is being renumbered to ER Table 9.3-7. ER Table 9.3-7, "Summary of Potential Cumulative Impacts of Construction and Operation to Environmental and Socioeconomic Criteria by Site," is being revised to clearly indicate the overall cumulative impacts of past, present, and future actions, and the SMR project's incremental contribution to the overall cumulative impact is provided in a separate column.

12. SI AltSit 4c.

Another issue related to cumulative impacts is the discussion of multiple cumulative impacts for the same resource. For example, for surface water use there is a discussion of the "cumulative impacts" for Limestone County. But cumulative impacts relate to a resource (water) and not to a County. Please address cumulative impacts for each affected resource in terms of a single impact determination for the resource as a whole.

TVA Response to SI AltSit 4c.

ER Subsection 9.3.5.3.2, "Cumulative Water Use Impacts," is being revised and renumbered to 9.3.4.2.2. Subsection 9.3.5.3.2 referred to the geographic area of interest as being the five county area surrounding Redstone Arsenal Site 12. However, the subsection did not provide any justification for that determination.

ER Subsection 9.3.4.2.2 is being revised to state that the geographic area of interest is the drainage basin of Wheeler Reservoir, which encompasses the six county area surrounding Redstone Arsenal. TVA reviewed the remainder of ER Subsection 9.3.4 and confirmed that the cumulative impacts for each affected resource are presented as a single impact determination for the resource as a whole.

13. *SI AltSit 5.*

Proximity to wetlands was listed as a criterion for the evaluation of Preliminary Potential Sites, although it was not discussed at all under the Preliminary Potential Site evaluations in Section 4 of the Siting Study. Please address such an omission and clarify under what criterion wetland avoidance was assessed for the Potential Sites. If a plant is eventually licensed, the U.S. Army Corps of Engineers will require that wetlands be avoided if at all possible. Thus wetland avoidance is a key consideration in the screening process.

TVA Response

The TVA Site Selection Report has been revised to clearly establish the criterion for the evaluation of the proximity to wetlands. Subsection C.2.2.3, "Disruption of Wetlands," establishes the criterion to evaluate the Preliminary Potential Sites with respect to potential construction-related impacts on wetlands. Wetland avoidance is evaluated as a measure of acres of wetlands impacted compared to total site acreage, identification of high quality wetlands within the site boundary, and the flexibility to avoid wetlands during construction related activities. Subsection C.2.2.4, "Dewatering Effects on Adjacent Wetlands," establishes the criterion to evaluate the potential impacts from construction related dewatering activities on area wetlands. This evaluation includes the review of the depth of water table and distance to nearby wetlands. The composite rating for the potential site wetland evaluations are shown in Table 5-1, "General Site Criteria Evaluation Results," of the TVA Site Selection Report.

14. *SI AltSit 6.*

The basis for the selection of the Clinch River site is unclear. The first bullet in Section 9.3.6 of the ER states that none of the alternative sites is environmentally preferable. But there is no clear comparison of the sites in the ER. Table 9.3-6 presents what are referred to as "incremental cumulative impacts," an undefined term that the staff does

not recognize, especially because cumulative impacts are, by definition, not incremental. Please explain the contents of this table, including a discussion of why a plain reading of this table would indicate that the Redstone 12 site is environmentally preferable to the proposed site. In addition, provide the staff with a table and text that compares the cumulative impacts at the proposed and alternative sites and provides a basis for the selection of the proposed site.

TVA Response to SI AltSit 6.

The text of ER Subsection 9.3.6, "Conclusions," is being replaced and renumbered. ER Subsection 9.3.5, "Conclusions," now discusses the basis for the determination of the preferred site for the SMR Project.

To determine the preferred site for the SMR Project, TVA evaluated the CRN Site and three Alternative Sites to determine if any site would be environmental preferable or obviously superior. ER Section 9.3 provides two levels of comparison of the Alternative Sites, Environmental Criteria and Cumulative Impacts.

ER Subsection 9.3.4.1, "Environmental Criteria," provides a comparison of the CRN and Alternative Sites specific project impacts. ER Table 9.3-2 is being renumbered to ER Table 9.3-1.The impact conclusions, for Alternative Site comparison, are provided in Table 9.3-1, "Summary of Preconstruction, Construction, and Operation Impact Evaluations for Environmental and Socioeconomic Criteria."

ER Subsection 9.3.4.2, "Cumulative Impacts," provides a comparison of the cumulative impacts of the SMR Project at the Alternative Sites. ER Table 9.3-6 is being renumbered to ER Table 9.3-7. The impact conclusions, for Alternative Site comparison, are provided in Table 9.3-7, "Summary of Potential Cumulative Impacts of Construction and Operation to Environmental and Socioeconomic Criteria by Site." ER Table 9.3-7 is being revised to include the cumulative impacts of past, present and foreseeable future actions on the applicable geographic area of interest. The SMR project's incremental contribution to the overall cumulative impact is provided in a separate column to provide an additional level of detail. The previous terminology "incremental cumulative impact" is being replaced by, "Incremental Contribution of the SMR Project to Cumulative Impacts." Based on the close proximity of the CRN Site to ORR Sites 2 and 8, TVA determined that the overall cumulative impacts as well as the site-specific incremental contributions to the cumulative impacts, associated with SMR Project, were equivalent. Therefore, the three sites are presented together in Table 9.3-7.

As shown on revised Table 9.3-7, Redstone Arsenal Site 12 is not the environmentally preferable site. The conclusion is based on the overall equivalency of the resource area evaluations with the exception of terrestrial ecology and economy and tax revenue. For the terrestrial ecology evaluation at Redstone Arsenal Site 12, the incremental contribution from the SMR Project to the cumulative impacts at Redstone Arsenal Site 12 would be greater than at the ORR Sites, based on the long-term changes in a sensitive habitat within the Wheeler Natural Wildlife Refuge.

For economy and tax revenue evaluation, the contribution of the SMR Project to the overall geographic area of interest would be primarily beneficial at each of the four sites. TVA's tax equivalent payment associated with the SMR Project would be the same at the state level. Although the two states distribute tax equivalent payments differently,

resulting in variations in beneficial impacts at the county level, TVA determined that this was not a discriminating factor in site selection.

TVA determined, based on a detailed environmental review of the four sites that, none of the sites were environmentally preferable and none of the Alternative Sites are obviously superior to the CRN Site. Therefore, TVA applied business considerations to conclude that the CRN Site was the preferred site for the SMR Project.

References:

1. Letter from TVA to NRC, CNL-16-081, "Application for Early Site Permit for Clinch River Nuclear Site," dated May 12, 2016

2. Letter from TVA to NRC, CNL-16-112, "Submittal of Siting Study in Support of Early Site Permit Application for Clinch River Site," dated July 6, 2016

3. Letter from TVA to NRC, CNL-16-134, "Schedule for Submittal of Supplemental Information in Support of Early Site Permit Application for Clinch River Nuclear Site," dated August 11, 2016

4. NRC Presentation to TVA, "Discussions Related to TVA's Planned Submittal of Information to its Supplement May 12, 2016 Early Site Permit Application," public meeting held on September 15, 2016 (ML16252A182)

Attachments:

1. Tennessee Valley Authority Site Selection Report, Revision 2.
2. Clinch River Nuclear Early Site Permit Application, Part 3, Environmental Report, Section 9.3, "Alternative Sites"

ATTACHMENT 1

Tennessee Valley Authority Site Selection Report, Revision 2

L98 161205 001

Tennessee Valley Authority
Site Selection Report

ACCEPTED FOR USE (AU)	
JMH	12/5/2016
INITIALS	Date
PROJECT	Clinch River SMR
DISCIPLINE	NA
CONTRACT	PO 2371167
UNIT #	NA
COMMENTS:	
Report NA Rev 2	
November 30, 2016	

November 2016

Revision 2

Prepared by McCallum-Turner
for TVA with
contributions from AECOM

Tennessee Valley Authority
Site Selection Report

November 2016

Table of Contents

List of Tables

Table **Page**

List of Figures

Figure **Page**

1. Background and Approach

Tennessee Valley Authority (TVA) is submitting an Early Site Permit (ESP) application to resolve site suitability issues for a new nuclear power plant site and to obtain site approval from the Nuclear Regulatory Commission (NRC). An early step in the process for developing the application is selection of a site that will provide the geographic setting for the application. This Site Selection Report provides a description of the bases, assumptions, and processes applied to identify the candidate sites for detailed analysis and selection of the proposed site. It utilizes information from previously completed siting analyses, as feasible, consistent with TVA's business objectives (see Section 1.2 below).

1.1 Site Selection Process

The overall objective of the siting process is to identify a nuclear power plant site that:

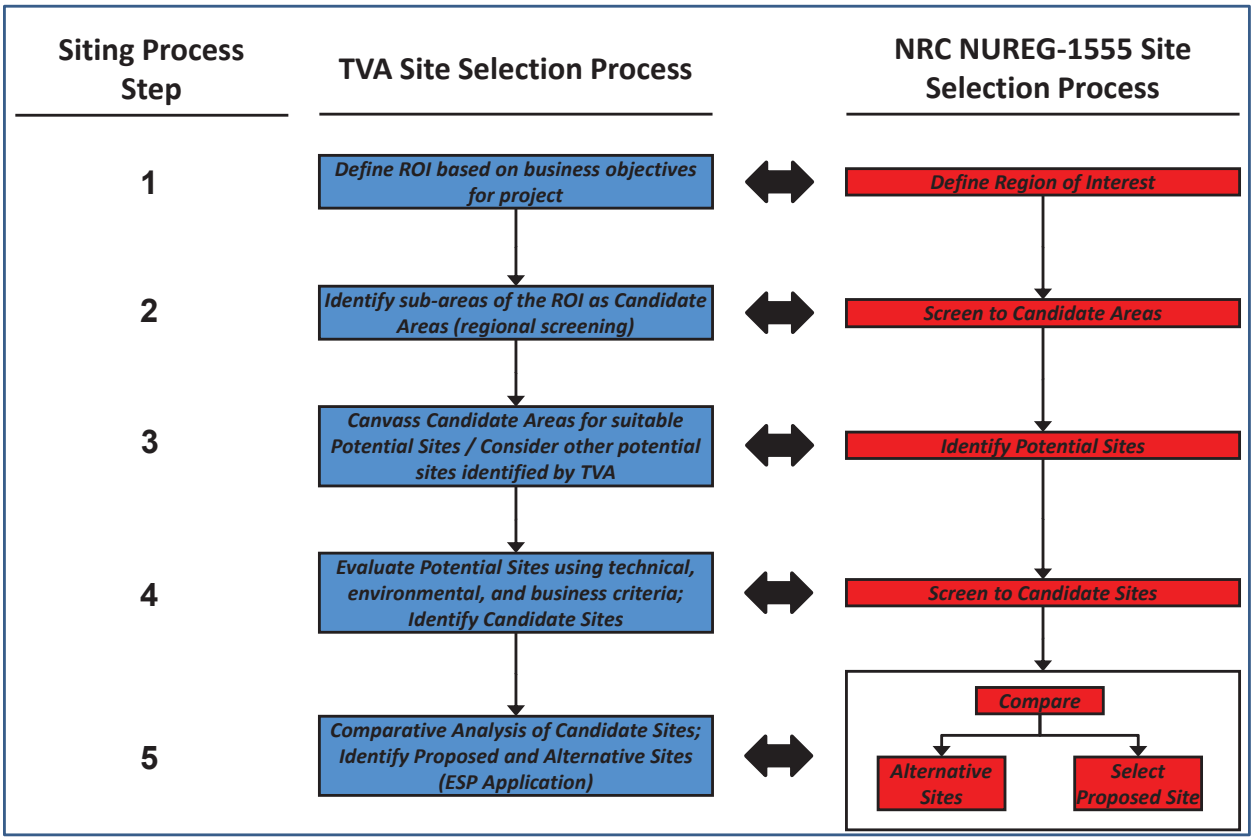
1. meets TVA's business objectives for the project,
2. satisfies applicable Nuclear Regulatory Commission (NRC) site suitability requirements, and
3. is compliant with NRC's implementation guidance for National Environmental Policy Act (NEPA) requirements regarding the consideration of alternative sites.

Site selection was conducted in accordance with the overall process outlined in the *Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Power Generation Facilities* (EPRI Siting Guide), June 2015, Report 3002005435 (EPRI 2015). This process, as adapted for the TVA site selection study, and its correlation with NRC's site selection process as defined in NUREG-1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan*, Revision 1, July 2007 (NRC 2007) is depicted in Figure 1–1. TVA Site Selection Process.

The region of interest (ROI) is defined in Section 2.0. The siting process began with a regional screening process, using geographic information systems (GIS) analyses to eliminate areas unsuitable for Small Modular Reactor (SMR) siting and to identify suitable candidate areas. Potential sites were then identified within the candidate areas, as described in Section 3.0. The potential sites were evaluated against criteria from the EPRI Siting Guide, resulting in identification of candidate sites, from which the proposed and alternate sites were selected.

The site selection study was conducted under strict confidentiality. Investigations conducted as part of the site selection process were executed using existing reconnaissance-level data, available in the public domain or in TVA files; no project-specific data collection contacts were made with data sources or regulatory agencies without the prior approval of TVA.

Figure 1–1. TVA Site Selection Process



1.2 Business Objectives

As authorized by the Tennessee Valley Authority Act, TVA is committed to maintaining a national leadership role in technological innovation (Tennessee Valley Authority Act 1933). TVA and the U.S. Department of Energy (DOE), through a Memorandum of Understanding (MOU), are working together to explore various options under which TVA could license, construct, operate, and maintain two or more small modular reactor (SMR) units to demonstrate the capability of SMR technology (Memorandum of Understanding: Construction of Small Modular Nuclear Reactors and Power Supply Arrangements). The SMR units could be used to help meet electric power needs and help meet federal agency greenhouse gas (GHG) emission reduction goals established by Executive Order (EO) 13514 (Obama, Barack, 2009).

In addition, in 2013, President Barack Obama issued EO 13636 on *Improving Critical Infrastructure Cybersecurity* and *Presidential Policy Directive (PPD) 21* on *Critical Infrastructure Security and Resilience* (Obama, Barack, 2013). 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, *Planning for Federal Sustainability in the Next Decade*, was issued (Obama, Barack, 2015). EO 13693 specifically addresses the reduction of greenhouse gas emissions and alternative energy sources, such as SMRs. 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 nuclear power generation facilities and transmission systems.

TVA proposes to deploy two or more SMRs, with a maximum total electrical output up to 800 megawatt electric (MWe) for the site, to demonstrate the capability of SMR technology. An SMR is a nuclear unit with an electrical output no more than 300 megawatts (MW), which is considerably less than the electrical output of approximately 1,000 MW provided by a typical commercial reactor in the United States. The SMRs are factory-built and shipped to the plant site; therefore, less onsite construction is required for SMR installation than for installation of a typical commercial reactor. The four SMR designs under consideration feature advanced passive safety systems. Operating cycles can be longer for SMRs than for TVA's currently operating nuclear reactors. SMRs may provide the benefits of nuclear-generated power in situations where large nuclear units are not practical because of transmission system constraints, limited space or water availability, or available capital for construction and operation.

TVA's business objectives for the project include the following:

- SMR technology enhances nuclear safety and security.
- Multiple units can be deployed incrementally to efficiently meet demand.
- SMR technology can assist federal facilities with meeting carbon reduction objectives.
- SMR technology is capable of supplying 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 nuclear power generation facilities and transmission systems.

A significant implication of the fourth objective 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.

2. Region of Interest and Siting Requirements

2.1 Region of Interest

The TVA Power Service Area was identified as the project Region of Interest (ROI) as TVA is limited to providing power to the service area as defined in the Tennessee Valley Authority Act 1933; the ROI is depicted in Figure 2–1. Figure 2–1 also depicts the existing federal TVA customers to potentially be served noted in the business objectives stated in Section 1.2 and detailed in Section A.1.

2.2 Parameter Siting Requirements

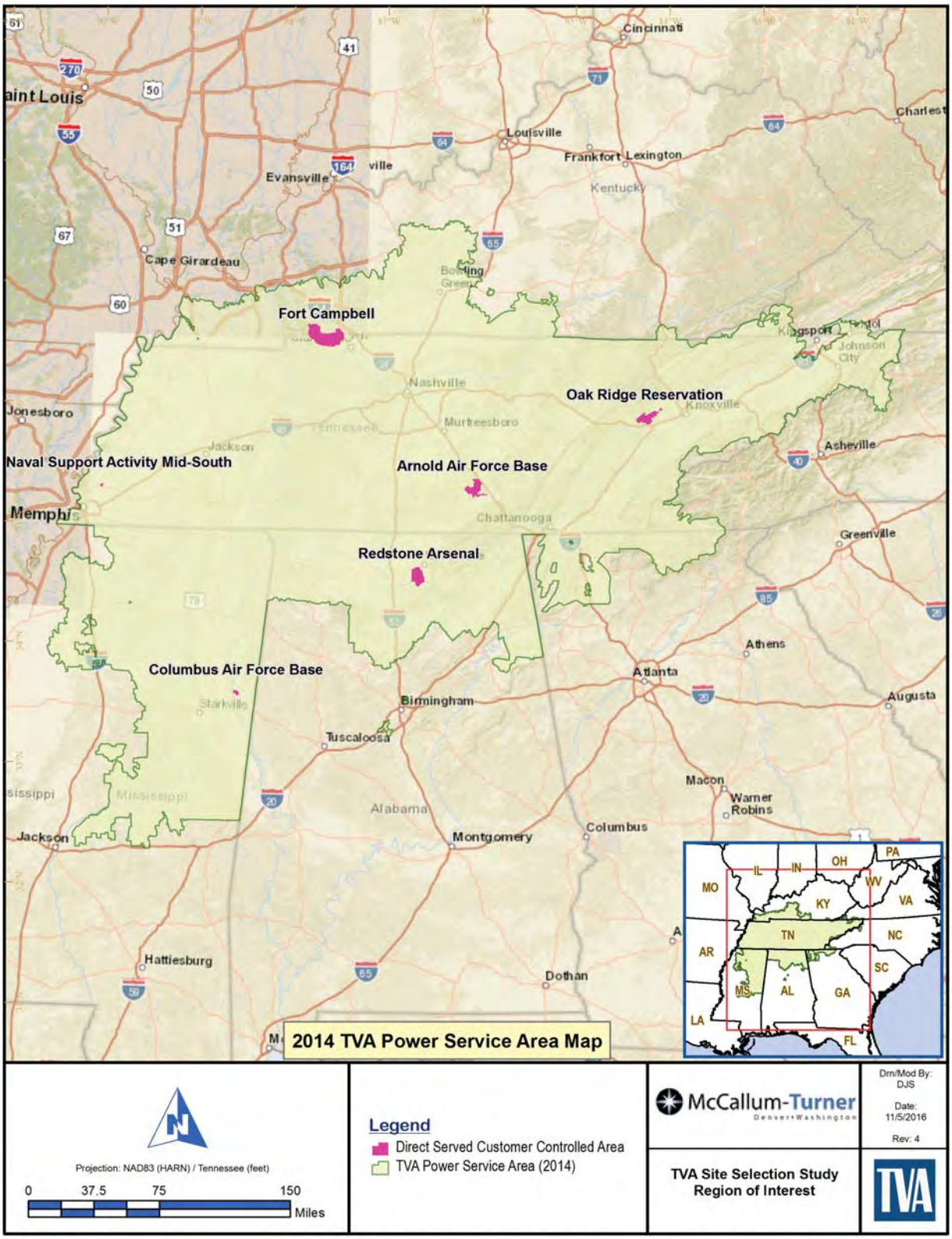
Because TVA has not yet selected an SMR reactor technology, the site selection analysis was conducted based on a bounding plant parameter envelope (PPE) approach. PPE values selected for the TVA siting study were established to bound the range of site requirements for candidate reactor technologies likely to be ultimately considered by TVA for possible development at the selected site.

A summary of the PPE values used in the TVA site selection study is provided in Table 2-1. It is noted that the PPE values listed in Table 2-1 do not cover the entire spectrum of site-related plant parameters; however, they do address the key site characteristics that are necessary to ensure site suitability for a nuclear power plant and to evaluate important trade-offs between site alternatives.

Table 2-1. PPE Values Used in Site Selection Analyses

Plant Parameter	Value
Safe Shutdown Earthquake (SSE) peak ground acceleration (PGA) based on 2% in 50 year probability	< 0.5g
Plant Water Intake	30,708 gallons per minute (gpm) (68.4 cfs) for 800 MWe plant assumed.
Land Availability	Contiguous area of 120-acres for SMR site preferably in a square configuration. Site must be able to accommodate a reactor block with sides of 0.4 miles in length.

Figure 2–1. Region of Interest with 6 Federal Direct-Served Customers



3. Regional Screening

Section 3.1 outlines the regional screening process. Section 3.2 describes the results of applying the process to the ROI, and Section 3.3 provides results of the identification of candidate areas.

3.1 Regional Screening Process

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. The regional screening process includes safety and security considerations including proximity to federal direct-served customers, distance to viable water sources, and other related physical features that provide insights into site suitability on an areal basis within the ROI. Such considerations are consistent with the exclusionary and avoidance criteria identified in the EPRI Siting Guide.

Direct-served customers are those customers that purchase their power directly from TVA instead of through a third party power distributor. Federal direct-served customers are listed below for the fiscal year 2014:

1. Oak Ridge Reservation
2. Redstone Arsenal
3. Arnold Air Force Base
4. Fort Campbell
5. Naval Support Activity Mid-South
6. Columbus Air Force Base

The exclusionary criteria applied in the regional screening of the ROI are listed in Table 3-1. Additional information provided in Table 3-1 includes:

- Identification of data to be mapped
- Mapping criteria that define how suitability was determined based on mapped data
- Effect on Candidate Area Identification (i.e., identification of areas excluded from further study)
- Sources for identification and location of data to be mapped
- Comments and rationale for the application of mapped data in determining site suitability

Information defined for each of the exclusionary criteria was mapped and displayed on separate maps of the ROI. These maps were then combined using a simple overlaying technique to produce a composite favorability map; Figure 3–1 provides a conceptual depiction of this process. The individual and composite regional screening maps are included in Appendix A.

Areas that are determined to remain eligible based on the screening process described above were reviewed to verify that the site areas remaining provide:

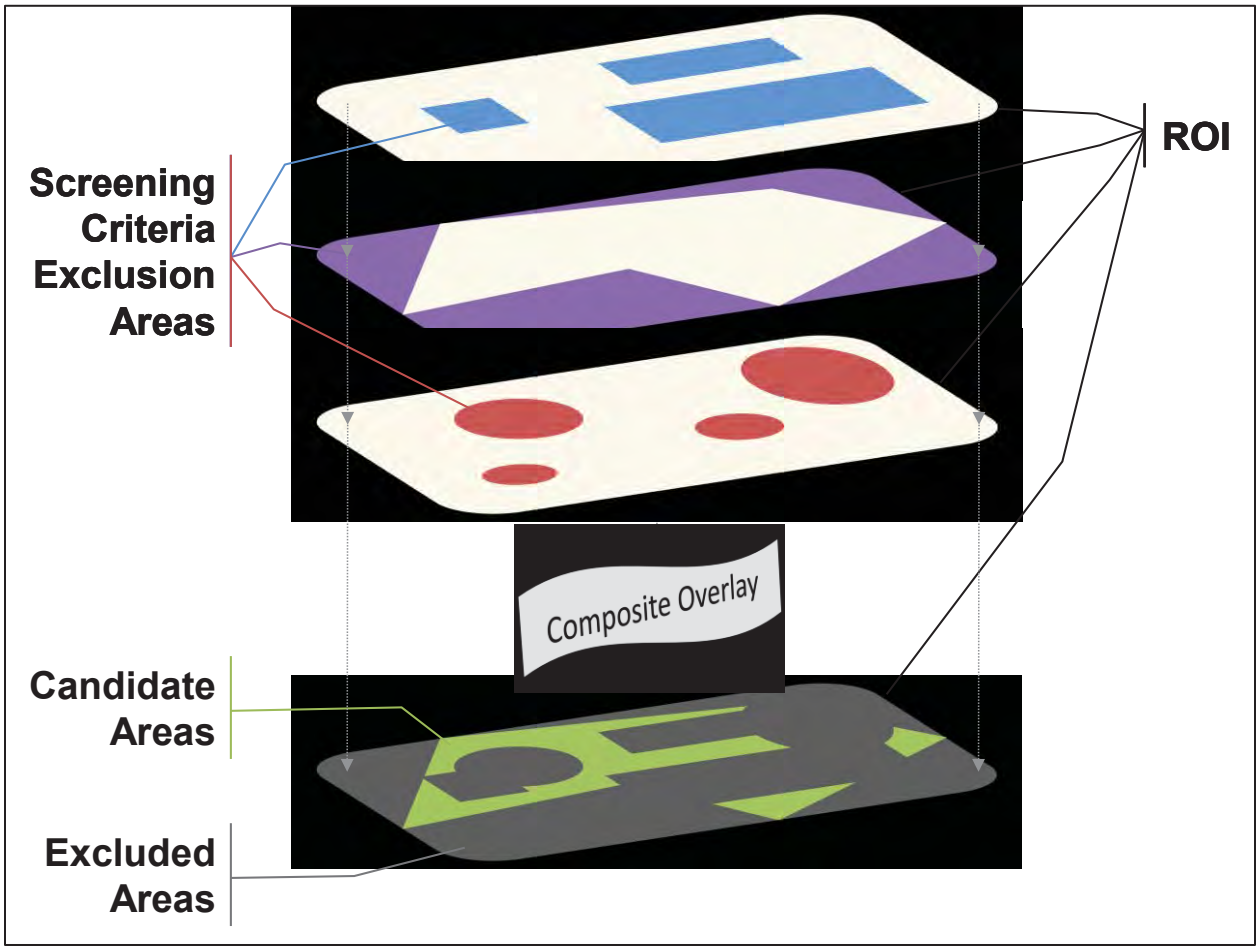
- Adequate land area for a reasonable number of potential sites.
- Reasonable diversity in potential sites, in terms of alternative settings within the ROI.
- Potential sites that are capable of satisfying TVA's business objectives for the project.

Table 3-1. Regional Screening Criteria

Criterion	Mapped Data	Mapping Criteria	Effect on Candidate Area Identification	Data Source(s)	Comments/Rationale
Federal Direct-Served Customers	Geographic area of identified potential federal direct-served customers.	Federal direct-served customers that purchase their power directly from TVA.	Excluded areas greater than 0.5 miles outside of identified federal direct-served customers.	National Map of the U.S., 2014.	TVA business objective to supply secure power to federal loads requires plant site to be contiguous with customer site, such that the entire transmission connection is on land controlled by either TVA or the customer. For these reasons sites greater than 0.5 mile outside of identified federal installations and/or across water bodies from federal customer property (i.e., sites where physical access restrictions for transmission connections to customer property are not practical) were excluded.
Seismology/ Geology	Peak Ground Acceleration (PGA)	PGA < 0.5 gravity (g)	Excluded areas with PGA ≥ 0.5g	USGS National Seismic Hazard Maps, 2014.	Areas with PGA ≥ 0.5g are more likely to require a site-specific reactor design.
	Faults	Locations of Quaternary faults and fault sources	Excluded areas within 5 miles of Quaternary faults and fault sources	USGS/AGS Quaternary Faults, 2010. USGS National Seismic Hazard Maps, 2014.	
	Volcanic Activity	Locations of known volcanic centers	Excluded areas within 5 miles of known volcanic centers	USGS Volcano Hazards Program	
Population Density	U.S. Census Bureau Block Groups	Block Groups > 300 persons/mi^2 (psm)	Excluded census blocks with population density > 300 psm	USCB, 2010.	Areas with a population density > 300 psm likely have multiple imbedded areas with a population density > 500 psm (NRC 1998). Siting outside of these areas would more likely result in a population density less than the NRC guideline of 500 psm within a 20-mile radius of a site. Portions of candidate areas with Census Block Groups > 300 psm were excluded.

Criterion	Mapped Data	Mapping Criteria	Effect on Candidate Area Identification	Data Source(s)	Comments/Rationale
Cooling Water Availability	Water sources (major rivers, existing reservoirs, Wastewater Treatment Plant (WWTP) effluent.	River reaches for which the source water annual flow > 20 times the plant water intake.	Excluded areas requiring unsecured cooling water supply systems (pipelines) greater than 0.5 miles.	USGS records	Rivers for which more than 5% of the average flow will be required for plant water intake may present permitting or operational water supply problems. Thus the source water body must be capable of providing 1,300 cfs (~20 x plant water intake requirement of 68.4 cfs). A reconnaissance level search was performed for adequate ground water sources and no viable sources were identified. Generally groundwater supplies in the mid-South cannot reliably support the cooling water demands for power production. Subsequently, groundwater is not considered and surface water is the preferred source of plant water intake supply. To provide secure power, plant water intake system components (intake structure and pipeline) must be controlled by TVA. Acquisition and control of cooling water pipeline corridors (i.e., not on the plant site or on federal customer property) longer than 0.5 mile was judged to be impractical due to operational, logistical, security and cost challenges. Plant water intake requirements are documented in Table 2-1 PPE value.

Figure 3–1. Conceptual Depiction of ROI Screening Process



3.2 Regional Screening Results

The individual and composite regional screening maps are included in Appendix A. Federal direct-served customer area descriptions are included in Appendix D. Status of each federal direct-served customer with regard to key screening criteria is provided in Table 3-2.

Table 3-2. Regional Screening Results

Federal Direct-Served Customer	Regional Screening Characterization	Results
Oak Ridge Reservation	PGA < 0.5g Adjacent to Census Block Groups > 300 psm (northeast) Adjacent to the Clinch River, which has average flow at nearby gaging station MORE THAN 1,300 cfs	Several off-site areas for canvassing potential sites identified. (Candidate Area 1)
Redstone Arsenal	PGA < 0.5g Adjacent to Census Block Groups > 300 psm Adjacent to the Tennessee River, which has average flow at nearby gaging station MORE THAN 1,300 cfs	Several off-site areas for canvassing potential sites identified. (Candidate Area 2)

Federal Direct-Served Customer	Regional Screening Characterization	Results
Columbus Air Force Base (Area Excluded – Cooling Water Availability)	PGA < 0.5g Not adjacent to Census Block Groups > 300 psm (north and west) Adjacent to the Buttahatchee River which has average flow for each month at nearby gaging station LESS THAN 1,300 cfs	Deferred from further consideration due to inadequate cooling water availability.
Arnold Air Force Base (Area Excluded – Cooling Water Availability)	PGA < 0.5g Adjacent to Census Block Groups > 300 psm (north and west) Adjacent to the Elk River, which has average flow at nearby gaging station LESS THAN 1,300 cfs	Deferred from further consideration due to inadequate cooling water availability.
Fort Campbell (Area Excluded – Cooling Water Availability)	PGA < 0.5g Adjacent to Census Block Groups > 300 psm (east) > 0.5 mile from Cumberland River	Deferred from further consideration due to distance from water source.
Naval Support Activity Mid-South (Area Excluded – Seismic and Cooling Water Availability)	PGA > 0.5g Adjacent to Census Block Groups > 300 psm > 0.5 mile from Loosahatchie River	Deferred from further consideration due to PGA > 0.5g throughout the property and due to distance from water source.

3.3 Candidate Areas

As discussed in Section 3.2, four customer locations were eliminated from further consideration because they did not meet one or more exclusionary screening criteria:

Arnold Air Force Base – Entire area is > 0.5 mile from adequate cooling water source.

Columbus Air Force Base – Entire area is > 0.5 mile from adequate cooling water source.

Fort Campbell – Entire area is > 0.5 mile from adequate cooling water source.

Naval Support Activity Mid-South – Entire area is characterized as PGA > 0.5g and entire area is > 0.5 mile from adequate cooling water sources.

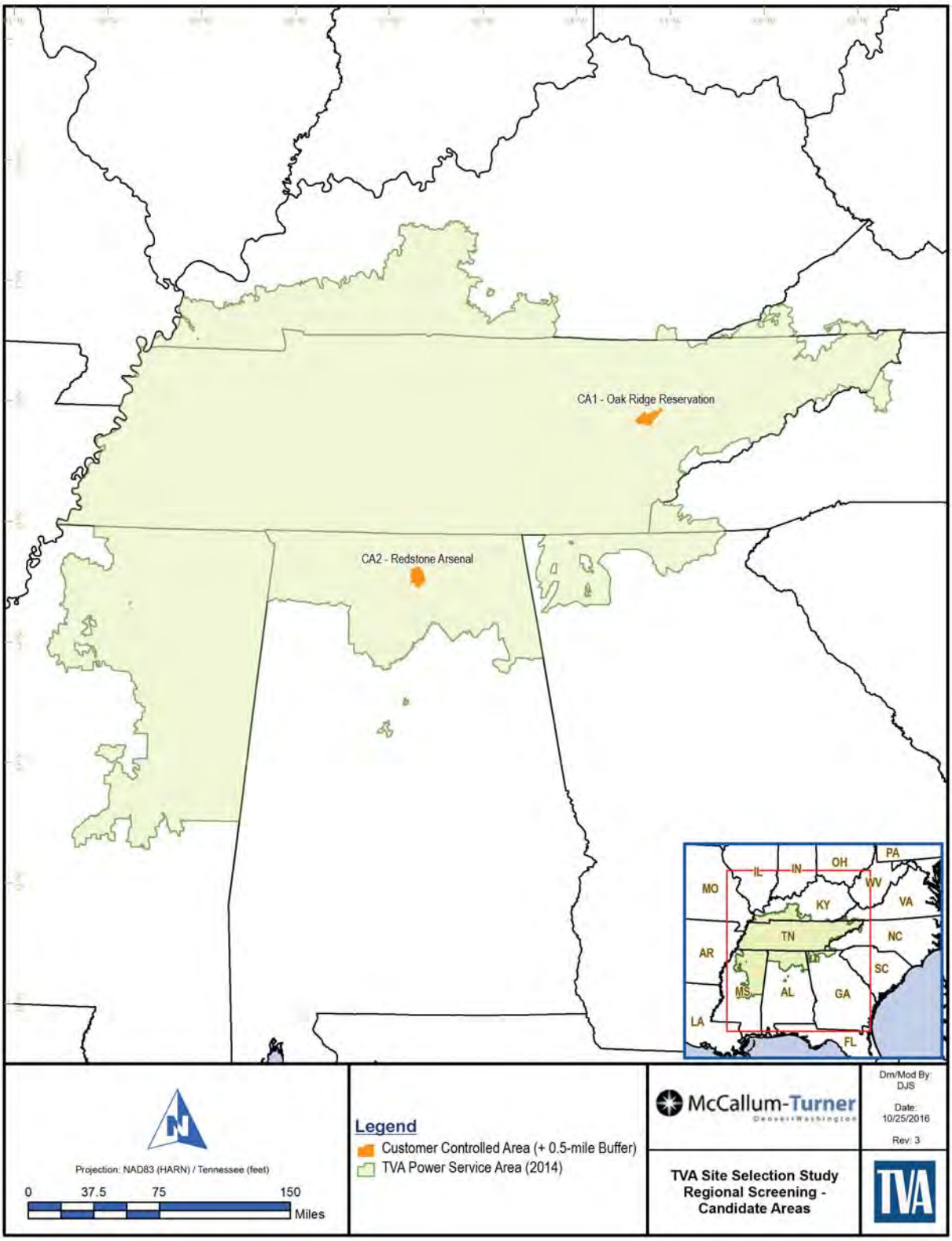
Thus, regional screening yielded two candidate areas (CA), as follows:

CA-1 Oak Ridge Reservation
CA-2 Redstone Arsenal

Each candidate area consists of the customer property plus those areas within a one-half mile distance around the property boundary that also met regional screening criteria.

Figure 3–2 depicts the candidate areas.

Figure 3–2. Candidate Areas



4. Identification of Potential Sites

Section 4.1 outlines the processes used in identifying potential sites; Section 4.2 describes the results of applying the processes and the potential sites identified.

4.1 Potential Site Identification Process

As noted in Section 3.3, each candidate area consists of the customer property plus areas within one half mile around the property boundary that also met regional screening criteria. In order to obtain a set of potential sites that spans the nuclear power plant siting options within the ROI, two independent processes for potential site identification – tailored to address customer-owned versus non-owned components of the candidate areas – were implemented as follows:

4.1.1 Customer-Identified Sites of Interest

At Redstone Arsenal (RSA) and Oak Ridge Reservation (ORR) candidate areas, TVA identified sites that:

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

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

TVA then consulted with the RSA and ORR sharing results of the initial site investigation. The customers were requested to review the identified sites and provide their perspective on the siting locations to be considered. This included both suggesting additional sites for consideration and removing identified sites that were not appropriate for SMR deployment. Both customers identified areas that should be considered and areas that should not be considered as potential sites.

The boundaries and acreages of the land parcels identified to be available as potential sites are shown on Figures 4-1 and 4-2

4.1.2 Candidate Area Canvassing

The two candidate areas remaining after regional screening were canvassed to identify additional potential sites. These potential sites allowed for more comprehensive characterization of siting tradeoffs within the ROI, as well as providing further assurance that the process identified the best sites, from an environmental perspective, that could reasonably be identified within the ROI. The following process was used:

1. Satellite imagery of the areas was viewed using Google Earth® (http://earth.google.com/).

2. 1:100,000-scale and 1:24,000-scale topographic maps were examined to identify areas for potential sites and to clarify and optimize locations identified from satellite imagery. Information on identified sites was supplemented using state maps and atlases.
3. The latitude and longitude of the approximate center point of each potential site was noted.

For purposes of canvassing areas outside customer property, each site was identified as a minimum 120-acre area, nominally a circle centered on the site center-point.

As shown in Figures 4-1 and 4-2, water bodies lie along some customer property boundaries at the ORR and RSA. Because it is considered infeasible to construct secure transmission across water bodies, areas within the 0.5 mile band, but separated from the site by a water body, were excluded from potential site identification, i.e., canvassing was not conducted in these areas.

Identification of potential sites through canvassing was conducted as a qualitative process, applying best judgment regarding which land areas could be favorable for nuclear power plant development. No rigid criteria were applied in making these judgments, but – where supported by available data – attempts were made to optimize suitability of potential sites identified. Site suitability considerations taken into account, as feasible and applicable, in identifying potential sites through the canvassing process were:

- Avoidance of ecologically sensitive areas (e.g., wetlands) and special designation areas.
- Ability to provide reliable underground transmission to the federal installation (i.e., not separated by a body of water).
- Optimizing proximity to existing transmission infrastructure and load centers.
- Optimizing proximity to existing transportation infrastructure.
- Diversity of potential sites within each candidate area to allow comparison of trade-offs among various site suitability characteristics (e.g., water source, transmission distance and approach, land use).
- Flexibility to optimize site layout and design for cost minimization.
- Flexibility to optimize site layout and design for avoidance or mitigation of environmental impacts.
- Avoidance of dedicated lands for offsite features (e.g., cooling water pipeline).
- Avoidance of severe topographic relief.

4.2 Potential Site Identification Results

As a result of the potential site identification processes described above, 15 potential sites were identified for further consideration. Table 4-1 contains the nominal potential site center point coordinates. The potential sites are depicted in Figures 4-1 and 4-2.

Table 4-1. Potential Sites

Process	Potential Site ID	Latitude	Longitude
Candidate Area 1 – Oak Ridge Reservation:			
Customer	2	35.917 °N	84.387 °W
Customer	3	35.899 °N	84.378 °W
Customer	4	35.905 °N	84.358 °W
Customer	5	35.892 °N	84.321 °W
Customer	8	35.886 °N	84.291 °W
Customer	10	35.906 °N	84.287 °W
Canvass	O1	35.933 °N	84.441 °W
Canvass	O2	36.000 °N	84.204 °W
Candidate Area 2 – Redstone Arsenal:			
Customer	12	34.625 °N	86.712 °W
Customer	13	34.622 °N	86.658 °W
Customer	14	34.608 °N	86.679 °W
Customer	15	34.610 °N	86.702 °W
Customer	16	34.601 °N	86.681 °W
Customer	17	34.571 °N	86.663 °W
Canvass	R1	34.638 °N	86.598 °W

Figure 4–1. Potential Sites - Oak Ridge Reservation

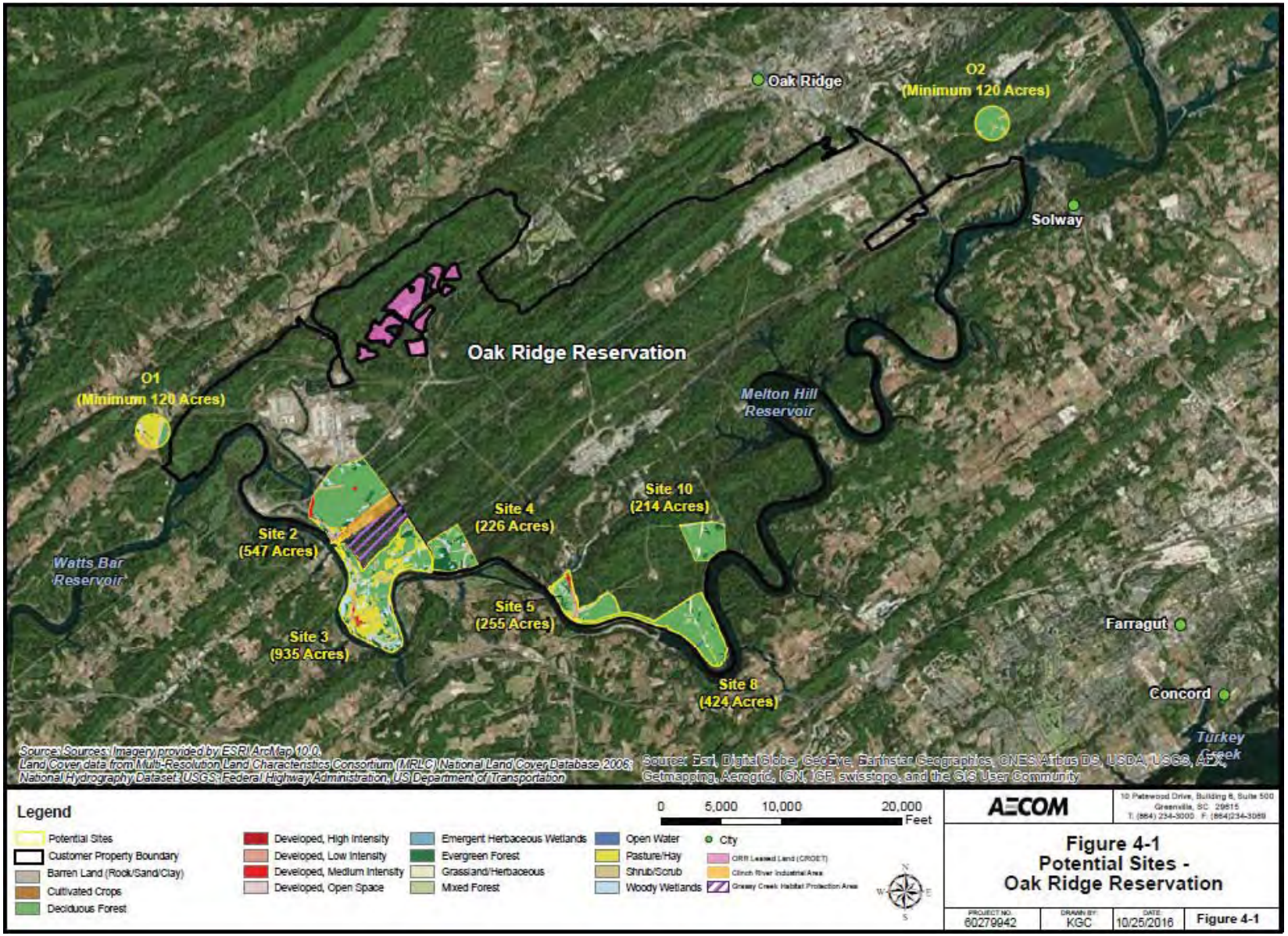
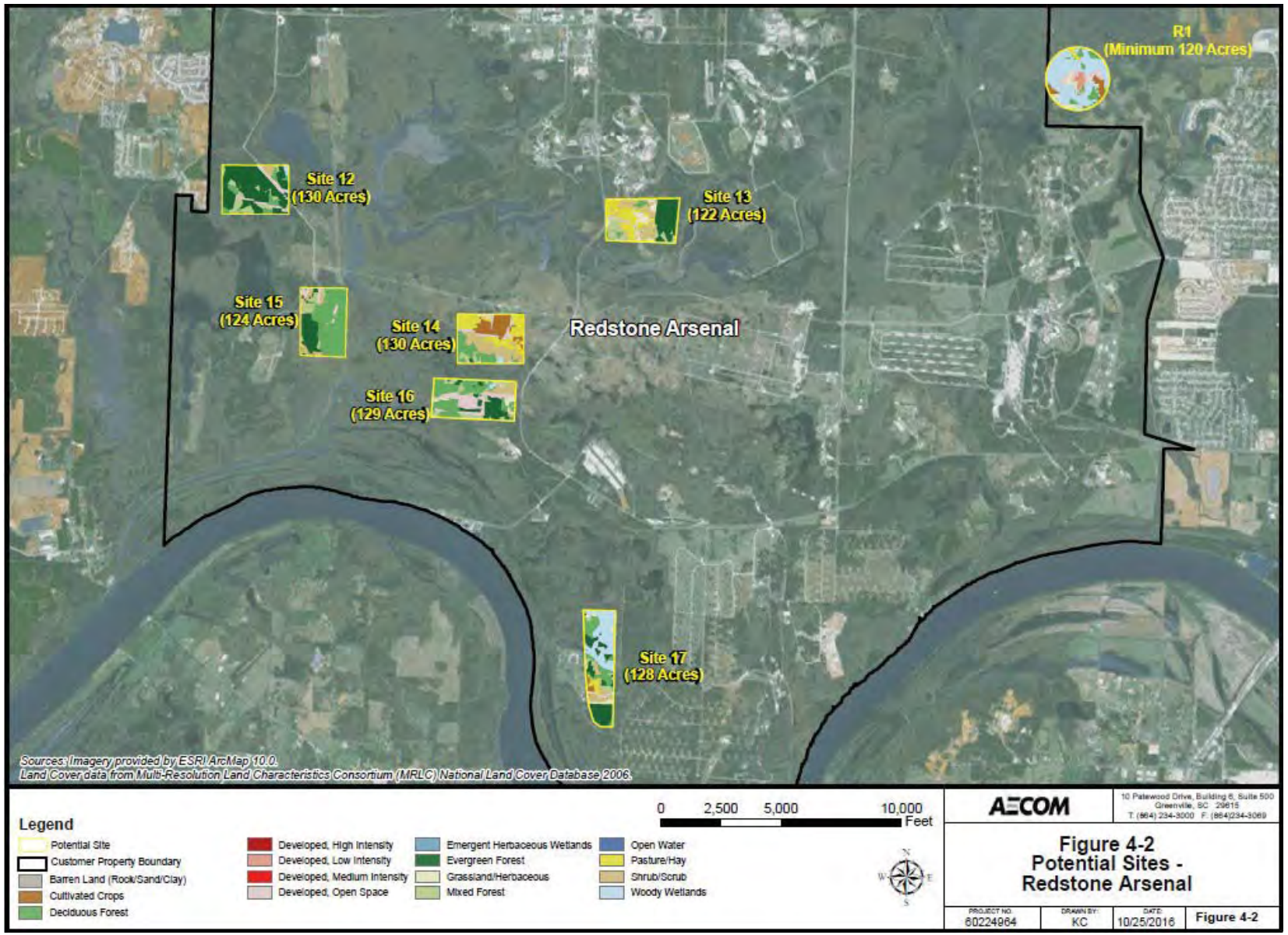


Figure 4–2. Potential Sites - Redstone Arsenal



5. Evaluation of Potential Sites and Identification of Candidate Sites

The objective of this component of the site-selection process was to evaluate the potential sites and select a smaller set of candidate sites for ultimate selection of the proposed site for the TVA ESP Application. Section 5.1 outlines the process for evaluating potential sites, while Section 5.2 describes process results and the selection of candidate sites.

5.1 Evaluation of Potential Sites

General siting criteria used to evaluate the primary sites were derived from those presented in Chapter 3.0 of the *Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Power Generation Facilities* (EPRI Siting Guide), June 2015 (EPRI 2015). The overall process for evaluation of potential sites was composed of the following elements; each element is described in the following paragraphs.

- Develop criterion ratings for each site;
- Develop weight factors reflecting the relative importance of each criterion; and
- Develop composite site-suitability ratings.

Criterion Ratings – Each potential site was assigned a rating of 1 to 5 (1 = least suitable, 5 = most suitable) for each general siting criterion, using the rationale described in Appendix C. Information sources for these evaluations included publicly available data, data available from TVA files and personnel, USGS topographic maps, and large-scale satellite photographs. Reconnaissance-level information was used in the evaluations.

Weight Factors – Weight factors reflecting the relative importance of these criteria were developed by a multi-disciplinary committee in the areas of nuclear power plant site suitability; this committee was composed of subject matter experts in geology/geotechnical/seismic, hydrology, ecology & wetlands, land use/zoning, transmission, socioeconomics, engineering, and public/institutional relations. The weight factors were derived using methodology consistent with the modified Delphi process specified in the EPRI Siting Guide (see Appendix B). Weight factors used (1 = least important, 10 = most important) are included in Table 5-1 below.

Composite Suitability Ratings – Ratings reflecting the overall suitability of each site were developed by multiplying criterion ratings by the criterion weight factors and summing over all criteria for each site.

Results from applying the process are described in Section 5.2. Appendix C provides the detailed technical basis for the general site-criteria ratings.

5.2 Identification of Candidate Sites

Results of applying the evaluation process described in Section 5.1 to the potential sites are summarized in Table 5-1 and Figure 5-1. Detailed discussions of the basis for site ratings for each of the criteria are provided in Appendix C.

Table 5-1. General Site Criteria Evaluation Results

Oak Ridge Reservation Potential Sites

Health and Safety Criteria

Criteria		Weight Factor	2		3		4		5		8		10		O1		O2	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
1.1.1	Geology/Seismology	**8.4**	3	25.2	3	25.2	3	25.2	3	25.2	3	25.2	3	25.2	3	25.2	3	25.2
1.1.2	Cooling System Requirements	**7.0**	3	21.0	3	21.0	3	21.0	3	21.0	3	21.0	3	21.0	3	21.0	3	21.0
1.1.3	Flooding	**8.7**	4	34.8	4	34.8	4	34.8	4	34.8	4	34.8	4	34.8	4	34.8	4	34.8
1.1.4	Nearby Hazardous Land Uses	**5.5**	3	16.5	3	16.5	2	11.0	3	16.5	3	16.5	3	16.5	3	16.5	3	16.5
1.1.5	Extreme Weather Conditions	**4.6**	3	13.8	3	13.8	3	13.8	3	13.8	3	13.8	3	13.8	3	13.8	3	13.8
1.2	Accident Effect Related	**7.7**	4	30.8	4	30.8	4	30.8	4	30.8	4	30.8	4	30.8	4	30.8	3	23.1
1.3.1	Surface Water – Radionuclide Pathway	**3.9**	4	15.6	4	15.6	4	15.6	4	15.6	4	15.6	4	15.6	4	15.6	4	15.6
1.3.2	Groundwater Radionuclide Pathway	**4.6**	3	13.8	3	13.8	3	13.8	3	13.8	3	13.8	3	13.8	3	13.8	3	13.8
1.3.3	Air Radionuclide Pathway	**3.9**	4	15.6	4	15.6	4	15.6	4	15.6	4	15.6	4	15.6	4	15.6	4	15.6
1.3.4	Air-Food Ingestion Pathway	**3.8**	5	19.0	5	19.0	5	19.0	5	19.0	5	19.0	5	19.0	5	19.0	5	19.0
1.3.5	Surface Water-Food Radionuclide Pathway	**3.7**	5	18.5	5	18.5	5	18.5	5	18.5	5	18.5	5	18.5	5	18.5	5	18.5
1.3.6	Transportation Safety	**3.7**	4	14.8	4	14.8	4	14.8	4	14.8	4	14.8	4	14.8	4	14.8	4	14.8

Ecological Criteria

Criteria		Weight Factor	2		3		4		5		8		10		O1		O2	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
2.1.1	Disruption of Important Species/Habitats Aquatic	**6.3**	3	18.9	4	25.2	3	18.9	3	18.9	3	18.9	3	18.9	3	18.9	3	18.9
2.1.2	Bottom Sediment Disruption Effects	**4.8**	2	9.6	2	9.6	2	9.6	2	9.6	3	14.4	3	14.4	2	9.6	3	14.4
2.2.1	Disruption of Important Species/Habitats Terrestrial - Plant Site	**5.9**	3	17.7	4	23.6	3	17.7	3	17.7	3	17.7	3	17.7	3	17.7	3	17.7
2.2.2	Disruption of Important Species/Habitats Terrestrial - Transmission	**5.1**	5	25.5	5	25.5	5	25.5	5	25.5	5	25.5	5	25.5	5	25.5	5	25.5
2.2.3	Disruption of Wetlands	**6.1**	4	24.4	4	24.4	4	24.4	4	24.4	5	30.5	5	30.5	5	30.5	5	30.5
2.2.4	Dewatering Effects on Adjacent Wetlands	**4.9**	4	19.6	3	14.7	4	19.6	4	19.6	5	24.5	5	24.5	5	24.5	5	24.5
2.3.1	Thermal Discharge Effects	**6.2**	3	18.6	3	18.6	3	18.6	3	18.6	3	18.6	3	18.6	3	18.6	3	18.6
2.3.2	Entrainment/Impingement Effects	**3.9**	3	11.7	3	11.7	3	11.7	3	11.7	3	11.7	3	11.7	3	11.7	3	11.7
2.3.3	Dredging/Disposal Effects	**4.0**	2	8.0	2	8.0	2	8.0	2	8.0	3	12.0	3	12.0	2	8.0	3	12.0
2.4.1	Drift Effects on Surrounding Areas	**2.7**	4	10.8	4	10.8	4	10.8	4	10.8	4	10.8	4	10.8	4	10.8	4	10.8

Socioeconomic Criteria

Criteria		Weight Factor	2		3		4		5		8		10		O1		O2	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
3.1	Socioeconomics – Construction – Related Effects	**4.7**	5	23.5	5	23.5	5	23.5	5	23.5	5	23.5	5	23.5	5	23.5	5	23.5
3.3	Environmental Justice	**4.2**	4	16.8	4	16.8	4	16.8	4	16.8	4	16.8	4	16.8	4	16.8	4	16.8
3.4	Land Use	**4.6**	3	13.8	4	18.4	3	13.8	3	13.8	3	13.8	3	13.8	3	13.8	1	4.6

Engineering and Cost Related Criteria

Criteria		Weight Factor	2		3		4		5		8		10		O1		O2	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
4.1.1	Water Supply	**6.8**	5	34.0	5	34.0	5	34.0	5	34.0	5	34.0	5	34.0	5	34.0	5	34.0
4.1.2	Pumping Distance	**6.3**	5	31.5	5	31.5	5	31.5	5	31.5	5	31.5	5	31.5	5	31.5	5	31.5
4.1.3	Flooding	**7.5**	5	37.5	4	30.0	4	30.0	5	37.5	5	37.5	5	37.5	4	30.0	5	37.5
4.1.5	Civil Works	**5.5**	4	22.0	4	22.0	4	22.0	4	22.0	4	22.0	4	22.0	4	22.0	4	22.0
4.2.1	Railroad Access	**4.5**	5	22.5	4	18.0	4	18.0	4	18.0	4	18.0	3	13.5	4	18.0	3	13.5
4.2.2	Highway Access	**5.7**	5	28.5	5	28.5	5	28.5	5	28.5	5	28.5	5	28.5	4	22.8	5	28.5
4.2.3	Barge Access	**4.0**	5	20.0	5	20.0	5	20.0	5	20.0	5	20.0	5	20.0	5	20.0	5	20.0
4.2.4	Transmission Access	**8.4**	5	42.0	5	42.0	5	42.0	5	42.0	5	42.0	5	42.0	5	42.0	5	42.0
4.3.1	Topography	**5.7**	3	17.1	5	28.5	5	28.5	3	17.1	3	17.1	1	5.7	5	28.5	3	17.1
4.3.2	Land Rights	**6.4**	3	19.2	5	32.0	1	6.4	2	12.8	2	12.8	2	12.8	1	6.4	1	6.4

Composite Site Rating	**2**	**3**	**4**	**5**	**8**	**10**	**O1**	**O2**
	732.60	**756.70**	**713.70**	**721.70**	**741.50**	**725.60**	**724.50**	**713.70**

Redstone Arsenal Potential Sites

Health and Safety Criteria

Criteria		Weight Factor	12		13		14		15		16		17		R1	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
1.1.1	Geology/Seismology	**8.4**	5	42.0	5	42.0	5	42.0	5	42.0	5	42.0	5	42.0	5	42.0
1.1.2	Cooling System Requirements	**7.0**	4	28.0	4	28.0	4	28.0	4	28.0	4	28.0	4	28.0	4	28.0
1.1.3	Flooding	**8.7**	1	8.7	1	8.7	1	8.7	1	8.7	1	8.7	1	8.7	1	8.7
1.1.4	Nearby Hazardous Land Uses	**5.5**	2	11.0	2	11.0	1	5.5	2	11.0	2	11.0	2	11.0	3	16.5
1.1.5	Extreme Weather Conditions	**4.6**	2	9.2	2	9.2	2	9.2	2	9.2	2	9.2	2	9.2	2	9.2
1.2	Accident Effect Related	**7.7**	3	23.1	3	23.1	3	23.1	3	23.1	3	23.1	3	23.1	3	23.1
1.3.1	Surface Water – Radionuclide Pathway	**3.9**	4	15.6	4	15.6	4	15.6	4	15.6	4	15.6	4	15.6	4	15.6
1.3.2	Groundwater Radionuclide Pathway	**4.6**	3	13.8	3	13.8	3	13.8	3	13.8	3	13.8	3	13.8	3	13.8
1.3.3	Air Radionuclide Pathway	**3.9**	5	19.5	5	19.5	5	19.5	5	19.5	5	19.5	5	19.5	5	19.5
1.3.4	Air-Food Ingestion Pathway	**3.8**	3	11.4	3	11.4	3	11.4	3	11.4	3	11.4	3	11.4	3	11.4
1.3.5	Surface Water-Food Radionuclide Pathway	**3.7**	4	14.8	4	14.8	4	14.8	4	14.8	4	14.8	4	14.8	4	14.8
1.3.6	Transportation Safety	**3.7**	5	18.5	5	18.5	5	18.5	5	18.5	5	18.5	5	18.5	5	18.5

Ecological Criteria

Criteria		Weight Factor	12		13		14		15		16		17		R1	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
2.1.1	Disruption of Important Species/Habitats Aquatic	**6.3**	3	18.9	3	18.9	3	18.9	3	18.9	3	18.9	3	18.9	3	18.9
2.1.2	Bottom Sediment Disruption Effects	**4.8**	2	9.6	2	9.6	2	9.6	2	9.6	2	9.6	2	9.6	2	9.6
2.2.1	Disruption of Important Species/Habitats Terrestrial - Plant Site	**5.9**	2	11.8	2	11.8	2	11.8	2	11.8	2	11.8	2	11.8	2	11.8
2.2.2	Disruption of Important Species/Habitats Terrestrial - Transmission	**5.1**	3	15.3	4	20.4	2	10.2	2	10.2	2	10.2	2	10.2	2	10.2
2.2.3	Disruption of Wetlands	**6.1**	3	18.3	4	24.4	3	18.3	4	24.4	3	18.3	3	18.3	2	12.2
2.2.4	Dewatering Effects on Adjacent Wetlands	**4.9**	3	14.7	3	14.7	3	14.7	3	14.7	3	14.7	2	9.8	2	9.8
2.3.1	Thermal Discharge Effects	**6.2**	3	18.6	3	18.6	3	18.6	3	18.6	3	18.6	3	18.6	3	18.6
2.3.2	Entrainment/Impingement Effects	**3.9**	3	11.7	3	11.7	3	11.7	3	11.7	3	11.7	3	11.7	3	11.7
2.3.3	Dredging/Disposal Effects	**4.0**	2	8.0	2	8.0	2	8.0	2	8.0	2	8.0	2	8.0	2	8.0
2.4.1	Drift Effects on Surrounding Areas	**2.7**	3	8.1	4	10.8	3	8.1	3	8.1	3	8.1	3	8.1	4	10.8

Socioeconomic Criteria

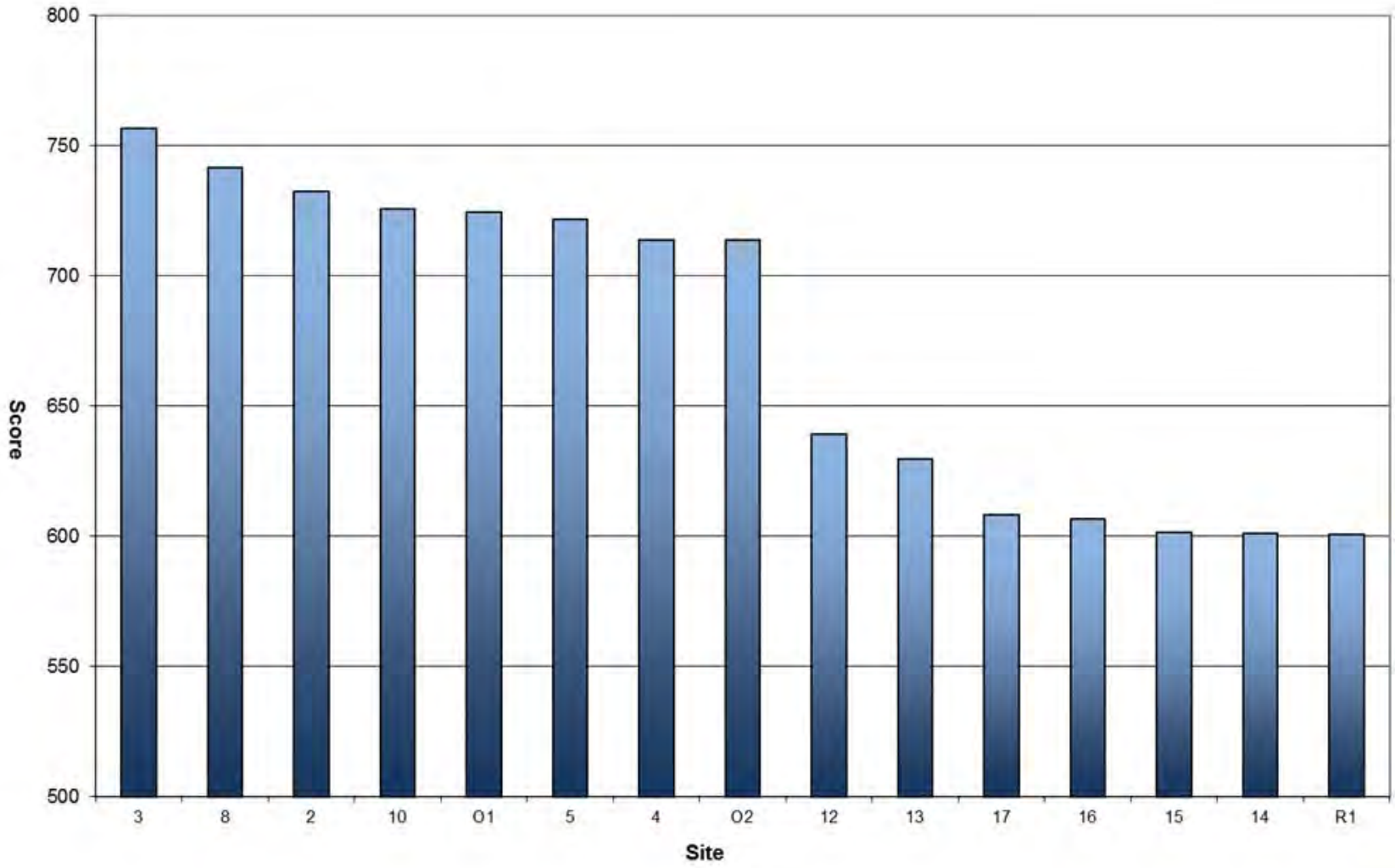
Criteria		Weight Factor	12		13		14		15		16		17		R1	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
3.1	Socioeconomics – Construction – Related Effects	**4.7**	5	23.5	5	23.5	5	23.5	5	23.5	5	23.5	5	23.5	5	23.5
3.3	Environmental Justice	**4.2**	3	12.6	3	12.6	3	12.6	3	12.6	3	12.6	3	12.6	3	12.6
3.4	Land Use	**4.6**	3	13.8	3	13.8	3	13.8	3	13.8	3	13.8	3	13.8	3	13.8

Engineering and Cost Related Criteria

Criteria		Weight Factor	12		13		14		15		16		17		R1	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
4.1.1	Water Supply	**6.8**	5	34.0	5	34.0	5	34.0	5	34.0	5	34.0	5	34.0	5	34.0
4.1.2	Pumping Distance	**6.3**	3	18.9	3	18.9	4	25.2	4	25.2	4	25.2	5	31.5	3	18.9
4.1.3	Flooding	**7.5**	4	30.0	2	15.0	2	15.0	2	15.0	2	15.0	2	15.0	2	15.0
4.1.5	Civil Works	**5.5**	4	22.0	4	22.0	4	22.0	4	22.0	4	22.0	4	22.0	4	22.0
4.2.1	Railroad Access	**4.5**	4	18.0	3	13.5	3	13.5	3	13.5	3	13.5	3	13.5	4	18.0
4.2.2	Highway Access	**5.7**	4	22.8	3	17.1	3	17.1	3	17.1	3	17.1	3	17.1	5	28.5
4.2.3	Barge Access	**4.0**	5	20.0	5	20.0	5	20.0	5	20.0	5	20.0	5	20.0	5	20.0
4.2.4	Transmission Access	**8.4**	3	25.2	4	33.6	2	16.8	2	16.8	2	16.8	2	16.8	2	16.8
4.3.1	Topography	**5.7**	5	28.5	5	28.5	5	28.5	3	17.1	5	28.5	5	28.5	5	28.5
4.3.2	Land Rights	**6.4**	3	19.2	2	12.8	3	19.2	3	19.2	3	19.2	3	19.2	1	6.4

Composite Site Rating	**12**	**13**	**14**	**15**	**16**	**17**	**R1**
	639.10	**629.80**	**601.20**	**601.40**	**606.70**	**608.10**	**600.70**

Figure 5–1. General Site Criteria Evaluation Results



Based on these results, Sites 2, 3, and 8 (Oak Ridge Reservation) and Site 12 (Redstone Arsenal) were selected as candidate sites. These Oak Ridge Reservation 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 Site 2. In addition, Site 8 was also ranked highest for wetlands considerations and ranked highest when considering only environmental criteria (i.e., excluding cost and geology/seismology). These characteristics demonstrate that the ORR sites identified as candidate sites includes 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. Therefore, no additional sites for ORR will be carried forward for further evaluation in the environmental comparison.

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

Thus the Candidate Sites identified are:

- Site 2;
- Site 3;
- Site 8; and
- Site 12

6. References

EPRI 2015. *Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Power Generation Facilities (Siting Guide)*. Electric Power Research Institute, Palo Alto, CA. June 2015, Report 3002005435.

NRC 1998. Regulatory Guide 4.7, *General Site Suitability Criteria for Nuclear Power Stations*, Revision 2, April 1998.

NRC 2007. *Environmental Standard Review Plan, Standard Review Plans for Environmental Reviews for Nuclear Power Plants* (NUREG-1555), Revision 1, July 2007.

Obama, Barack, 2009. *Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance*, EO 13514, October 5, 2009.

Obama, Barack, 2013. *Executive Order 13636: Improving Critical Infrastructure Cybersecurity*, EO 13636, February 19, 2013.

Obama, Barack, 2013. *Presidential Policy Directive-21: Critical Infrastructure and Resilience*, PPD-21, February 12, 2013.

Obama, Barack, 2015. *Executive Order 13693, Planning for Federal Sustainability in the Next Decade*, EO 13693, March 25, 2015.

Tennessee Valley Authority and U.S. Department of Energy, *Memorandum of Understanding: Construction of Small Modular Nuclear Reactors and Power Supply Arrangements*, May 31, 2012.

United States Congress, *Tennessee Valley Authority Act*, 1933.

USGS 2016. 02439400 Buttahatchee River Near Aberdeen, MS.

Appendix A Results of Regional Screening

Figures provided in this Appendix provide results of the regional screening of the TVA Region of Interest in accordance with the regional screening criteria described in Section 3.1. The following information related to identification of candidate areas is contained in subsections of this Appendix:

- Section A-1, Proximity to Customers (Security Requirements)
- Section A-2, Seismology
- Section A-3, Population Density
- Section A-4, Cooling Water Availability
- Section A-5, Composite Regional Screening Results

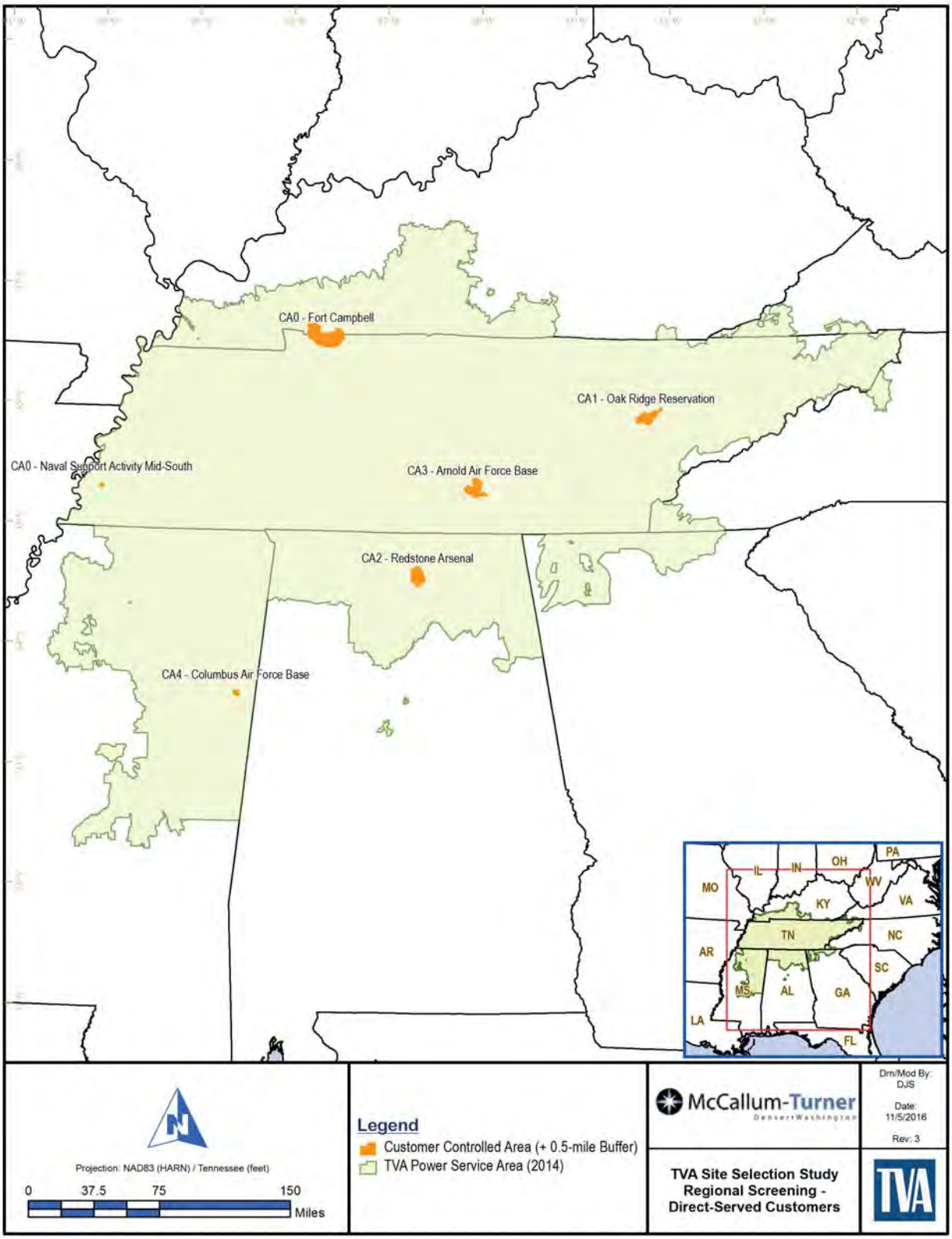
A.1 Proximity to Customers (Security Requirements)

Within the ROI, TVA established an exclusionary criterion based on the project objectives associated with (1) assisting federal facilities with meeting carbon reduction objectives, and (2) supplying 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. Areas which allow TVA to accomplish the project objectives are those which are in close proximity (defined as adjacent to and within 0.5 mile) to TVA's six federal direct-served customers. Areas across water bodies from federal customer property (i.e., areas where physical access restrictions for transmission connections to customer property are not practical) were excluded. Direct-served customers are those customers that purchase their power directly from TVA instead of through a third party power distributor. Federal direct-served customers are listed below for the fiscal year 2014:

1. Oak Ridge Reservation
2. Redstone Arsenal
3. Arnold Air Force Base
4. Fort Campbell
5. Naval Support Activity Mid-South
6. Columbus Air Force Base

Figure A–1. Proximity to Customers Screening Map depicts the results of screening the TVA ROI for proximity to TVA's federal direct-served customers.

Figure A–1. Proximity to Customers Screening Map



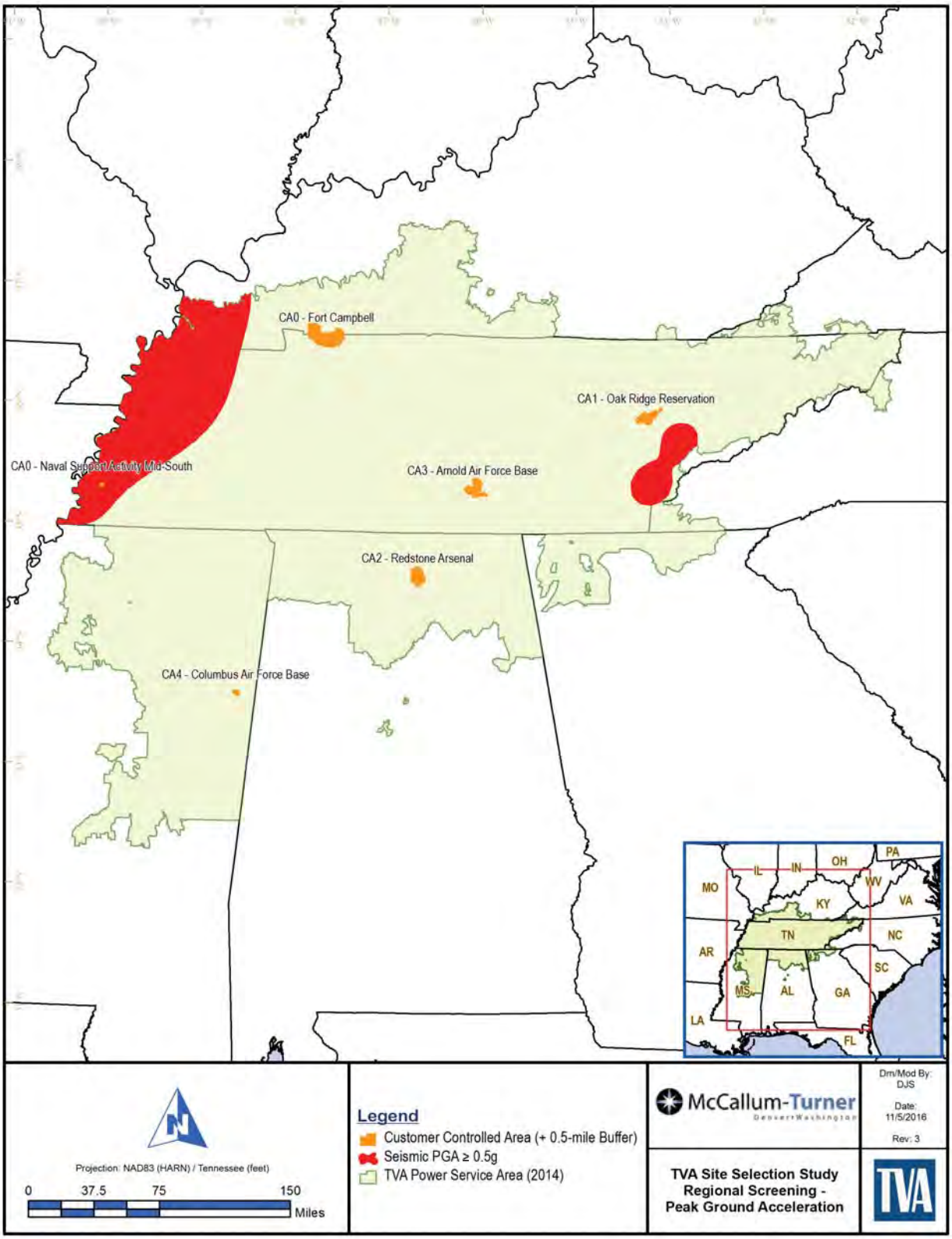
A.2 Seismology/Geology

Areas of higher seismicity were mapped and screened out as areas less suitable for siting a new nuclear power plant. Areas with a peak ground acceleration (PGA) ≥ 0.5g with a 2 percent probability of exceedance in 50 years were excluded as these areas are more likely to require a site-specific reactor design. Areas within 5 miles of identified Quaternary faults and fault sources and areas within 5 miles of known volcanic centers were reviewed. No faults or volcanic centers were identified in the TVA ROI.

- U.S. Geologic Survey, Earthquake Hazards Program, National Seismic Hazard Maps, 2014. http://earthquake.usgs.gov/hazards/products/conterminous/.
- U.S. Geologic Survey, Volcano Hazards Program, 2014. http://volcanoes.usgs.gov/.

Figure A-2 depicts the results of screening the TVA ROI for areas of higher PGA. The Naval Support Activity Mid-South is within a PGA area ≥ 0.5g.

Figure A–2. PGA Screening Map



A.3 Population Density

Areas of higher population density were mapped and screened out as areas less suitable for siting a new nuclear power plant. Using 2010 U.S. Census data, census blocks with a population density greater than 300 persons per square mile (psm) were identified as less suitable siting areas; siting outside of these areas would more likely result in a population density less than the NRC guideline of 500 psm within a 20-mile radius of a site.

- U.S. Department of Commerce, U.S. Census Bureau, Geography Division. Block Groups – Statewide, 2010 edition.

Figure A–3. Population Density Screening Map depicts the results of screening the TVA ROI for areas of higher population density. Figures A-4 and A-5 depict these results for the Oak Ridge Reservation and Redstone Arsenal customer locations respectively. Portions of Candidate Areas adjacent to Census Block Groups > 300 psm were excluded from consideration.

Figure A–3. Population Density Screening Map

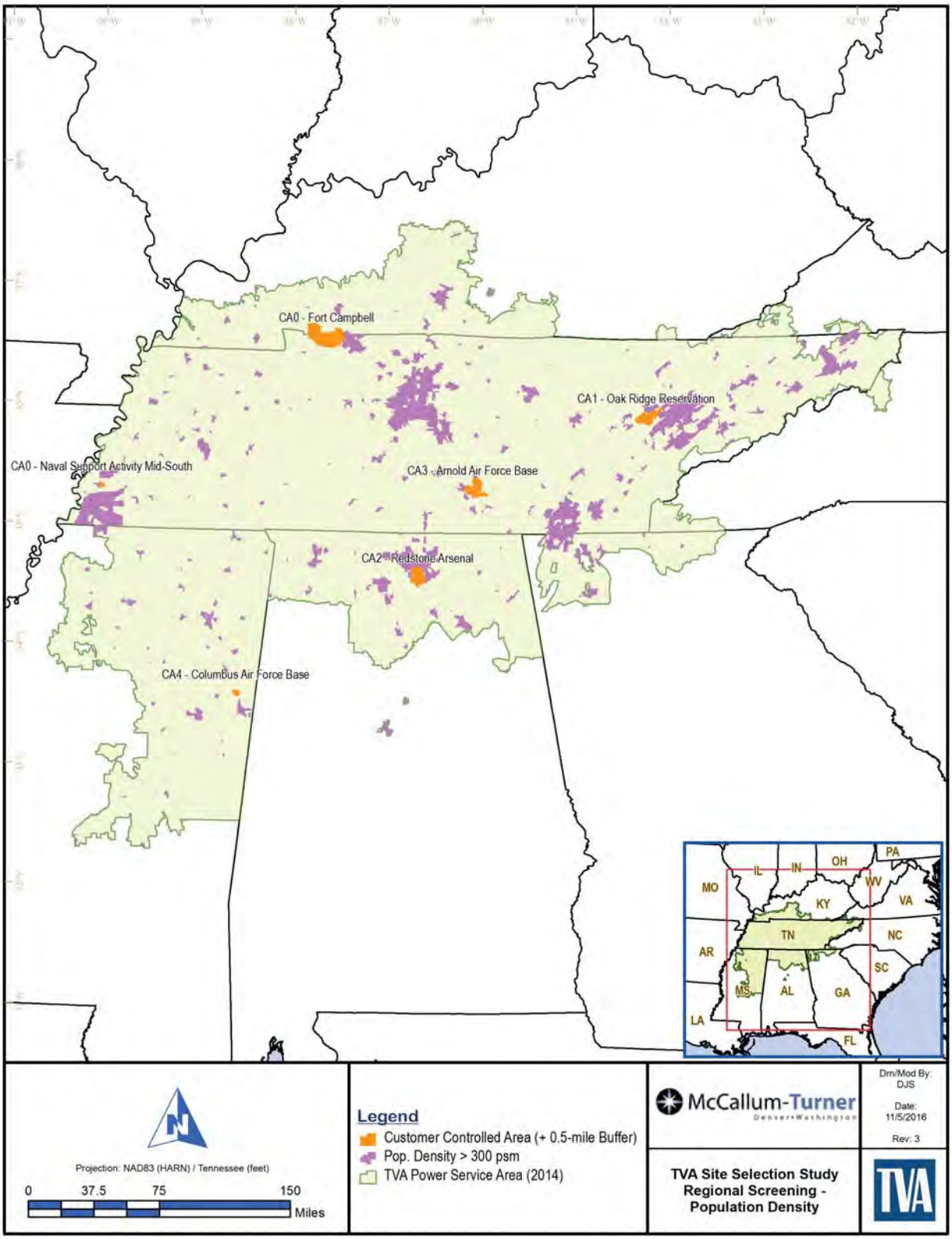


Figure A–4. Population Density Screening Map - Oak Ridge Reservation

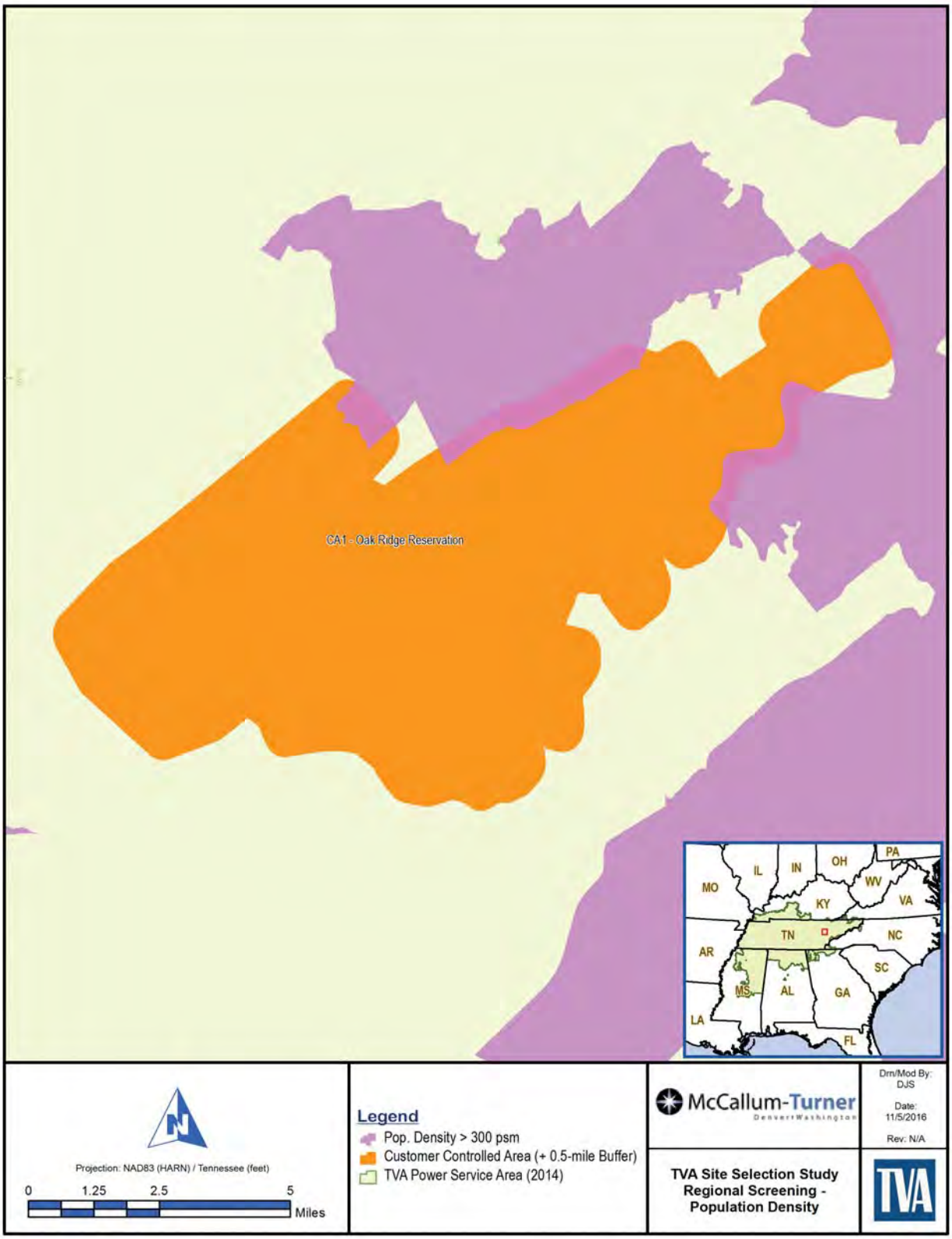
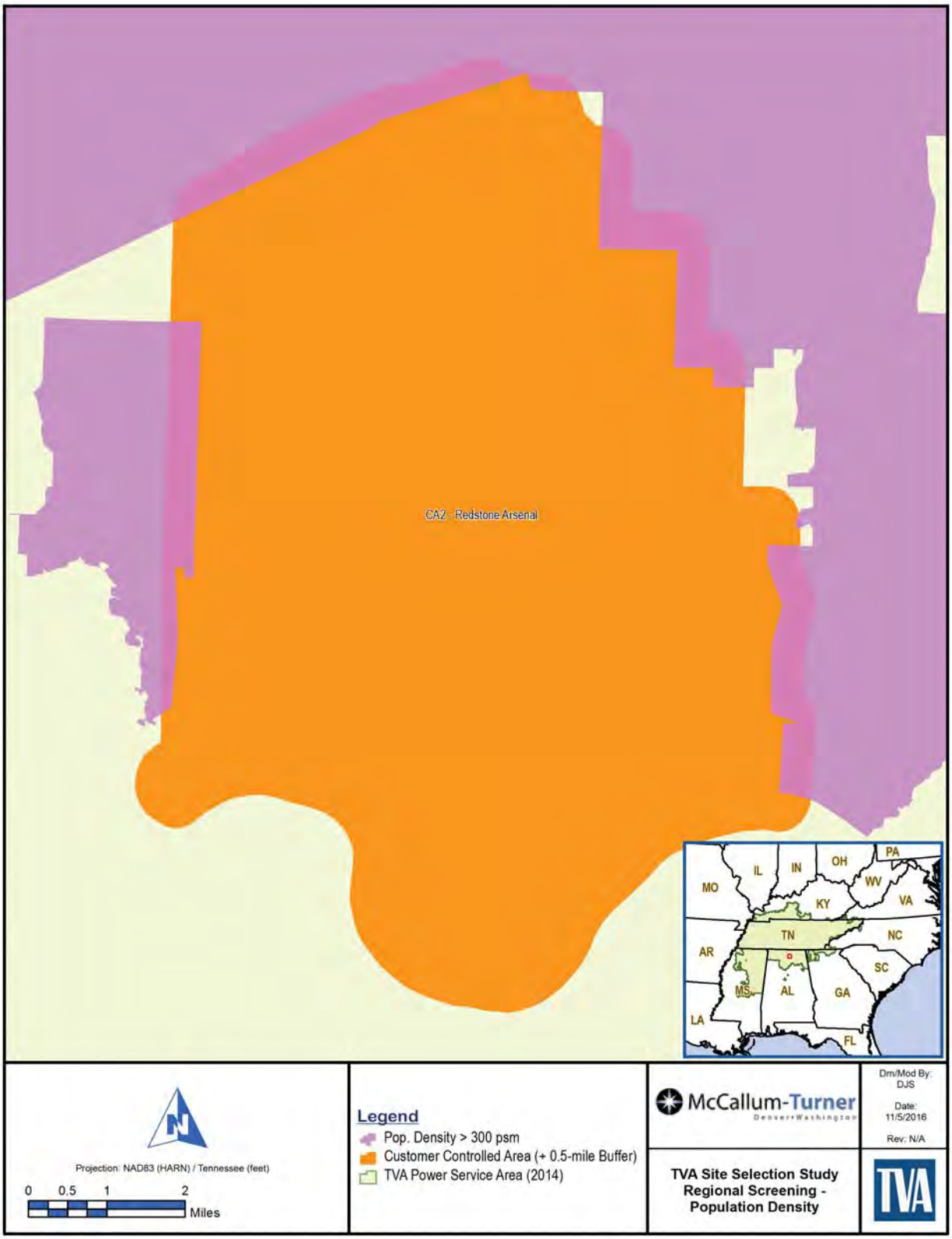


Figure A–5. Population Density Screening Map - Redstone Arsenal



A.4 Cooling Water Availability

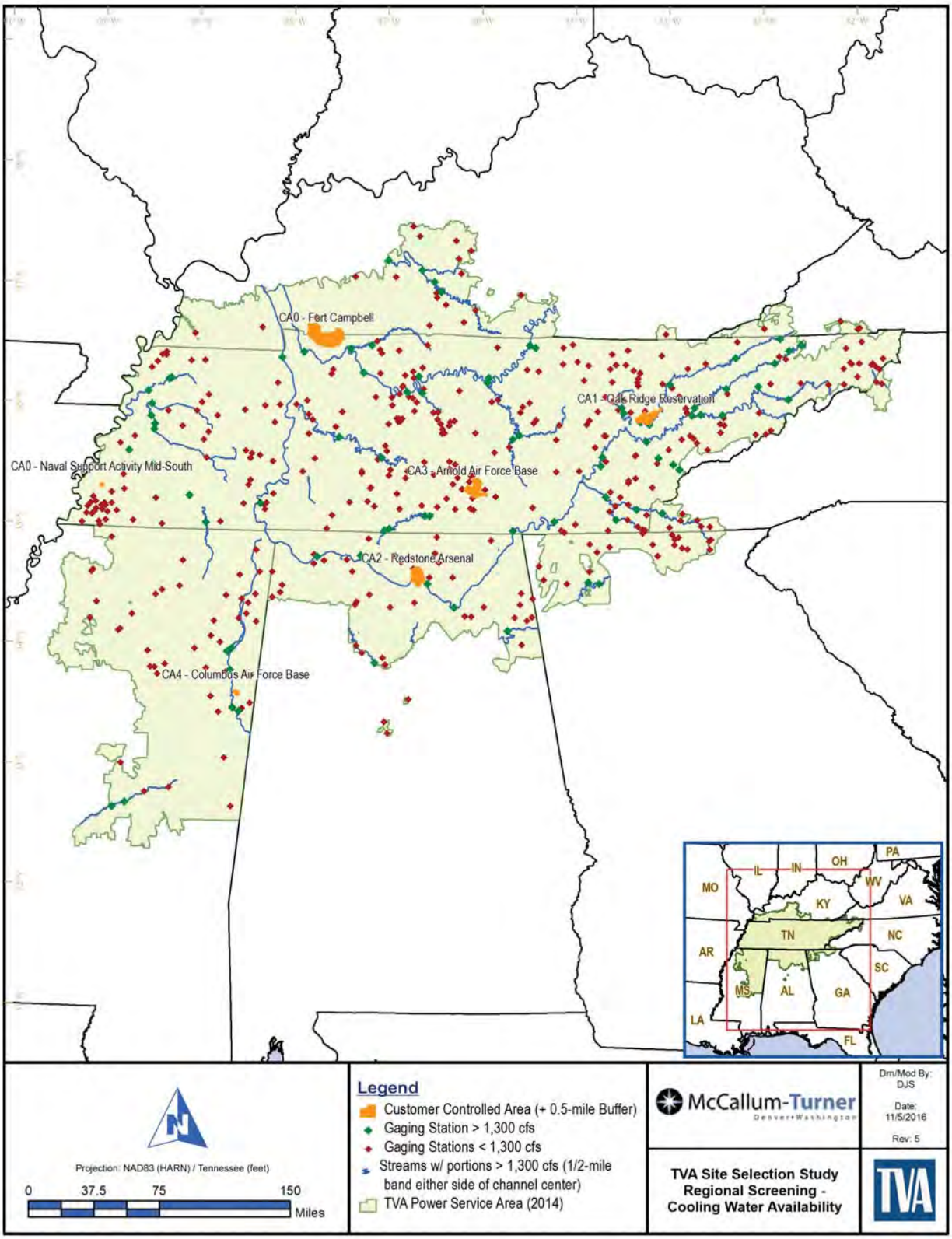
The plant water intake requirement for an 800 MWe closed-cycle plant is assumed to be 68.4 cfs (30,708 gpm). A reconnaissance level search was performed for adequate ground water sources and no viable sources were identified. Generally, groundwater supplies in the mid-South cannot reliably support the cooling water demands for power production. Subsequently, groundwater is not considered and surface water is the preferred source of plant water intake supply. No feasible sources of Waste Water Treatment Plant effluent were found within the ROI.

Rivers for which more than 5% of the annual average flow will be required for plant water intake may present permitting or operational water supply problems and is based on requirements discussed in 40 CFR 125.84(b)(3). Therefore, the source water body must be capable of providing 1,300 cfs (approximately 20 times the plant water intake requirement of 68.4 cfs). To provide secure power, plant water intake system components (e.g., intake structure and pipeline) must be controlled by TVA. Accordingly, acquisition and control of cooling water pipeline corridors (i.e., not on the plant site or on Federal customer property) longer than 0.5 mile was judged to be infeasible due to operational, logistical, security and cost challenges.

- USGS: Annual Water Data Reports, http://wdr.water.usgs.gov/.

Figure A–6. Cooling Water Availability Screening Map depicts the cooling water availability screening results, showing river segments that meet the 1,300 cfs flow requirement. Columbus Air Force Base, Arnold Air Force Base, Fort Campbell and Naval Support Activity Mid-South are > 0.5 miles from an adequate cooling water source. Table 3-2 summarizes the cooling water supply scenario for TVA's six federal direct-served customers.

Figure A–6. Cooling Water Availability Screening Map



Source: USGS: Annual Water Data Reports, http://wdr.water.usgs.gov/.

A.5 Composite Regional Screening Results

Figures A-7 through A-12 depict the composite results of the regional screening process, identifying two candidate areas of higher favorability for siting a new nuclear power plant. Each figure depicts one of TVA's direct-served customers and the associated regional screening results. The following summarizes the regional screening results for TVA's six federal direct-served customers.

Federal Direct-Served Customer	Regional Screening Characterization	Results
Oak Ridge Reservation	PGA < 0.5g Adjacent to Census Block Groups > 300 psm (northeast) Adjacent to the Clinch River, which has average flow at nearby gaging station MORE THAN 1,300 cfs	Several off-site areas for canvassing potential sites identified. (Candidate Area 1)
Redstone Arsenal	PGA < 0.5g Adjacent to Census Block Groups > 300 psm Adjacent to the Tennessee River, which has average flow at nearby gaging station MORE THAN 1,300 cfs	Several off-site areas for canvassing potential sites identified. (Candidate Area 2)
Columbus Air Force Base (Area Excluded – Cooling Water Availability)	PGA < 0.5g Not adjacent to Census Block Groups > 300 psm (north and west) Adjacent to the Buttahatchee River which has average flow for each month at nearby gaging station LESS THAN 1,300 cfs.	Deferred from further consideration due to inadequate cooling water availability.
Arnold Air Force Base (Area Excluded – Cooling Water Availability)	PGA < 0.5g Adjacent to Census Block Groups > 300 psm (north and west) Adjacent to the Elk River, which has average flow at nearby gaging station LESS THAN 1,300 cfs	Deferred from further consideration due to inadequate cooling water availability.
Fort Campbell (Area Excluded – Cooling Water Availability)	PGA < 0.5g Adjacent to Census Block Groups > 300 psm (east) > 0.5 mile from Cumberland River	Deferred from further consideration due to distance from water source.
Naval Support Activity Mid-South (Area Excluded – Seismic and Cooling Water Availability)	PGA > 0.5g Adjacent to Census Block Groups > 300 psm > 0.5 mile from Loosahatchie River	Deferred from further consideration due to PGA > 0.5g throughout the property and due to distance from water source.

Figure A–7. Composite Regional Screening Results - Oak Ridge Reservation

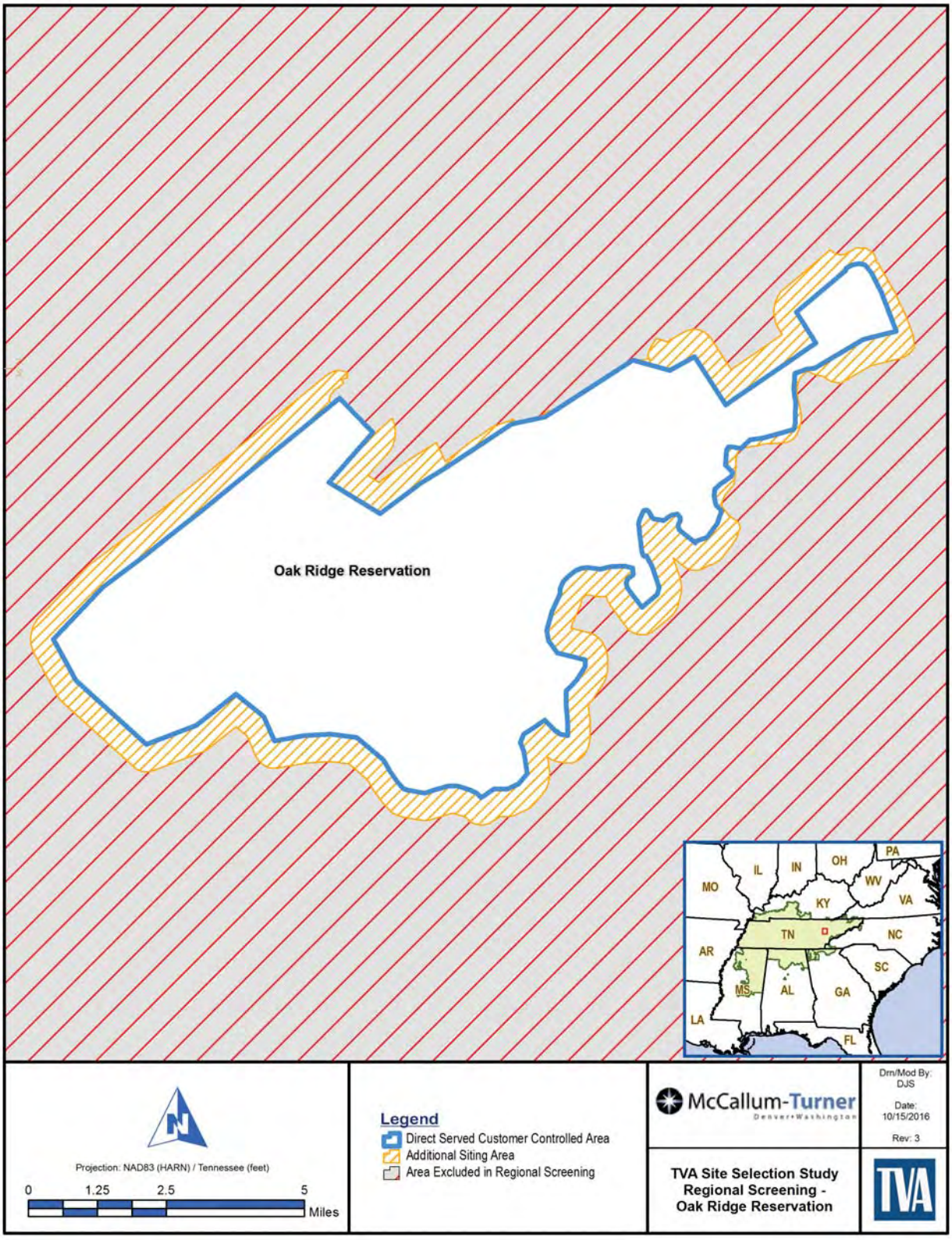


Figure A–8. Composite Regional Screening Results - Redstone Arsenal

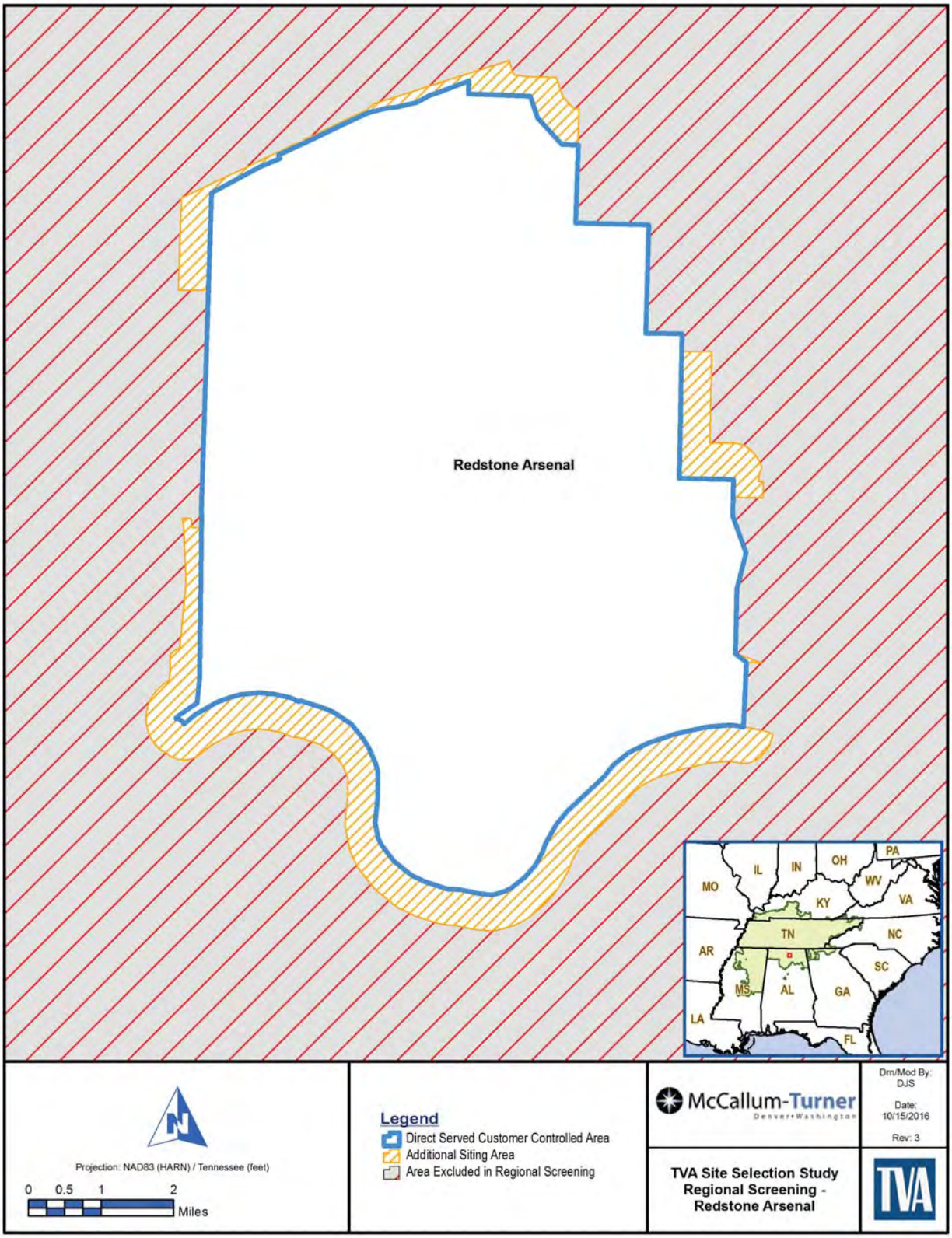


Figure A–9. Composite Regional Screening Results - Columbus Air Force Base

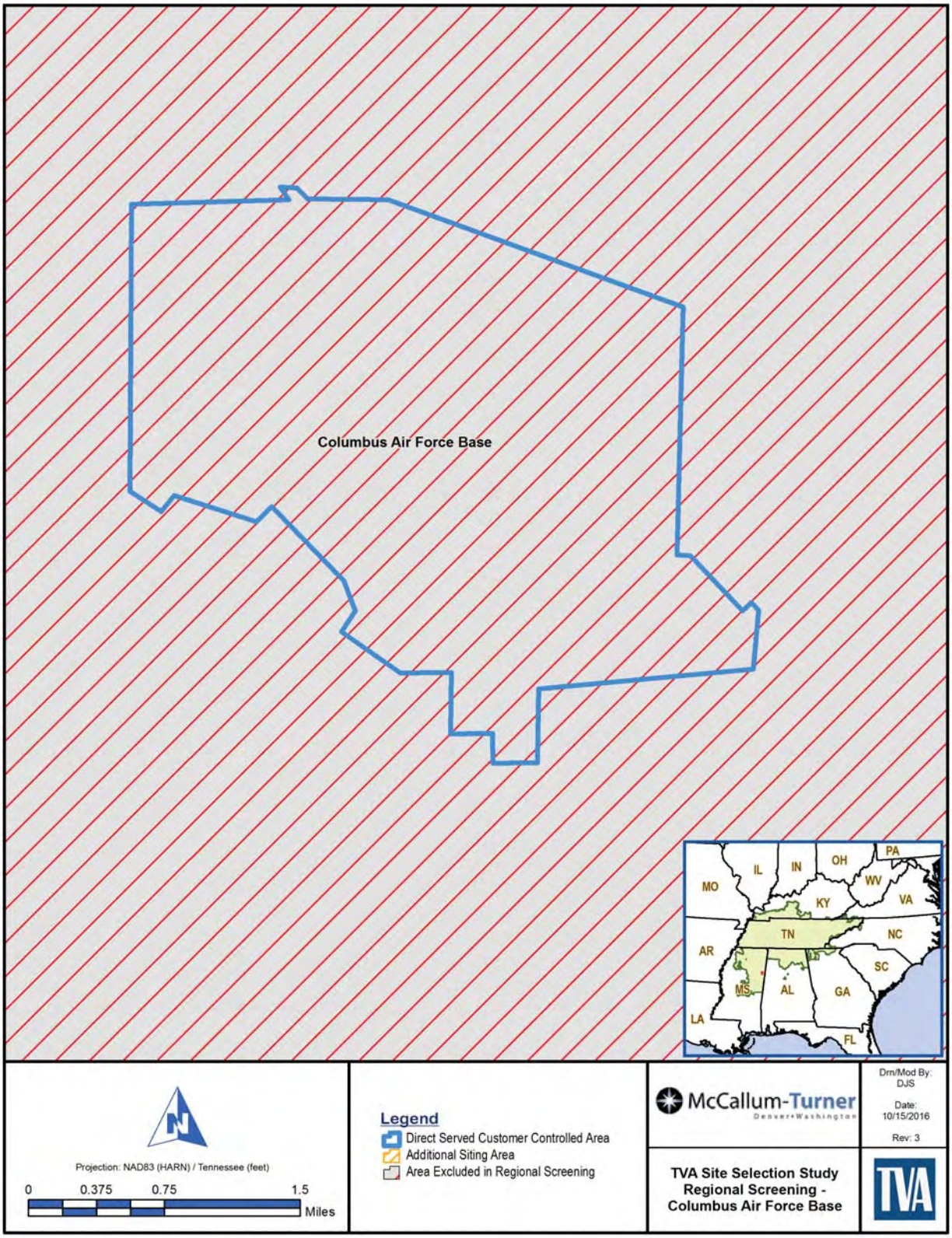


Figure A–10. Composite Regional Screening Results - Arnold Air Force Base

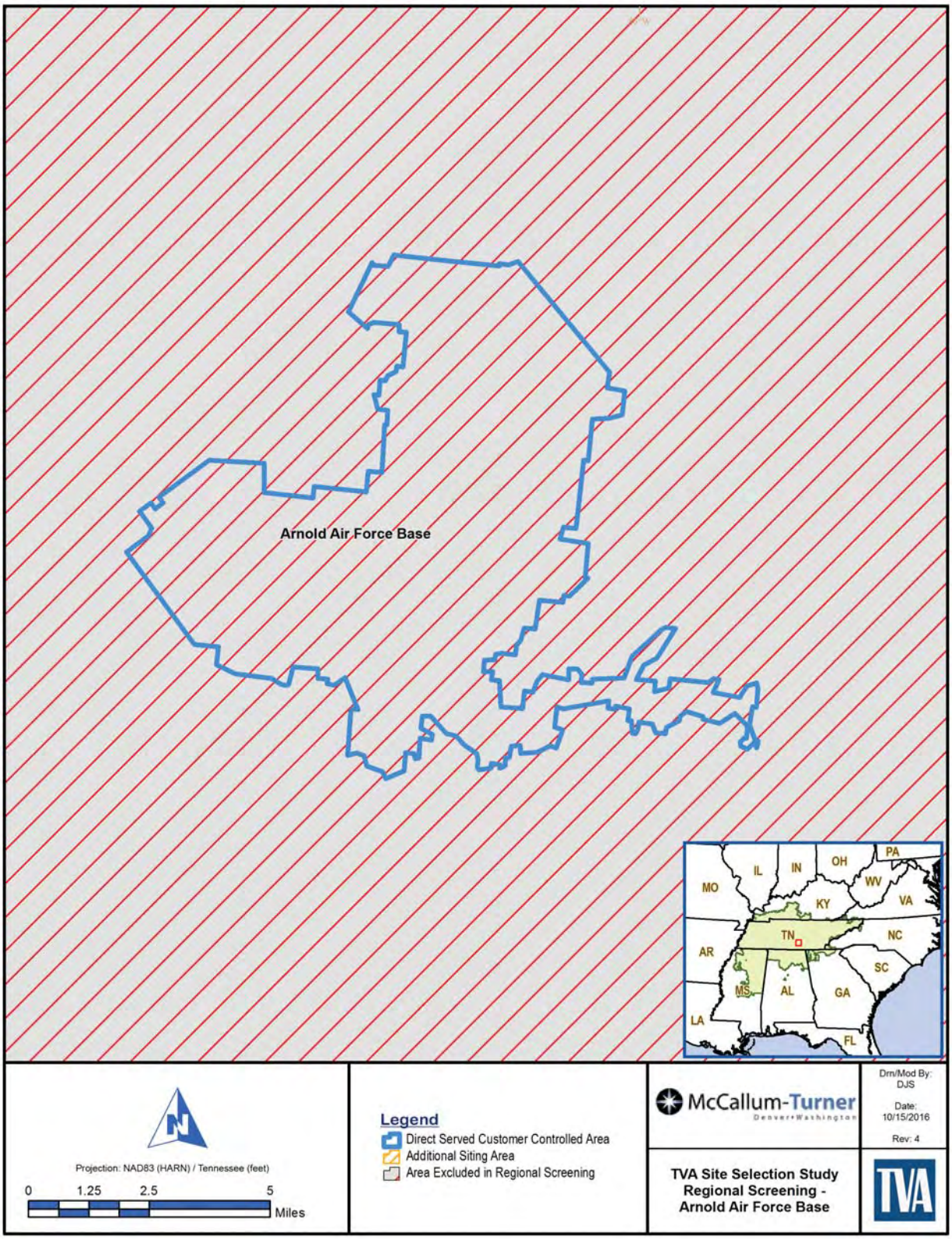


Figure A–11. Composite Regional Screening Results - Fort Campbell

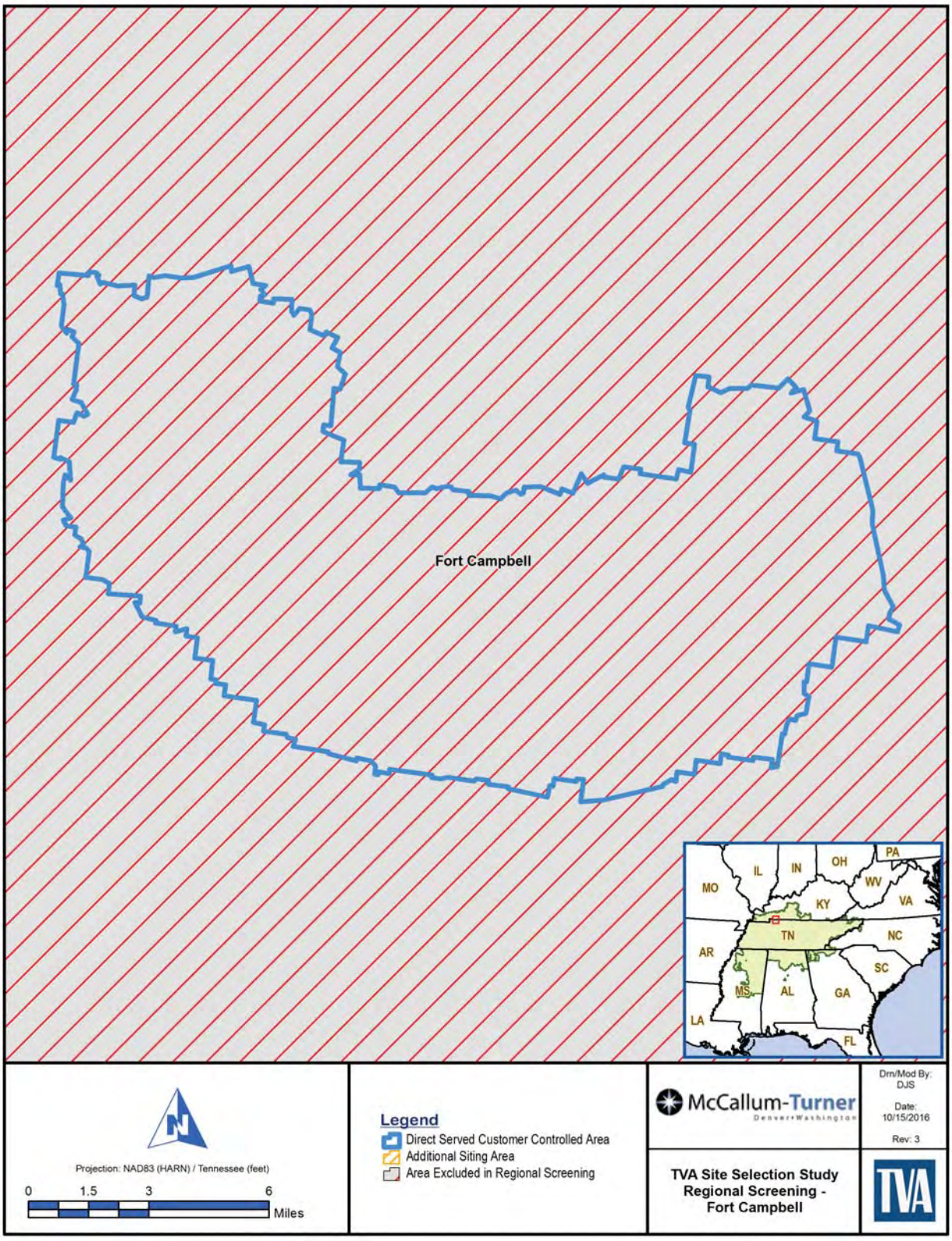
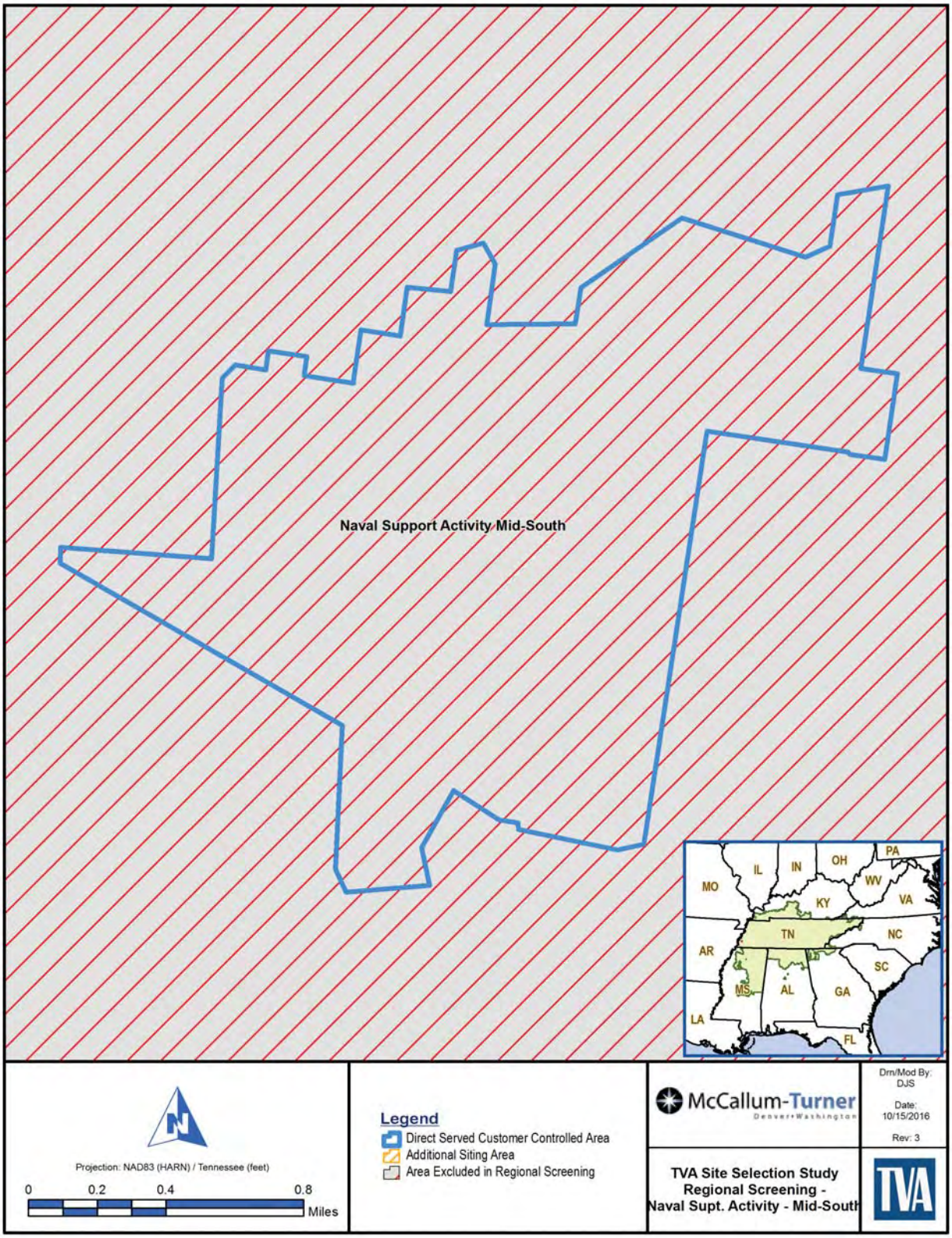


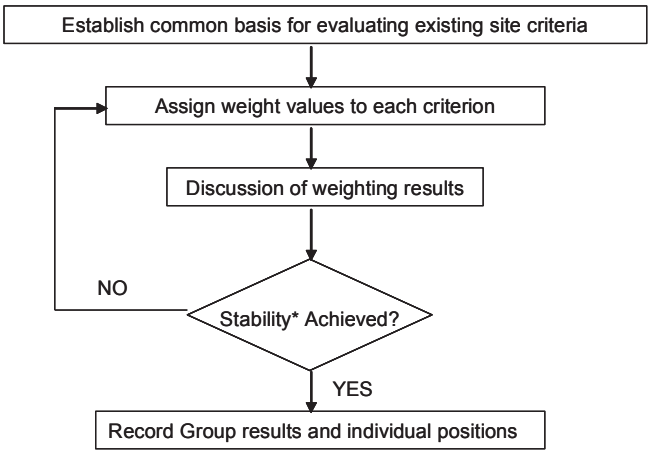
Figure A–12. Composite Regional Screening Results - Naval Support Activity Mid-South



Appendix B Weight Factor Development

Weight factors reflecting the relative importance of the general site evaluation criteria used to evaluate potential sites were developed consistent with the modified Delphi method suggested in the EPRI Siting Guide. The process used for weight factor development is summarized in Figure B-1.

Figure B–1. Weight Factor Development Process



Weight factors reflecting the relative importance of these criteria were developed by a multi-disciplinary committee in the areas of nuclear power plant site suitability; this committee was composed of subject matter experts in geology/geotechnical/seismic, hydrology, ecology & wetlands, land use/zoning, transmission, socioeconomics, engineering, and public/institutional relations.

A brief description of the criteria, data inputs, and rating methodologies were provided. Weights were assigned (scale of 1 to 10 with 1 = least important and 10 = most important) to each of the criteria based on the view of how important each criterion is in nuclear plant siting. Individual weight scores were averaged to arrive at group composite category weighting factors.

After the first round of voting, a group discussion was held during which committee members provided the rationale for their weight factor assignments. Following this discussion, another polling of the group was conducted and committee members modified their weights, as they deemed appropriate, based on the discussions and arguments presented after the first round. A second discussion was held after the second round of voting. This process continued for a third round of voting. Following the third round of voting no members of the committee indicated, when polled, that they had been persuaded to change their weight assignments, and the Delphi session was terminated. The resulting weight factors are provided in Table 5-1.

Appendix C Technical Basis for General Site Criteria Evaluations

General siting criteria used in the TVA nuclear power plant siting study were derived from those presented in Chapter 3.0 of the *Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Power Generation Facilities* (EPRI Siting Guide), June 2015 (EPRI 2015). The following information is provided in this appendix for each criterion:

- Objective – what aspect of site suitability is being measured;
- Evaluation approach – technical basis/methodology used to develop site ratings from available data;
- Discussion – data and information available for the potential sites under consideration; and
- Results – ratings and rationale.

Technical bases for site ratings developed for each general site criterion are provided in the following sections. Criterion/section numbering is designed to reflect section numbers in Chapter 3 of the EPRI Siting Guide where the criteria is discussed, e.g., Criterion C.1.1.1 – Geology/Seismology appears in Section 3.1.1.1 of the Siting Guide.

C.1 Health and Safety Criteria

C.1.1 Accident Cause-Related

C.1.1.1 Geology/Seismology

Objective – The objective of this criterion is to rank the suitability of the potential sites with respect to the geologic and seismic setting. As each set of potential sites is located in the same general vicinity within a candidate area, the potential site evaluations below in effect compare site suitability for each candidate area. A GEOL Index (weight x rating), as defined in the discussions below, was developed to provide a quantitative measure of geology/seismology site suitability.

Evaluation approach – The geology/seismology criterion encompasses several sub-criteria, including vibratory ground motion, capable tectonic sources, surface faulting and deformation, geologic hazards, and soil stability. The potential sites were evaluated against each geologic/seismic sub-criterion (Sections C.1.1.1.1 through C.1.1.1.5). A numerical system of weights and ratings based upon suitability or avoidance measures specific to each sub-criterion, were used to compute an index number (i.e., rating times weight) for each sub-criterion. To enable the comparative evaluation of sites, the weights and rating schemes adopted herein are the same for all potential sites. The index numbers for each sub-criterion were then summed for each site to compute a site composite GEOL Index as presented in Section C.1.1.1.6. The range of GEOL indexes was then used to develop an overall Geology/Seismology rating scale of 1 to 5 for the potential sites (Section C.1.1.1.6), based on the GEOL scale, with the most suitable sites receiving an overall rating of 5. Weights and the bases for deriving site ratings from the GEOL scale are discussed with respect to each sub-criterion in the sections below. NOTE: Within the

GEOL Index, an inverse rating basis is used for each sub-criterion, with lower numbers indicating more suitable and higher numbers the less suitable.

C.1.1.1.1 Vibratory Ground Motion

Objective – The purpose of this sub-criterion is to rate sites according to the expected magnitude of ground motion that can be expected.

Evaluation approach – Peak Ground Acceleration (PGA) is a measure of the maximum force experienced by a small mass located at the surface of the ground during an earthquake and is an index of hazard for some structures. The units for PGA are in percent of gravity (%g); i.e. an acceleration of 0.30g is expressed as 30%g. PGA provided herein is for a probability of exceedance (PE) of 2% in 50 years (once in 2,500 years). PGA data for the candidate areas were obtained from GIS Data from the USGS National Seismic Hazards Mapping Project, 2014 (http://earthquake.usgs.gov/hazards/products/conterminous/index.php#2014).

Discussion/Results – The PGA values for each of the candidate areas evaluated were obtained directly from USGS digital geographic data and are shown in the table below.

Probabilistic ground motion values in %g

Area	PGA (%g) with 2% PE in 50 years
Oak Ridge Reservation	30 – 40
Redstone Arsenal	12 – 14

The following table shows the assigned weight and rating scheme for vibratory ground motion.

Weight	Range	Rating	GEOL Index Range (weight x rating)
5	**PGA (%g)**		5 - 50
	0 – 5	1	
	5 – 10	2	
	10 – 15	3	
	15 – 20	4	
	20 – 25	5	
	25 – 30	6	
	30 – 35	7	
	35 – 40	8	
	40 – 45	9	
	45 – 50	10	

Based upon the information provided above, each candidate area received the following rating and resulting index number for vibratory ground motion.

Site	Rating	GEOL Index No.
Oak Ridge Reservation	7 – 8	35 – 40
Redstone Arsenal	3	15

C.1.1.1.2 Capable Tectonic Structure or Source

Objective – The objective of this sub-criterion is to identify the existence of capable or potentially capable tectonic structures within 200 miles of each site. Potential sites that are farthest from capable or potentially capable tectonic structures are considered more suitable.

Evaluation Approach – Capable tectonic structures are addressed as avoidance conditions. A database compiled by USGS (Quaternary Fault and Fold Database, http://earthquake.usgs.gov/hazards/qfaults/map/#qfaults) and Crone and Wheeler (2000) was utilized to identify capable and potentially capable tectonic sources within 200 miles of each of the potential sites. It was assumed that capable and potential capable tectonic sources, which are Quaternary features that may generate strong ground motion, fall into two categories as defined by Crone and Wheeler (2000, p5):

> Class A features have good geologic evidence of tectonic origin and are potentially seismogenic; and
>
> Class B features have geologic evidence that supports the existence of a seismogenic fault or suggests Quaternary deformation, but the currently available geologic evidence for Quaternary tectonic activity is less compelling than for a Class A feature.

Discussion/Results – There are no Class A or B features within 200 miles of the potential sites. The following table shows the assigned weight and the rating scheme for capable tectonic sources.

Weight	Range (miles)	Rating	GEOL Index Range (weight x rating)
Class A	None within 200-mile radius	0	
2	Between 100 and 200 miles	2	
	Between 50 and 100 miles	3	0 – 10
	Between 25 and 50 miles	4	
	Within 25 miles	5	
Class B	None within 200-mile radius	0	
1	Between 100 and 200 miles	2	
	Between 50 and 100 miles	3	0 – 5
	Between 25 and 50 miles	4	
	Within 25 miles	5	

Based on the information provided above, each potential site receives the following ratings and computed index numbers.

Class A

Area	Rating	GEOL Index No.
Oak Ridge Reservation	0	0
Redstone Arsenal	0	0

Class B

Area	Rating	GEOL Index No.
Oak Ridge Reservation	0	0
Redstone Arsenal	0	0

Crone and Wheeler (2000) and the USGS Fault Database (2003) also identify Class C and D features. Class C features are defined by Crone and Wheeler (2000) as features where:

> Geologic evidence is insufficient to demonstrate (1) the existence of a tectonic fault, or (2) Quaternary slip or deformation associated with the feature.

No Class C features are known to occur within 200 miles of any of the potential sites.

Class D features are defined by Crone and Wheeler (2000) as features where:

Geologic evidence demonstrates that the feature is not a tectonic fault or feature; this category includes features such as demonstrated joints or joint zones, landslides, erosional or fluvial scarps, or landforms resembling fault scarps, but of demonstrable non-tectonic origin.

No Class D features are known to occur within 200 miles of any of the potential sites.

C.1.1.1.3 Surface Faulting and Deformation

Objective – The objective of this sub-criterion is to develop site ratings for site suitability relative to surface faulting and deformation in the site vicinity.

Evaluation approach – Suitability measures have been established based on the occurrence of surface faulting and tectonic and non-tectonic structures within a 25-mi and 5-mi radius of the potential sites, as follows:

Within 25 miles:

- No such structures altogether (Most Suitable);
- Potential non-capable structures; and
- Potential capable structures (Least Suitable).

Within 5 miles:

- No such structures altogether (Most Suitable);
- Potential non-capable structures;
- Potential capable structures; and
- Fault exceeding 1,000 feet in length (Least Suitable).

The potential for surface faulting or deformation primarily concerns plant design; therefore, features identified within 5 miles of a potential site receive a higher weight. Following are the assigned weights and ratings for surface faulting and deformation.

Weight	Range	Rating	GEOL Index Range (weight x rating)
Between 5 and 25 miles – 1	No structures Potential non-capable structures Potential capable structures	0 1 5	0–5
Within 5 miles – 2	No structures Potential non-capable structures Potential capable structures Fault exceeding 1,000 feet in length Capable fault exceeding 1,000 feet in length	0 2 3 4 5	0–10

Discussion/Results – It is not apparent that significant faulting occurs within 25 miles of any of the potential sites. Based upon this information, the potential sites received the following ratings and computed index numbers for surface faulting and deformation.

Within 25 miles

Area	Rating	GEOL Index No.
Oak Ridge Reservation	0	0
Redstone Arsenal	0	0

Within 5 miles

Area	Rating	GEOL Index No.
Oak Ridge Reservation	0	0
Redstone Arsenal	0	0

C.1.1.1.4 Geologic Hazards

Objective – Based on EPRI guidance, sites having the following geologic and man-made conditions should be avoided:

- Areas of active (and dormant) volcanic activity;
- Subsidence areas caused by withdrawal of subsurface fluids such as oil or groundwater, including areas which may be affected by future withdrawals;
- Potential unstable slope areas, including areas demonstrating paleolandslide characteristics;
- Areas of potential collapse (e.g. karst areas, salt, or other soluble formations);
- Mined areas, such as near-surface coal mined-out areas, as well as areas where resources are present and may be exploited in the future; and
- Areas subject to seismic and other induced water waves and floods.

Evaluation approach – Sites farthest away from these features would be considered the most suitable sites; potential sites were rated in accordance with the presence of – and distance from – these features. Following are the assigned weight and rating used for the geologic hazards sub-criterion:

Weight	Range	Rating	GEOL Index Range (weight x rating)
1	Geologic hazard(s) present	0–1	0–1

Discussion/Results – Oak Ridge Reservation is located in an area of relatively low to moderately low sinkhole density (http://tnlandforms.us/landforms/sinks.php).

Redstone Arsenal is located in an area of relatively high sinkhole density, and related features may be located in the site area (http://gsa.state.al.us/gsa/geologichazards/sinkholes-04-15-2013-small.jpg).

Design specifications for a new nuclear facility must address the possibility of solutioning and sinkhole formation. The potential sites received the following ratings and computed index numbers for geologic hazards:

Area	Rating	GEOL Index No.
Oak Ridge Reservation	0	0
Redstone Arsenal	1	1

C.1.1.1.5 Soil Stability

Objective – The objective of this sub-criterion is to evaluate the sites with respect to the difficulty of expected soil conditions.

Evaluation approach – Certain soil properties have unfavorable characteristics in association with vibratory ground motion. These soil properties include poor mineralogy, low density soil (lack of compaction), and high water content (or high water table). Sites with the highest values of PGA in combination with deleterious site soils would receive a relatively lower rating. Sites having rock foundations or more suitable soil conditions are considered to be better sites.

Following are the assigned weights and ratings for soil stability:

Weight	Range	Rating	GEOL Index Range (weight x rating)
2	Rock site	0	0 – 4
	Deep soil site, no known deleterious soil conditions	1	
	Deep soil site with potential stability issues, or insufficient information available to assign a rating of 1	2	

Discussion/Results – According to the Geologic Map of Tennessee (http://mrdata.usgs.gov/geology/state/state.php?state=TN), the Oak Ridge Reservation (ORR) Sites are underlain by hundreds of feet of predominately limestone or shale with some sandstone. Accordingly, each of these sites is a rock site.

According to the Geologic Map of Alabama (http://mrdata.usgs.gov/geology/state/state.php?state=AL), the Redstone Arsenal sites are underlain by limestone of varying thickness. Accordingly, each of these sites is a rock site.

Each potential site will require specific site investigations to determine if deleterious soil conditions exist.

Based upon this information the potential sites receive the following rating and computed index number for soil stability:

Area	Rating	Index No.
Oak Ridge Reservation	0	0
Redstone Arsenal	0	0

C.1.1.1.6 Overall Rating for Geology/Seismology

The range of GEOL index numbers, which extended from 5 to 85, was used to develop an overall rating for the Geology/Seismology criterion as follows:

GEOL Index Range	Overall Rating
5 – 21	5
22 – 37	4
38 – 53	3
54 – 69	2
70 – 85	1

The GEOL index numbers for each sub-criterion were summed, by site, resulting in a composite GEOL index for each site (Sections C.1.1.1 through C.1.1.2). Accordingly, the composite GEOL index was compared to the index ranges in the above table to determine the overall Geology/Seismology rating for each site. Based upon this methodology, the potential sites are rated as follows:

Area	Composite GEOL Index Number	Overall Rating
Oak Ridge Reservation	35 – 40	**3**
Redstone Arsenal	16	**5**

Ratings for Oak Ridge Reservation

Feature	Source	Weight	Rating	GEOL Index No.
Vibratory Ground Motion	PGA 30-40%g with 2% PE in 50 years (USGS National Seismic Hazards Mapping Project, 2014).	5	7 – 8	35 – 40
Capable Tectonic Source (Class A)	No Class A features occur within 200 miles of the DeSoto site (USGS Fault and Fold Database, 2003. Crone & Wheeler, 2000).	2	0	0
Capable Tectonic Source (Class B)	No Class B features occur within 200 miles of the DeSoto site (USGS Fault and Fold Database, 2003. Crone & Wheeler, 2000).	1	0	0
Surface Faulting & Deformation within 25 miles	No surface faulting or deformation is known to occur near the site.	1	0	0
Surface Faulting & Deformation within 5 miles	No surface faulting or deformation is known to occur at the site.	2	0	0
Geologic Hazards	The site is located in an area of relatively low solutioning and sinkhole formation.	1	0	0
Soil Stability	Area is presumed to be a rock site.	2	0	0
			Composite GEOL Index	**35 – 40**

Ratings for Redstone Arsenal

Feature	Source	Weight	Rating	GEOL Index No.
Vibratory Ground Motion	PGA 12 – 14%g with 2% PE in 50 years (USGS National Seismic Hazards Mapping Project, 2002).	5	3	15
Capable Tectonic Source (Class A)	No Class A features occur within 200 miles of the Glades site (USGS Fault and Fold Database, 2003. Crone & Wheeler, 2000).	2	0	0
Capable Tectonic Source (Class B)	No Class B features occur within 200 miles of the Glades site (USGS Fault and Fold Database, 2003. Crone & Wheeler, 2000).	1	0	0
Surface Faulting & Deformation within 25 miles	No surface faulting or deformation is known to occur near the site.	1	0	0
Surface Faulting & Deformation within 5 miles	No surface faulting or deformation is known to occur near the site.	2	0	0
Geologic Hazards	The site is located in an area of relatively high solutioning and sinkhole formation.	1	1	1
Soil Stability	Area is presumed to be a rock site.	2	0	0
			Composite GEOL Index	**16**

References

Crone, A.J. and Wheeler, R.L. 2000. Data for Quaternary faults, liquefaction features, and possible tectonic features in the Central and Eastern United States, east of the Rocky Mountain front. USGS Open File Report 00-260.

NRC. 1997. Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion Regulatory Guide 1.165.

USGS Earthquakes Hazards Program. National Seismic Hazard Mapping Project. Interpolated Probabilistic Ground Motion for the Conterminous 48 States by Latitude Longitude, 2014 data.

USGS Earthquakes Hazards Program. National Seismic Hazard Mapping Project. Quaternary Fault and Fold Database for the United States, 2005.

USGS. Topographic, various.

C.1.1.2 Cooling System Requirements

Objective – Cooling system requirements are important siting considerations for new power generating facilities. The objective of this criterion is to rate the potential sites with respect to specific cooling system requirements.

Evaluation approach – The principal requirements of interest are the quantity of cooling water available and the ambient air temperature.

Cooling System Type	Cooling System Requirement
Closed-cycle	Make-up flow rate: 30,708 gpm (68.4 cfs, 44.2 Mgal/day) per 800 MWe Assumes no more than 5% of surface water flow is available for new withdrawal

Ambient air temperature characteristics of a potential site affect the design of heat removal systems. The potential sites are all located within a region of similar ambient air characteristics; this aspect is evaluated in section C.1.1.2.2. Various temperature data (e.g., average annual, extreme highs and lows) are compared between sites and ratings assigned based on best professional judgment; sites with overall lower temperatures are considered to be the most suitable.

Discussion/Results – Site data and results are presented for each sub-criterion in Sections C.1.1.2.1 and C.1.1.2.2, below. Overall ratings for the Cooling System Requirements criterion are provided in Section C.1.1.2.3.

C.1.1.2.1 Cooling Water

The potential sites were evaluated with respect to the cooling water criterion during the regional screening phase, and all were found to have access to a river with an adequate flow to support the requirements of a closed-cycle cooling water system. For the evaluation the potential sites were compared based on the recorded flow rate, where greater flow would be expected to result in less risk for regulatory challenge. Site attributes associated with pipeline routing or pumping are reflected in section C.4.1.2. Ratings were assigned based on the average flow for the nearest gaging station's period of record.

5 = Flow greater than 80 times requirement
4 = Flow greater than 60 times requirement and less than or equal to 80 times requirement
3 = Flow greater than 40 times requirement and less than or equal to 60 times requirement
2 = Flow greater than 20 times requirement less than or equal to 40 times requirement

Site	Rating	Evaluation
2	4	Gaging Station – Clinch River near Oak Ridge, TN (03538150) Average Flow = 4,571 cfs (66 times plant requirement)

Site	Rating	Evaluation
3	4	Gaging Station – Clinch River near Oak Ridge, TN (03538150) Average Flow = 4,571 cfs (66 times plant requirement)
4	4	Gaging Station – Clinch River near Oak Ridge, TN (03538150) Average Flow = 4,571 cfs (66 times plant requirement)
8	4	Gaging Station – Clinch River at Melton Hill Dam (03535912) Average Flow = 4,908 cfs (71 times plant requirement)
10	4	Gaging Station – Clinch River at Melton Hill Dam (03535912) Average Flow = 4,908 cfs (71 times plant requirement)
O1	4	Gaging Station – Clinch River near Oak Ridge, TN (03538150) Average Flow = 4,571 cfs (66 times plant requirement)
O2	4	Gaging Station – Clinch River at Melton Hill Dam (03535912) Average Flow = 4,908 cfs (71 times plant requirement)
12	5	Gaging Station – Tennessee River at Whitesburg, AL (03575500) Average Flow = 43,472 cfs (635 times plant requirement)
13	5	Gaging Station – Tennessee River at Whitesburg, AL (03575500) Average Flow = 43,472 cfs (635 times plant requirement)
14	5	Gaging Station – Tennessee River at Whitesburg, AL (03575500) Average Flow = 43,472 cfs (635 times plant requirement)
15	5	Gaging Station – Tennessee River at Whitesburg, AL (03575500) Average Flow = 43,472 cfs (635 times plant requirement)
16	5	Gaging Station – Tennessee River at Whitesburg, AL (03575500) Average Flow = 43,472 cfs (635 times plant requirement)
17	5	Gaging Station – Tennessee River at Whitesburg, AL (03575500) Average Flow = 43,472 cfs (635 times plant requirement)
R1	5	Gaging Station – Tennessee River at Whitesburg, AL (03575500) Average Flow = 43,472 cfs (635 times plant requirement)

C.1.1.2.2 Ambient Temperature Requirements

Temperature data were obtained from local weather stations as compiled by the Southeast Regional Climate Center – historical climate summaries – which is part of the National Oceanic and Atmospheric Administration's National Climate Data Center (NOAA NCDC). Closest daily weather stations with a reasonable period of record (e.g., more than 20 years) were selected for each site. Maximum and minimum annual temperature values, as well as the highest and lowest average monthly temperatures values, and the annual average monthly mean values, were compared between sites. Actual meteorological conditions at the potential sites, however, may vary slightly from the data collected and evaluated for the closest reporting (representative) weather stations: Oak Ridge Average Temperature Deviation Detection (ATDD) for the ORR Sites (2, 3, 4, 5, 8, 10, O1 and O2); and Huntsville International Airport for the Redstone Arsenal sites (12, 13, 14, 15, 16, 17, R1). The periods of record for all sites extends from 1981 to 2010; the period of record for highest and lowest temperatures is 1958 to 2015 for Huntsville and 1948 to 2015 for Oak Ridge.

Discussion/Results – Differences between individual sites within a given candidate area are negligible for purposes of this study such that the set of Oak Ridge and Redstone sites were compared to each other to assess their relative suitability with respect to selected temperature extremes and frequency values.

With the exception of extreme low temperature values, sites with the lower temperatures are considered to be the most suitable. Based on a comparison of highest and lowest temperature (daily extremes), average daily high and low temperature records, annual average monthly mean temperatures, and consideration of general climate conditions at the sites, the variation in temperatures between candidate areas was very small. This is not surprising given that they are located in the same geographic area of the southeastern United States. The differences were small enough that identical ratings were assigned to each site. In addition, because the temperatures are, in general, higher than other parts of the country, and the maximum temperatures exceeded 100 in all cases, a conservative rating of 3 was given to all sites.

Ambient Temperature (degrees F)	Highest temperature of record	Highest monthly average	Lowest temperature of record	Lowest monthly average	Annual Monthly Average Mean	Rating
Oak Ridge Reservation (ATDD)	105	88	-17	27.9	58.5	**3**
Huntsville International (Airport)	106	90.9	-11	31.8	62	**3**

Sources:
NOAA National Centers for Environmental Information, Summary of Monthly Normals (Huntsville Intl AP, AL and Oak Ridge ATDD, TN), 1981-2010
National Weather Service, Huntsville, AL5
http://www.srh.noaa.gov/hun/?n=huntsvillenormalsandextremesdatabase
Oak Ridge Climate Page at http://www.srh.noaa.gov/mrx/?n=oqtclimate
NOAA low temperature and high temperature data at: www1.ncdc.noaa.gov/pub/data/ccd-data/lowtmp15.dat and www1.ncdc.noaa.gov/pub/data/ccd-data/hghtmp15.dat

C.1.1.2.3 Cooling System Requirements Rating

The composite ratings for the potential sites are based on the average of the ratings for the cooling water supply composite and ambient air temperature ratings. Numerical results ending in a decimal fraction of 0.5 or less are rounded down to the nearest whole number. This convention is used throughout the criteria evaluations.

Site	Cooling Water Supply	Ambient Temperature	Composite Rating
2	4	3	3
3	4	3	3

Site	Cooling Water Supply	Ambient Temperature	Composite Rating
4	4	3	3
8	4	3	3
10	4	3	3
O1	4	3	3
O2	4	3	3
12	5	3	4
13	5	3	4
14	5	3	4
15	5	3	4
16	5	3	4
17	5	3	4
R1	5	3	4

References

USGS: Annual Water Data Reports, http://wdr.water.usgs.gov/.

http://www.ncdc.noaa.gov/cdo-web/quickdata
https://www.ncdc.noaa.gov/ghcn/comparative-climatic-data
http://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/climate-normals/1981-2010-normals-data

C.1.1.3 Flooding

Objective – The objective of this criterion is to evaluate the suitability of the potential sites with respect to potential flooding.

Evaluation Approach – The relative suitability of the potential sites was evaluated with respect to site grade elevation and the 100-year flood elevation for the major river or lake on which the plant would be located. The 100-year flood elevations were based on Flood Insurance Rate Maps (FIRM) from FEMA for the respective counties in which the sites are located. Primary emphasis was on flood elevations for the main water bodies (rivers and reservoirs) and their major tributaries where flood elevations were identified. Finally, other potential flooding sources (e.g., upstream dam failure concerns) were also considered. Ratings were assigned as follows:

5 = Site is not located within 100-year floodplain, and no potential upstream flooding concerns exist (e.g., dam failure).
4 = Site is not located within 100-year floodplain, but potential upstream flooding concerns exist.

3 = Site (or portions of site) is within or adjacent to 100-year floodplain, site is protected from flooding by existing levees or flood protection structures, and no potential upstream flooding concerns exist.
2 = Site (or portions of site) is located within or adjacent to 100-year floodplain, but no potential upstream flooding concerns exist.
1 = Site (or portions of site) is located within or adjacent to 100-year floodplain, and potential upstream flooding concerns exist.

Discussion/Results – Additional pertinent flood-related information for the potential sites is shown in the following table, followed by the site ratings.

Site	Evaluation	Rating
2	Site elevation = approx. 900 ft. Clinch River elevation = approx. 739 ft. Difference = 161 ft. Site is located in Flood Zone X (outside of 500-year flood zone), area base flood elevations = 747 ft. Melton Hill Dam is located upstream of the site.	4
3	Site elevation = approx. 800 ft. Clinch River elevation = approx. 739 ft. Difference = 61 ft. Site is located in Flood Zone X (outside of 500-year flood zone), area base flood elevations = 748 ft. Melton Hill Dam is located upstream of the site.	4
4	Site elevation = approx. 800 ft. Clinch River elevation = approx. 739 ft. Difference = 61 ft. Site is primarily located in Flood Zone X (outside of 500-year flood zone), but areas of site include a drainage from an unnamed stream and are within Flood Zone AE (within 100-year flood zone). Area base flood elevations = 749-750 ft. Melton Hill Dam is located upstream of the site.	4
5	Site elevation = approx. 900 ft. Clinch River elevation = approx. 739 ft. Difference = 161 ft. Site is located in Flood Zone X (outside of 500-year flood zone), area base flood elevations = 751 ft. Melton Hill Dam is located upstream of the site.	4
8	8Site elevation = approx. 950 ft. Clinch River elevation = approx. 801 ft. Difference = 149 ft. Site is located in Flood Zone X (outside of 500-year flood zone), area base flood elevations = 796 ft. Norris Dam is located upstream of the site.	4

Site	Evaluation	Rating
10	Site elevation = approx. 1,100 ft. Clinch River elevation = approx. 801 ft. Difference = 299 ft. Site is located in Flood Zone X (outside of 500-year flood zone), area base flood elevations = 796 ft. Norris Dam is located upstream of the site.	4
O1	Site elevation = approx. 800 ft. Clinch River elevation = approx. 739 ft. Difference = 61 ft. Site is located in Flood Zone X (outside of 500-year flood zone), between areas with base flood elevations = 747 ft. Melton Hill Dam is located upstream of the site.	4
O2	Site elevation = approx. 1,050 ft. Clinch River elevation = approx. 801 ft. Difference = 249 ft. Site is located in Flood Zone X (outside of 500-year flood zone), between areas with base flood elevations = 796 ft. Norris Dam is located upstream of the site.	4
12	Site elevation = approx. 650 ft. Tennessee River elevation = approx. 555 ft. Difference = 95 ft. Site is located in Flood Zone X (outside of 500-year flood zone), adjacent to areas in Flood Zone A (within 100-year flood zone). Guntersville Dam is located upstream of the site.	1
13	Site elevation = approx. 571 ft. Tennessee River elevation = approx. 555 ft. Difference = 16 ft. Site is located in Flood Zone X (outside of 500-year flood zone), adjacent to areas in Flood Zone A (within 100-year flood zone). Guntersville Dam is located upstream of the site.	1
14	Site elevation = approx. 571 ft. Tennessee River elevation = approx. 555 ft. Difference = 16 ft. Site is located on the border of Flood Zone X (outside of 500-year flood zone) and Flood Zone A (within 100-year flood zone). Guntersville Dam is located upstream of the site.	1
15	Site elevation = approx. 640 ft. Tennessee River elevation = approx. 555 ft. Difference = 85 ft. Site is located in on the border of Flood Zone X (outside of 500-year flood zone) and Flood Zone A (within 100-year flood zone). Guntersville Dam is located upstream of the site.	1

Site	Evaluation	Rating
16	Site elevation = approx. 625 ft. Tennessee River elevation = approx. 555 ft. Difference = 70 ft. Site is located in on the border of Flood Zone X (outside of 500-year flood zone) and Flood Zone A (within 100-year flood zone). Guntersville Dam is located upstream of the site.	1
17	Site elevation = approx. 625 ft. Tennessee River elevation = approx. 555 ft. Difference = 70 ft. Site is located in on the border of Flood Zone X (outside of 500-year flood zone) and Flood Zone A (within 100-year flood zone). Guntersville Dam is located upstream of the site.	1
R1	Site elevation = approx. 610 ft. Tennessee River elevation = approx. 555 ft. Difference = 55 ft. Site is located in on the border of Flood Zone X (outside of 500-year flood zone) and Flood Zone A (within 100-year flood zone). Area base flood elevations = 576 ft. Guntersville Dam is located upstream of the site.	1

References

FEMA Digital Flood Insurance Rate Maps, http://www.msc.fema.gov.

Google Earth, http://earth.google.com.

NOAA Stream and Flood Data, http://www.weather.gov/ahps/.

USGS Topographic Maps (1:100,000 and 1:24,000 scale).

U.S. Flood Hazard Areas, http://www.esri.com/hazards/makemap.html.

C.1.1.4 Nearby Hazardous Land Uses

Objective – The objective of this criterion is to include NRC guidance on considerations regarding the nature and proximity of man-made hazards (dams, airports, transportation routes, and military and chemical manufacturing and storage facilities).

Evaluation approach – Site suitability is evaluated based on the relative number of and distance to the off-site man-made hazards (within 5 to 10 miles) that could be identified on USGS topographic maps, supplemented by information found in existing environmental reports for each site (e.g., major airport, freight rail, barge traffic, oil and gas pipelines, etc.). Potential sites

evaluated in this study are located within government facilities that include hazardous activities and facilities as part of their overall mission. Therefore, the focus of this evaluation has been on a general comparison of the hazards present on the ORR and Redstone Arsenal based on their respective missions. Given the known hazards present, the assigned ratings are based on a qualitative evaluation and best professional judgment given the number and types of hazards identified; proximity to major airports was also taken into account.

Discussion – Identified hazards at each of the sites are as follows:

Oak Ridge Reservation Sites:

Airports:
The closest commercial airports to the approximate center of the ORR are the McGhee Tyson Airport (approximately 14 mi away with more than 83,000 operations per year) and the Knoxville Downtown Island Airport (approximately 24 m away with more than 100,000 operations in 2014. The nearest private airport is the Oliver Springs Inc. Airport is located approximately 7 mi north of the approximate center of the ORR with an average of 25 operations per day (9125 operations per year). All ORR Sites are considered to be equal distance from regional airports.

Onsite Hazards:
The ORR includes three DOE campuses with distinct missions: the Oak Ridge National Laboratory (ORNL), the Y-12 National Security Complex (Y-12 Complex), and the East Tennessee Technology Park (ETTP) (Figure 3.1-3). The ORNL is the DOE's largest multipurpose laboratory conducting research in advanced materials exploration, alternative fuels, climate change, and supercomputing. Two of ORNL's more significant facilities include the Spallation Neutron Source facility, the world's foremost center for neutron science research, and the High Flux Isotope Reactor, an 85-MW high flux reactor-based source of neutrons. The Y-12 Complex mission includes modernizing defense systems and reducing nuclear stockpiles worldwide. The ETTP is located on the former uranium enrichment complex, which is currently being remediated, revitalized, and transitioned into a private sector business/industrial park.

Each potential site on and off the Reservation are located within 5 miles of ETTP, Y-12 or ORNL. Site 4 includes a surface danger zone.

An assessment of the industrial, military, and/or transportation facilities surrounding the ORR Candidate Area did not indicate any limiting conditions that would affect suitability of the ORR Sites.

Redstone Arsenal Sites:

Airports:
The primary mission of Redstone Arsenal is explosives training and research. The installation includes 25,860 acres of land dedicated to testing areas and a 7,200-foot airfield runway. Redstone Arsenal Sites 12, 14 and 15 are located within 5 miles of the Huntsville International Airport, which has an average of 160 operations per day (58,400 per year). Additionally, these three sites are also located less than 5 mi from the Redstone Army Airfield. Sites 13 and 16 are also located within 5 miles from the Redstone Army Airfield and between 5 and 10 miles from

Huntsville International Airport. Site 17 and R1 is located between 5 and 10 miles from both Huntsville International Airport and Redstone Army Airfield.

Onsite Hazards:
The primary mission of Redstone Arsenal is explosives training and research. The installation is a garrison for the following:

- U.S. Army Aviation and Missile Command;
- U.S. Army Materiel Command;
- U.S. Department of Defense (DOD) Missile Defense Agency;
- U.S. Army Space and Missile Defense Command; and
- Aviation & Missile Research, Development and Engineering Center.

The Industrial Zone comprises the majority of the garrison property, covering the lower half and northwest corner of the property. Industrial and explosives operations, test areas, warehousing, and ammunition storage, which support the primary mission, are located within the Industrial Zone. Additionally, the National Aeronautics and Space Administration's (NASA) Marshall Space Flight Center occupies approximately 1800 ac within the Redstone Arsenal reservation.

All the Redstone sites are located within the Industrial Zone, except R1 which is outside the Arsenal boundary. However, Site14 has been called out to have special hazard concerns since it is almost entirely within an active munitions firing range and has been frequently affected historically and currently by range activities that include explosives detonations, grass fires, mowing, and vehicle traffic.

Based on the military mission at Redstone Arsenal, there are issues associated with the safety consideration that may limit the ability to identify suitable Potential Sites unless cognizant military organizations agree to change the land use in some areas of the installation to reduce both the potential effects on the project and the effects on the installation's mission.

Redstone Arsenal's mission is directly associated with research and development of innovative sciences and technologies, and is focused on space operations and defense systems. 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 a Redstone Arsenal Site is selected as the preferred location for the SMR facility. Additionally, Redstone Arsenal has expressed interest in an SMR at a Redstone Arsenal Site to aid in meeting federal agency GHG emission reduction goals.

Results:

Because potentially hazardous land uses are found on both installations the highest rating assigned to any site was a 3. The ORR Sites are given a rating of 3 except for Site 4, which includes a safety danger zone and is given a slightly lower rating of 2. The potential impacts to an SMR would appear to be greater for Redstone Arsenal than ORR sites, given its mission and use for munition storage and explosive operations. It is also closer to a major airport and includes a runway on the installation. These were initially assigned a rating of 1 but given the Arsenal's intent to modify mission to meet land use requirements the ratings were increased to a 2 (there

would still be potential safety concerns from nearby hazards even if they no longer occurred on the selected site). The exceptions are 14 and R1. Site 14 is given a lower rating of 1 given it is almost entirely within an active munitions firing range and has been affected historically and is currently by range activities that include explosives detonations. Site R1 is given a slightly higher rating of 3 since it is not located in the industrial area but just off-site and farthest away from the airports and installation runway.

Site	Rating
2, 3, 5, 8, 10, O1, O2	3
4	2
12, 13, 15, 16, 17	2
14	1
R1	3

References

Oakridge Reservation (General and Basic Facts) available at:
DOE Oak Ridge Operations: http://energy.gov/em/oak-ridge-site;
ORNL: https://www.ornl.gov/
Y-12: http://www.y12.doe.gov/
ETTP: http://www.ettpreuse.com/ and http://www.ucor.com/

McGhee Tyson Airport, Downtown Island Airport, Website:
http://www.flyknoxville.com/tys/work-with-the-airport/downtown-island-airport-documents/
McGhee Tyson Airport, McGhee Tyson Airport, Website:
http://www.flyknoxville.com/tys/assets/Aviation-Activity-plus-Freight-December-2014.pdf
AirNav.com, TN08 Oliver Springs Inc Airport, Website:
http://www.airnav.com/airport/TN08

Redstone Arsenal (General Information and Basic Facts) available at:
http://www.garrison.redstone.army.mil/#

Huntsville International Airport, HSV Huntsville International Airport, Website:
http://www.flyhuntsville.com/hsv/airport-information/#.WDyDf9KQzcs

Google Earth, http://earth.google.com.

USGS Topographic Maps.

C.1.1.5 Extreme Weather Conditions

Objective – The objective of this criterion is to rate the suitability of the potential sites with respect to extreme weather conditions.

Evaluation approach – Extreme weather data readily available for the potential sites included fastest mile speed (available for selected cities); number of tornadoes and violent tornadoes per 10,000 square miles (state average); and maximum 24-hour precipitation values. Available extreme weather data were obtained from government sources (National Climate Data Center and Southeast Regional Climate Center), including NCDC Climatic Wind Data for U.S.

Rating of the sites was performed based on a comparison of fastest mile (wind) speeds, maximum 24-hour precipitation and severe storm records, including hurricanes and tornadoes, where proximity to coast as an indicator of greater probability of hurricane threat, and/or to Dixie Alley (Gulf Coast) as an indicator of greater probability of tornado threat.

Hurricane direct hits on the mainland U.S. coastline and for individual states 1851-2004 by Saffir/Simpson category.

Area	Category Number					All (1-5)	Major (3-5)
	1	2	3	4	5		
Alabama	11	5	6	0	0	22	6

Source: National Hurricane Center at http://www.nhc.noaa.gov/paststate.shtml

Site	Fastest Mile (1972-2015)	Tornado Frequency: State Annual Average Overall / Strong violent / Strong violent per 10,000 sq mi [1991-2010]	Proximity to Coast/ Hurricane Threat	Maximum 24-hr precip. [in]
2, 3, 4, 5, 8, 10, O1, O2	86 [Knoxville, TN]	26 2.7 0.6 Tennessee	Inland	7.45 (Oak Ridge, TN; 1960) [1948-current]
12, 13, 14, 15, 16, 17, R1	94 [Huntsville, AL]	44 1.7 0.3 Alabama	Inland	9.07 (in 1990) [1971-2000]

https://www.ncdc.noaa.gov/climate-information/extreme-events/us-tornado-climatology/trends
http://www.srh.noaa.gov/hun/?n=huntsvillenormalsandextremesdatabase
http://www.srh.noaa.gov/mrx/?n=oqtclimate
http://www1.ncdc.noaa.gov/pub/data/ccd-data/maxwnd15.dat

Discussion/Results – In general, all the sites are inland and while the Redstone sites are slightly closer to the coast (potentially greater hurricane fallout) and within Dixie Alley. The annual average number of tornadoes is higher for Alabama than for Tennessee; the annual average number violent tornadoes is lower for Alabama than Tennessee as a whole, although this may not necessarily be representative of East Tennessee given its greater topographic relief. Because precipitation and wind speeds are slightly higher for Huntsville than Oak Ridge, the Redstone sites were rated slightly lower than the ORR Sites.

Site	Rating
2, 3, 4, 5, 8, 10, O1 and O2	3
12, 13, 14, 15, 16, 17, R1	2

C.1.2 Accident Effects-Related

Objective – The overall objective of this criterion is to evaluate sites with respect to design-related accident evaluations and potential effects of accidents.

Evaluation approach – Site ratings for this criterion were developed as a composite of three sub-criteria that address site characteristics relevant to consideration of accidents: Population, Emergency Planning, and Atmospheric Dispersion.

Discussion/Results – A discussion of each sub-criterion appears in the following sections C.1.2.1, C.1.2.2, and C.1.2.3. A discussion of the roll-up of the sub-criterion ratings into an overall rating for the Accident Effects-Related criterion appears in Section C.1.2.4.

C.1.2.1 Population

Objective – The objective of this sub-criterion is to evaluate the relative suitability of the potential sites with respect to the population density in the vicinity of the sites. For the purposes of this evaluation, it was assumed the potential sites meet the population density conditions codified in 10 CFR 100.21. These conditions are:

- The sites have exclusion area authority;
- A low population zone exists beyond the exclusion area; and
- Sufficient distance exists to high-population centers.

Evaluation approach – As outlined in NRC Regulatory Guide 4.7 – General Site Suitability Criteria for Nuclear Power Stations, low-population areas are preferred and low-population zones should have densities less than 500 people per square mile (equivalent to less than 25,000 persons within 4 miles).

Host county population density and proximity to the nearest incorporated area are considered. In the case of County population density, the following metric was used:

5 = less than 100 psm
4 = less than 200 psm

3 = less than 300 psm
2 = less than 400 psm
1 = 400 psm or greater

With respect to proximity to nearest populated area, the following ratings metric was used:

5 = > 20 miles
4 = < 20 miles
3 = < 15 miles
2 = < 10 miles
1 = < 5 miles

An additional component, proximity to densely populated areas, was considered at this phase which was based on distance to the nearest metropolitan statistical area (MSA), or more specifically as measured to the largest city(ies) found within the MSA. While not tied to a specific population density, the MSAs were assumed to have sufficiently high population levels that some areas could exceed a population density of 500 psm. Online data were obtained from the U.S. Census Bureau. Finally, since both sets of sites are on or adjacent to large federal installations with a large workforce, the facility workforce is also taken into account.

Discussion/Results – The population data and distance to population centers that drive the ratings are presented for each site in the following table.

Population and Population Density (By County)	Notes
Anderson County, Tennessee [host county O2]	
75,749 (2015); 75,126 (2010) 0.8% growth County Population Density: 220.8 psm (2010) ORR Workforce (federal and contractor employees – approximately 12,000)	Population Area Within 5 miles Oak Ridge (29,302) [2015], 2 miles Karns (11,119) [2007] Population Area Within 10 miles Oliver Springs (3,246) [2013] Clinton (10,049) [2015] Population Area Within 15 miles Knoxville (185,291) [2015] Nearest MSA – Knoxville (857,585) [between 10 and 15 miles]

Population and Population Density (By County)	Notes
Roane County, Tennessee [host county 1, 2, 3, 4, 5, 8, 10, O1]	
52,753 (2015); 54,180 (2010); -2.6% growth County Population Density: 150.2 psm ORR Workforce (federal and contractor employees – approximately 12,000)	Population Area Within 5 miles Kingston (5,846) [O1] Population Area Within 10 miles Oak Ridge (29,302) [all listed ORR Sites; 3 farthest at just around 10 miles] Kingston (5,846) [2, 3, 4] Harriman (6,224) [2, 3, O1] Lenoir City (9,091): [3, 4, 5, 8, 10] Farragut (21,919): [5, 8, 10] Population Area Within 15 miles Oliver Springs (3,246): [3, 5, 8] Population Area Within 20 miles Knoxville (185,291) [2015] [all listed ORR Sites] Nearest MSA – Knoxville (857,585) [between 15 and 20 miles]
Madison County, Alabama [host county 12, 13, 14, 15, 16, 17, R1]	
353,089 (2015); 334,811 (2010); 5.5% growth County Population Density: 417.7 psm Note that the federal and contractor workforce at Redstone Arsenal is over 35,000; they are concentrated in the professional zone located in the northeastern and central portions of the Arsenal. All of the Redstone Sites are within 5 miles of the Professional Zone. Site 13 is closest to the Professional Zone.	Population Area Within 5 miles Huntsville (190,582) (2015): R1 (right at 5 miles) Chelsea (12,059) (2015): R1 (less than 5 miles) Madison (46,962) (2015): 12 (right at 5 miles) Triana (514) (2013): 12, 13, 14, 15, 16 Laceys Spring (5,284) (2014): 17 Population Area Within 10 miles: Huntsville (190,582): 12, 13, 14, 15, 16, 17 Madison (46,962) (2015): 13, 14, 15, 16, 17, R1 Triana (514): R1 Laceys Spring (5,284): 12, 13, 14, 15, 16, R1 Huntsville, AL 190,582 Proximity to Huntsville, AL MSA [441,086 estimated 2014]: R1 and 13 closest to Huntsville MSA – less than 5 miles for R1 and both less than 5 miles from the population south extending along Route 231 south of Huntsville

ORR is located 25 mi west of Knoxville, Tennessee, which is the closest metropolitan area. The Knoxville, Tennessee 2015 city population is 185,291 (U.S. Census Bureau 2016). ORR is located within the city limits of Oak Ridge, Tennessee, which has a population of 29,302 (U.S. Census Bureau 2016).

Redstone Arsenal is located immediately west of the city of Huntsville, Alabama, which has a 2015 population of 190,582 (U.S. Census Bureau 2016). The next closest community is the city of Madison, Alabama, approximately 1 mi to the northwest, with a 2015 population of 46,962 (U.S. Census Bureau 2016).

Based on the above information, the following site ratings were assigned.

Site	County Population	Distance to Populated Area	Proximity to Densely Populated Area	Composite Rating
2	4	2	4	3
3	4	2	4	3
4	4	2	4	3
5	4	2	4	3
8	4	2	4	3
10	4	2	4	3
O1	4	1	4	3
O2	3	1	3	2
12	1	1	2	1
13	1	1	1	1
14	1	1	2	1
15	1	1	2	1
16	1	1	2	1
17	1	1	2	1
R1	1	1	1	1

References

Oak Ridge workforce population numbers available at:
http://www.eteda.org/data_library/major_employers/largest_employers.aspx
http://science.energy.gov/laboratories/oak-ridge-national-laboratory/
http://www.y12.doe.gov/sites/default/files/pdf/page/ygg-14-0371r3_about_y12.pdf

Redstone Arsenal workforce population numbers available at:
http://www.garrison.redstone.army.mil/#

US Census Bureau, 2010 to 2015 population data [Quick Facts], available at:
http://quickfacts.census.gov/qfd/states/12000.html.

http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk [MSA data – American Fact Finder]

C.1.2.2 Emergency Planning

Objective – The objective of this criterion is to evaluate the relative suitability of the potential sites with respect to emergency planning characteristics of the general area around each site.

Evaluation approach – In particular, this evaluation relies on information pertaining to general population in the surrounding area, road conditions the near site, access to major traffic networks, terrain features, and climatic conditions. Sites with the least constrained evacuation planning issues (low population, good access from the site to major traffic networks, and no terrain or climate limitations) were considered the most suitable. Ratings are based on review of county websites (transportation information), USGS topographic maps, and best professional judgment. Ratings relate to extent of development in the general area, the number of roads providing egress from the site area, and proximity to major U.S. highway systems.

Because all sites are in the vicinity of existing federal facilities with established emergency plans, feasible evacuation plans for the potential SMR should be readily achievable. Accordingly, each site was given an initial rating of 5, with points deducted for sites having geographic or physical constraints to evacuation in some directions conducted and/or it is particularly close to population areas.

Discussion/Results – A summary of information for each site is shown in the table below.

Site	Evaluation	Rating
2	Potential site is located immediately southeast of Highway 58. Area evacuation is possible in all directions. Potential site is in the vicinity of ORNL K-25. No other special evacuation considerations are in the immediate vicinity of the site. Potential site is located in the general vicinity of Oak Ridge National Laboratory, which has existing emergency plans in place.	5
3	Potential site is located southeast of Highway 58 and west of Highway 95. Immediate area evacuation is limited to the south due to the Clinch River. Potential site is in the vicinity of ORNL K-25. No other special evacuation considerations are in the immediate vicinity of the site. Potential site is located in the general vicinity of Oak Ridge National Laboratory, which has existing emergency plans in place.	4

Site	Evaluation	Rating
4	Potential site is located southeast of Highway 58 and west of Highway 95. Immediate area evacuation is limited to the south due to the Clinch River. Potential site is in the vicinity of ORNL K-25. No other special evacuation considerations are in the immediate vicinity of the site. Potential site is located in the general vicinity of Oak Ridge National Laboratory, which has existing emergency plans in place.	4
5	Potential site is located adjacent to Highway 95. Area evacuation is possible in all directions. Potential site is in the vicinity of ORNL facilities. No other special evacuation considerations are in the immediate vicinity of the site. Potential site is located in the general vicinity of Oak Ridge National Laboratory, which has existing emergency plans in place.	5
8	Potential site is located east of Highway 95. Immediate area evacuation is limited to the south and east due to the Clinch River. Potential site is in the vicinity of ORNL facilities. No other special evacuation considerations are in the immediate vicinity of the site. Potential site is located in the general vicinity of Oak Ridge National Laboratory, which has existing emergency plans in place.	4
10	Potential site is located east of Highway 95. Immediate area evacuation is limited to the south and east due to the Clinch River. Potential site is in the vicinity of ORNL facilities. No other special evacuation considerations are in the immediate vicinity of the site. Potential site is located in the general vicinity of Oak Ridge National Laboratory, which has existing emergency plans in place.	4
O1	Potential site is located west of Highway 58 and south of Highway 325. Immediate area evacuation is limited to the south due to the Clinch River. Potential site is immediately adjacent to ORNL K-25. No other special evacuation considerations are in the immediate vicinity of the site. Potential site is located in the general vicinity of Oak Ridge National Laboratory, which has existing emergency plans in place.	4

Site	Evaluation	Rating
O2	Potential site is located adjacent to Highway 170. Area evacuation is possible in all directions. Potential site is in the vicinity of ORNL facilities. Potential site is located nearer Oak Ridge, TN than other area sites, and site location is in closer proximity to potential special evacuation considerations. Potential site is located in the general vicinity of Oak Ridge National Laboratory, which has existing emergency plans in place.	3
12	Potential site is located south of I-565. Immediate area evacuation is limited to the south due to the Tennessee River. Potential site is in the vicinity of Redstone Arsenal facilities. Surrounding populations could present special evacuation considerations. Potential site is located in the general vicinity of Redstone Arsenal, which has existing emergency plans in place.	3
13	Potential site is located south of I-565. Immediate area evacuation is limited to the south due to the Tennessee River. Potential site is in the vicinity of Redstone Arsenal facilities. Surrounding populations could present special evacuation considerations. Potential site is located in the general vicinity of Redstone Arsenal, which has existing emergency plans in place.	3
14	Potential site is located south of I-565. Immediate area evacuation is limited to the south due to the Tennessee River. Potential site is in the vicinity of Redstone Arsenal facilities. Surrounding populations could present special evacuation considerations. Potential site is located in the general vicinity of Redstone Arsenal, which has existing emergency plans in place.	3
15	Potential site is located south of I-565. Immediate area evacuation is limited to the south due to the Tennessee River. Potential site is in the vicinity of Redstone Arsenal facilities. Surrounding populations could present special evacuation considerations. Potential site is located in the general vicinity of Redstone Arsenal, which has existing emergency plans in place.	3

Site	Evaluation	Rating
16	Potential site is located south of I-565. Immediate area evacuation is limited to the south due to the Tennessee River. Potential site is in the vicinity of Redstone Arsenal facilities. Surrounding populations could present special evacuation considerations. Potential site is located in the general vicinity of Redstone Arsenal, which has existing emergency plans in place.	3
17	Potential site is located south of I-565. Immediate area evacuation is limited to the south due to the Tennessee River. Potential site is in the vicinity of Redstone Arsenal facilities. Surrounding populations could present special evacuation considerations. Potential site is located in the general vicinity of Redstone Arsenal, which has existing emergency plans in place.	3
R1	Potential site is located west of Highway 231. Area evacuation is possible in all directions. Potential site is in the vicinity of Redstone Arsenal facilities. Surrounding populations are nearer than other Redstone Arsenal sites and could present special evacuation considerations. Potential site is located in the general vicinity of Redstone Arsenal, which has existing emergency plans in place.	3

References

Rand McNally Road Atlas.

USGS Topographic Maps.

C.1.2.3 Atmospheric Dispersion

Objective – The objective of this criterion is to evaluate the suitability of the potential sites with respect to short-term atmospheric dispersion characteristics, as a measure of the relative level of concentrations that could occur during accident conditions at the sites.

Evaluation Approach – The efficiency of atmospheric diffusion is primarily dependent on wind speed, wind direction, and the change in air temperature with height which affects atmospheric stability. These factors are used to calculate an atmospheric dispersion function referred to X/Q.

Discussion/Results – The best way to calculate atmospheric dispersion (X/Q) is using on-site meteorological data; however, no such data were readily available for all potential sites. Therefore atmospheric dispersion was evaluated based on general area meteorological conditions for the ORR and Redstone Arsenal. Should atmospheric dispersion become a sensitive criterion

for site selection, site-specific meteorological data should be/ obtained to calculate an atmospheric dispersion function (X/Q) for more accurate site comparison.

Site	Evaluation	Rating
2	The ORR Sites are situated along mountain ranges, with alternating ridges and valleys in the vicinity. 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 mph) for all sites. Site meteorological characteristics (specific to Site 3, but representative of the area) include light winds speeds and predominately stable conditions. Professional judgement drawn from the above described meteorological conditions resulted in all ORR Sites received a rating of 4.	**4**
3		**4**
4		**4**
5		**4**
8		**4**
10		**4**
O1		**4**
O2		**4**
12	Topographic conditions at the Redstone sites include predominately flat terrain with the Tennessee River situated to the south, and hills and plateaus surrounding the area to the north and east. Flatter terrain and higher average wind speeds for the Redstone sites result in favorable dispersion conditions. Professional judgement drawn from the above described meteorological conditions resulted in all ORR Sites received a rating of 5.	**5**
13		**5**
14		**5**
15		**5**
16		**5**
17		**5**
R1		**5**

References

USGS Topographic Maps (1:100,000 and 1:24,000 scale).

Evaluation of Atmospheric Dispersion Characteristics for Alternative SMR Sites, TVA 2016.

C.1.2.4 Accident Effect-Related Overall Rating

Overall ratings for this criterion (Accident Effects-Related) are a composite of the sub-criterion ratings (C.1.2.1, C.1.2.2, and C.1.2.3). The ratings for each sub-criterion, along with the overall rating for this criterion, are provided in the following table.

Site	Population	Emergency Planning	Atmospheric Dispersion	Overall Rating
2	3	5	4	4
3	3	4	4	4
4	3	4	4	4
5	3	5	4	4
8	3	4	4	4

Site	Population	Emergency Planning	Atmospheric Dispersion	Overall Rating
10	3	4	4	4
O1	3	4	4	4
O2	2	3	4	3
12	1	3	5	3
13	1	3	5	3
14	1	3	5	3
15	1	3	5	3
16	1	3	5	3
17	1	3	5	3
R1	1	3	5	3

C.1.3 Operational Effects-Related

C.1.3.1 Surface Water – Radionuclide Pathway

Objective – The purpose of this criterion is to evaluate potential sites with respect to potential liquid pathway dose consequences. Besides potential source terms, dilution in the receiving surface water body is of primary importance. In order to evaluate the most conservative scenario, disposal of cooling tower blowdown to surface waters has been assumed at all sites. Three factors considered in evaluating the potential dilution for a receiving water body are dilution capacity, baseline loadings, and proximity to consumptive users.

Evaluation Approach – Site ratings for this criterion are developed as a composite of three sub-criteria that address site characteristics relevant to consideration of operation: Dilution Capacity, Baseline Loadings, and Proximity to Consumptive Users.

- Dilution Capacity – The purpose of this sub-criterion is to rate sites based on the overall capacity of the receiving water body to dilute effluents from a nuclear power plant. Information on the radioactive source term dilution at a new power plant will be site specific. For siting consideration where such information is not available, however, surrogate parameters, representing the dilution capacity of a stream, can be used. The greater the dilution capacity of the receiving water body, the shorter will be the mixing length downstream defined as the zone within which complete mixing of a discharge contaminant occurs. Sites with higher dilution capacity are rated higher: Flow in the receiving water body at both ORR and Redstone sites is >20 times the PPE value for blowdown volume; accordingly, sites at both locations were all assigned a rating of 5.
- Baseline Loadings – The capacity of a stream to impact health and safety of downstream consumers is related to the existing, or baseline loadings of, radionuclides that are present in the system or can be anticipated in the future. The purpose of this sub-criterion is to characterize sites in accordance with existing levels

of radioactive contamination in the receiving water body. Sites are given a rating of 5 for no baseline loadings; proportionally lower ratings are assigned as higher potential for existing levels of radionuclide contamination are identified.

- Proximity to Consumptive Users – The purpose of this sub-criterion is to rate sites in accordance with the proximity of plant effluent release point to the location(s) of potential public water supply withdrawal(s) or use (e.g., recreation). More proximal withdrawals present higher potential for dose impacts from the surface water ingestion pathway and can require additional design and licensing efforts. Nearest downstream locations of potential public use and recreational contact were identified for each site. Sites with greater pathway lengths (>20 miles) to users were more suitable and were assigned a score of 5. Other ratings were assigned as follows:

  10 – 20 miles: 4
  5 – 10 miles: 3
  < 5 miles: 2
  Onsite: 1

Discussion/Results – An evaluation of each site and a summary of the sub-criterion and overall ratings for the surface water-radionuclide pathway criterion are presented in the following tables.

Site	Evaluation
2	Dilution Capacity: The Clinch River is the nearest receiving body of water from the site. The Clinch River annual mean flow near the site is 4,571 cfs. Under these conditions, the receiving body of water is likely capable of diluting potential effluents. Baseline Loading: Due to nuclear operations of area facilities, sources of existing radionuclide loadings may be present. Proximity to Consumptive Users: The Clinch River is within 5 miles of the site.
3	Dilution Capacity: The Clinch River is the nearest receiving body of water from the site. The Clinch River annual mean flow near the site is 4,571 cfs. Under these conditions, the receiving body of water is likely capable of diluting potential effluents. Baseline Loading: Due to nuclear operations of area facilities, sources of existing radionuclide loadings may be present. Proximity to Consumptive Users: The Clinch River is within 5 miles of the site.
4	Dilution Capacity: The Clinch River is the nearest receiving body of water from the site. The Clinch River annual mean flow near the site is 4,571 cfs. Under these conditions, the receiving body of water is likely capable of diluting potential effluents. Baseline Loading: Due to nuclear operations of area facilities, sources of existing radionuclide loadings may be present. Proximity to Consumptive Users: The Clinch River is within 5 miles of the site.

Site	Evaluation
5	Dilution Capacity: The Clinch River is the nearest receiving body of water from the site. The Clinch River annual mean flow near the site is 4,908 cfs. Under these conditions, the receiving body of water is likely capable of diluting potential effluents. Baseline Loading: Due to nuclear operations of area facilities, sources of existing radionuclide loadings may be present. Proximity to Consumptive Users: The Clinch River is within 5 miles of the site.
8	Dilution Capacity: The Clinch River is the nearest receiving body of water from the site. The Clinch River annual mean flow near the site is 4,908 cfs. Under these conditions, the receiving body of water is likely capable of diluting potential effluents. Baseline Loading: Due to nuclear operations of area facilities, sources of existing radionuclide loadings may be present. Proximity to Consumptive Users: The Clinch River is within 5 miles of the site.
10	Dilution Capacity: The Clinch River is the nearest receiving body of water from the site. The Clinch River annual mean flow near the site is 4,908 cfs. Under these conditions, the receiving body of water is likely capable of diluting potential effluents. Baseline Loading: Due to nuclear operations of area facilities, sources of existing radionuclide loadings may be present. Proximity to Consumptive Users: The Clinch River is within 5 miles of the site.
O1	Dilution Capacity: The Clinch River is the nearest receiving body of water from the site. The Clinch River annual mean flow near the site is 4,571 cfs. Under these conditions, the receiving body of water is likely capable of diluting potential effluents. Baseline Loading: Due to nuclear operations of area facilities, sources of existing radionuclide loadings may be present. Proximity to Consumptive Users: The Clinch River is within 5 miles of the site.
O2	Dilution Capacity: The Clinch River is the nearest receiving body of water from the site. The Clinch River annual mean flow near the site is 4,908 cfs. Under these conditions, the receiving body of water is likely capable of diluting potential effluents. Baseline Loading: Due to nuclear operations of area facilities, sources of existing radionuclide loadings may be present. Proximity to Consumptive Users: The Clinch River is within 5 miles of the site.
12	Dilution Capacity: The Tennessee River is the nearest receiving body of water from the site. The Tennessee River annual mean flow near the site is 43,472 cfs. Under these conditions, the receiving body of water is likely capable of diluting potential effluents. Baseline Loading: No sources of existing radionuclide loadings were identified for the site. Proximity to Consumptive Users: The Tennessee River is within 5 miles of the site.

Site	Evaluation
13	Dilution Capacity: The Tennessee River is the nearest receiving body of water from the site. The Tennessee River annual mean flow near the site is 43,472 cfs. Under these conditions, the receiving body of water is likely capable of diluting potential effluents. Baseline Loading: No sources of existing radionuclide loadings were identified for the site. Proximity to Consumptive Users: The Tennessee River is within 5 miles of the site.
14	Dilution Capacity: The Tennessee River is the nearest receiving body of water from the site. The Tennessee River annual mean flow near the site is 43,472 cfs. Under these conditions, the receiving body of water is likely capable of diluting potential effluents. Baseline Loading: No sources of existing radionuclide loadings were identified for the site. Proximity to Consumptive Users: The Tennessee River is within 5 miles of the site.
15	Dilution Capacity: The Tennessee River is the nearest receiving body of water from the site. The Tennessee River annual mean flow near the site is 43,472 cfs. Under these conditions, the receiving body of water is likely capable of diluting potential effluents. Baseline Loading: No sources of existing radionuclide loadings were identified for the site. Proximity to Consumptive Users: The Tennessee River is within 5 miles of the site.
16	Dilution Capacity: The Tennessee River is the nearest receiving body of water from the site. The Tennessee River annual mean flow near the site is 43,472 cfs. Under these conditions, the receiving body of water is likely capable of diluting potential effluents. Baseline Loading: No sources of existing radionuclide loadings were identified for the site. Proximity to Consumptive Users: The Tennessee River is within 5 miles of the site.
17	Dilution Capacity: The Tennessee River is the nearest receiving body of water from the site. The Tennessee River annual mean flow near the site is 43,472 cfs. Under these conditions, the receiving body of water is likely capable of diluting potential effluents. Baseline Loading: No sources of existing radionuclide loadings were identified for the site. Proximity to Consumptive Users: The Tennessee River is within 5 miles of the site.
R1	Dilution Capacity: The Tennessee River is the nearest receiving body of water from the site. The Tennessee River annual mean flow near the site is 43,472 cfs. Under these conditions, the receiving body of water is likely capable of diluting potential effluents. Baseline Loading: No sources of existing radionuclide loadings were identified for the site. Proximity to Consumptive Users: The Tennessee River is within 5 miles of the site.

Site	Dilution Capacity	Baseline Loadings	Public water supply	Composite Rating
2	5	4	2	4
3	5	4	2	4
4	5	4	2	4
5	5	4	2	4
8	5	4	2	4
10	5	4	2	4
O1	5	4	2	4
O2	5	4	2	4
12	5	5	2	4
13	5	5	2	4
14	5	5	2	4
15	5	5	2	4
16	5	5	2	4
17	5	5	2	4
R1	5	5	2	4

References

USGS: Annual Water Data Reports, http://wdr.water.usgs.gov/.

USGS Topographic Maps.

C.1.3.2 Groundwater Radionuclide Pathway

Objective – The purpose of this section is to evaluate the potential sites with respect to the relative vulnerability of shallow groundwater resources to potential contamination.

Evaluation Approach – All potential sites overlie aquifers that have not been designated as sole source aquifers by EPA's (1986) classification scheme (https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=9ebb047ba3ec41ada1877155fe31356b). The relative vulnerability of aquifers to groundwater pollution was evaluated using a standard numerical rating system called DRASTIC (Aller et al. 1987). Sites considered most suitable are those that are least vulnerable to groundwater contamination. As the potential sites are located in the same general vicinity within a candidate area, the evaluation compares site suitability for each candidate area.

Discussion/Results – No potential sites overlie aquifers designated as sole source aquifers by EPA's (1986) classification scheme (https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=9ebb047ba3ec41ada1877155fe31356b).

The DRASTIC evaluation was completed using site-specific data, where available, or data from published sources. The most important variables that control the groundwater pollution potential are:

- D–Depth to water;
- R–Recharge (net);
- A–Aquifer media;
- S–Soil media;
- T–Topography (slope);
- I–Impact of the vadose zone; and
- C–Conductivity (hydraulic) of the groundwater flow system.

DRASTIC assigns a weighted numeric value to each characteristic, depending on its relative contribution to risk of groundwater contamination. This results in a numeric rating for each site, allowing the sites to then be ranked in order of suitability. The higher an area scores on the DRASTIC index, the more susceptible a site is to groundwater contamination. Following is a summary of the DRASTIC evaluations.

Oak Ridge Reservation (Piedmont and Blue Ridge, Mountain Flanks/River Alluvium)				
DRASTIC Variable	**Range and Source of Information**	**Weight**	**Rating**	**Number**
Depth to Water	65-70 ft bgs (http://nwis.waterdata.usgs.gov/usa/nwis/gwlevels/?site_no=355332084220301)	5	3	15
Net Recharge	4-7 in/yr	4	6	24
Aquifer Media	Bedded sandstone, limestone, and shale sequences (Tennessee geologic maps and text)	3	6	18
Soil Media	Loam – Silt/Loam (USDA Soil Survey)	5	6	30
Topography	2-6% (USGS site topographic maps)	1	9	9
Impact Vadose Zone	Bedded limestone, sandstone, shale (Tennessee geologic map and text)	5	6	30
Hydraulic Conductivity	300 - 700 gpd/ft^2 (Driscoll, 1986; DRASTIC, 1987)	3	4	12
			INDEX	**138**

Redstone Arsenal (Piedmont and Blue Ridge, Swamp/Marsh)				
DRASTIC Variable	**Range and Source of Information**	**Weight**	**Rating**	**Number**
Depth to Water	6-12 ft bgs (http://nwis.waterdata.usgs.gov/usa/nwis/gwlevels/?site_no=343613086441701)	5	9	45
Net Recharge	4-7 in/yr	4	6	24
Aquifer Media	Massive limestone (Alabama geologic maps and text)	3	6	18
Soil Media	Sandy Loam (USDA Soil Survey)	2	6	12
Topography	0-2% (USGS site topographic maps)	1	10	10
Impact Vadose Zone	Limestone (Alabama geologic map and text)	5	6	30
Hydraulic Conductivity	1-100 gpd/ft^2 (Driscoll, 1986; DRASTIC, 1987)	3	1	3
			INDEX	**142**

DRASTIC indexes for all typical hydrogeologic settings range from 65 to 223 (Aller et al. 1987, p. 82). This range of indexes was used to develop a rating system to compare vulnerability of potential sites, as follows:

DRASTIC Index Range	Relative Vulnerability	Rating
65–98	Low	5
98–132	Low to Moderate	4
132–166	Moderate	3
166–199	High	2
199–233	Very High	1

Based on these DRASTIC Index Ranges for qualitative vulnerability, potential sites were ranked as follows:

Potential Site Area	DRASTIC Index	Rating
Oak Ridge Reservation	154	3
Redstone Arsenal	142	3

References

Aller, L., Bennett, T., Lehr, J., Petty, R. and G. Hackett. 1987. DRASTIC: A Standardized System for Evaluating Ground Water Pollution Potential Using Hydrogeologic Settings. EPA/600/2-87/035, June 1987.

DRASTIC: A Standardized System for Evaluating Ground Water Pollution Potential Using Hydrogeologic Settings; EPA Manual, 1987.

EPA, 1986. Guidelines for Groundwater Classification Under the EPA Groundwater Protection Strategy, Office of Groundwater Protection.

EPA, 2005. Source Water Protection. Sole Source Aquifer Program.

C.1.3.3 Air Radionuclide Pathway

Objective – The purpose of this criterion is to address the relative suitability of sites with respect to the potential for exposure to the public from routine airborne releases from a nuclear power plant.

Evaluation approach – The criterion is composed of two suitability characteristics:

Topographic Effects – Site ratings are based on whether there are any significant topographic features that would materially affect dispersion of the plume from plant releases (e.g., channeling of releases from a site located low in a high-banked river valley).

Atmospheric Dispersion – Measured in terms of long term (e.g., annual average X/Q) dispersion characteristics. Sites with lower X/Q values are rated higher than those with less favorable dispersion conditions.

Discussion/Results – None of the sites are believed to have significant potential for negative topographic effects on long-term dispersion. Annual average X/Q values were unavailable for potential sites. Therefore atmospheric dispersion was evaluated based on general area meteorological conditions for the Oak Ridge Reservation and Redstone Arsenal. Should atmospheric dispersion become a sensitive criterion for site selection, site-specific meteorological data should be obtained to calculate an atmospheric dispersion function (X/Q) for more accurate site comparison.

Site	Evaluation	Rating
2	The ORR Sites are situated along mountain ranges, with alternating ridges and valleys in the vicinity. 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 mph) for all sites. Site meteorological characteristics (specific to Site 3, but representative of the area) include light winds speeds and	**4**
3		**4**
4		**4**
5		**4**
8		**4**
10		**4**

Site	Evaluation	Rating
O1	predominately stable conditions. Professional judgement drawn from the above described meteorological conditions resulted in all ORR Sites received a rating of 4.	**4**
O2		**4**
12	Topographic conditions at the Redstone sites include predominately flat terrain with the Tennessee River situated to the south, and hills and plateaus surrounding the area to the north and east. Flatter terrain and higher average wind speeds for the Redstone sites result in favorable dispersion conditions. Professional judgement drawn from the above described meteorological conditions resulted in all ORR Sites received a rating of 5.	**5**
13		**5**
14		**5**
15		**5**
16		**5**
17		**5**
R1		**5**

References

USGS Topographic Maps (1:100,000 and 1:24,000 scale).

Evaluation of Atmospheric Dispersion Characteristics for Alternative SMR Sites, TVA 2016.

C.1.3.4 Air-Food Ingestion Pathway

Objective – The objective of this criterion is to rate potential sites in terms of the relative potential for exposure of humans to radioactive emissions through deposition of radioactive materials on food crops with subsequent consumption of exposed foodstuffs by individuals.

Evaluation approach – A potential exposure pathway for nuclear power plants is the emission of radionuclides into the food chain on local crops and pastures. Radiological doses and dose commitments resulting from a nuclear plant are well-known and documented. While the operational impacts on the public through food pathway exposures are negligible, sites with lower amounts of crop and pasture land uses are considered to be more suitable. Sites with less crop production nearby are rated higher than those with larger agricultural industries.

Discussion/Results – General information regarding crop lands and pastures near the sites is summarized in the table below. Ratings were assigned based on the relative percentage of local land use dedicated to crop production and site proximity to existing farmlands, with higher ratings assigned to lower crop production percentages and increased distance to existing farmlands.

Site	Evaluation	Rating
Tennessee (entire state)	Agriculture (farmland) represents 10,867,812 acres out of 26,934,000 acres in Tennessee (40%). Out of total farmland, **5,329,692** acres are planted in crop (49%).	N/A
2	Agriculture (farmland) represents 46,953 acres out of 252,800 acres in Roane County (19%). Out of the total farmland, 13,981 acres are planted in crop (30%). Other farmland is used for cattle (10,133 head), and lower numbers of hogs and pigs (94 head), sheep (296 head) and poultry (1,316 layers). Aerial imagery indicates that the site is not in the general vicinity of agricultural operations, and the actual impact to local crops, pastures, and livestock from radionuclide emission exposure would be less than the county-wide percentages.	5
3		5
4		5
5		5
8		5
10		5
O1		5
O2	Agriculture (farmland) represents 35,845 acres out of 216,000 acres in Anderson County (16%). Out of the total farmland, **10,163** acres are planted in crop (28%). Other farmland is used for cattle (7,189 head), and lower numbers of hogs and pigs (138 head), sheep (267 head) and poultry (1,944 layers). Aerial imagery indicates that the site is not in the general vicinity of agricultural operations, and the actual impact to local crops, pastures, and livestock from radionuclide emission exposure would be less than the county-wide percentages.	5
Alabama (entire state)	Agriculture (farmland) represents 8,902,654 acres out of 32,480,000 acres in Alabama (27%). Out of total farmland, **2,758,521** acres are planted in crop (31%).	N/A
12	Agriculture (farmland) represents 209,352 acres out of 513,280 acres in Madison County (41%). Out of the total farmland, **122,355** acres are planted in crop (58%). Other farmland is used for cattle (19,619 head), and lower numbers of hogs and pigs (335 head), sheep (807 head) and poultry (2,090 layers). Aerial imagery indicates that the site is in the general vicinity of agricultural operations (south of the site), and the actual impact to local crops, pastures, and livestock from radionuclide emission exposure would be similar to or greater than the county-wide percentages.	3
13		3
14		3
15		3
16		3
17		3
R1		3

References

StateMaster, State Land Acreages. http://www.statemaster.com/graph/geo_lan_acr_tot-geography-land-acreage-total.

Google Earth, http://earth.google.com.

National Agricultures Statistics Service (2012 Census of Agriculture), https://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/.

C.1.3.5 Surface Water-Food Radionuclide Pathway

Objective – The purpose of this criterion is to evaluate the relative suitability of sites in terms of the specific use of irrigation water by downstream locations as a potential pathway for potential exposure.

Evaluation approach – Sites with the fewest number of downstream irrigation uses are more suitable and are rated higher than sites with a large number of downstream irrigation withdrawals.

Discussion/Results – General information regarding irrigated lands near the sites is summarized in the table below. Higher ratings were assigned to sites with lower percentage of irrigated farmland and decreased likelihood of downstream irrigation withdrawals.

Site	Evaluation	Rating
Tennessee (entire state)	Total irrigated land represents 146,442 acres out of 10,867,812 acres of farmland in Tennessee (1.3%).	N/A
2	Total irrigated land represents 34 acres out of 46,953 acres of farmland in Roane County (0.072%). Withdrawals of water for irrigation from the Clinch River downstream of the site are improbable.	5
3		5
4		5
5		5
8		5
10		5
O1		5
O2	Total irrigated land represents 64 acres out of 35,845 acres of farmland in Anderson County (0.18%). Withdrawals of water for irrigation from the Clinch River downstream of the site are improbable.	5
Alabama (entire state)	Total irrigated land represents 113,008 acres out of 8,902,654 acres of farmland in Alabama (1.3%).	N/A
12	Total irrigated land represents 5,089 acres out of 209,352 acres of farmland in Anderson County (2.4%). Withdrawals of water for irrigation from the Tennessee River downstream of the site are possible.	4
13		4
14		4
15		4
16		4
17		4
R1		4

References

StateMaster, State Land Acreages. http://www.statemaster.com/graph/geo_lan_acr_tot-geography-land-acreage-total.

Google Earth, http://earth.google.com.

National Agricultures Statistics Service (2012 Census of Agriculture), https://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/.

C.1.3.6 Transportation Safety

Objective – The objective of this criterion is to evaluate the suitability of the potential sites with respect to potential to create fog and ice hazards to local transportation.

Evaluation approach – Potential impacts from plant operations on transportation safety could occur as a result of increased hazards from cooling towers. Cooling towers can increase area fogging conditions and ice formation on local roads and highways. Sites with high frequencies of naturally-occurring fog and ice events will likely be more adversely affected by cooling tower operations as humidity and temperature characteristics resulting in fogging and icing conditions will be exacerbated (i.e., humidity levels generally increase and/or temperatures generally decrease).

Discussion/Results – Maps delineating the mean number of days with heavy fog (<0.25 mile visibility) are available from the National Climatic Data Center. Each of the sites was located within a mapped region, and the annual average number of days with heavy fog was reported. Ratings were based on consideration of both fogging potential and proximity to major highways.

Site	Evaluation	Rating
2	Annual average of 30-35 days of heavy fog. Site is ~ 3 miles northwest of I-40.	4
3	Annual average of 30-35 days of heavy fog. Site is ~ 1 mile north of I-40.	4
4	Annual average of 30-35 days of heavy fog. Site is ~ 2 miles north of I-40.	4
5	Annual average of 30-35 days of heavy fog. Site is ~ 1 mile north of I-40.	4
8	Annual average of 30-35 days of heavy fog. Site is ~ 1 mile north of I-40.	4
10	Annual average of 30-35 days of heavy fog. Site is ~ 2 miles north of I-40.	4
O1	Annual average of 30-35 days of heavy fog. Site is ~ 4 miles north of I-40.	4

Site	Evaluation	Rating
O2	Annual average of 30-35 days of heavy fog. Site is ~ 1 mile north of Highway 170.	4
12	Annual average of 15-20 days of heavy fog. Site is ~ 4 miles southeast of I-565.	5
13	Annual average of 15-20 days of heavy fog. Site is ~ 5 miles southeast of I-565.	5
14	Annual average of 15-20 days of heavy fog. Site is ~ 6 miles southeast of I-565.	5
15	Annual average of 15-20 days of heavy fog. Site is ~ 6 miles southeast of I-565.	5
16	Annual average of 15-20 days of heavy fog. Site is ~ 6 miles southeast of I-565.	5
17	Annual average of 15-20 days of heavy fog. Site is ~ 9 miles southeast of I-565.	5
R1	Annual average of 15-20 days of heavy fog. Site is ~ 6 miles southeast of I-565.	5

C.2 Environmental Criteria

C.2.1 Construction-Related Effects on Aquatic Ecology

C.2.1.1 Disruption of Important Species/Habitats

Objective – The objective of this criterion is to evaluate the potential sites with respect to potential construction-related impacts on aquatic or marine ecology. Regulatory Guide 4.7 defines important plant and animal species as meeting one or more of the following conditions:

- (1) the species is commercially or recreationally valuable;
- (2) the species is state- and/or federally listed (e.g., state and/or federal) as endangered or threatened;
- (3) the species effects the well-being of another species within (1) or (2) above;
- (4) the species is a critical component of the structure and function of a valuable ecosystem; or
- (5) the species is a biological indicator of radionuclides in the environment.

Of particular concern are potential impacts to habitat areas used by important species. These areas include those used for:

- breeding and nursery;
- nesting and spawning;
- wintering; and
- feeding.

Evaluation approach – The evaluation focused on the relative suitability of the potential sites based on the number of areas where potential impact is expected. The number of potential impact areas was directly correlated to the number of rare, threatened, and endangered (RTE) aquatic species that may occur in the host county (see metric below), their habitat (based on existing reports and professional judgment of the amount and quality of habitat available for species), and flexibility (professional judgment of the amount of space in the site area available to avoid known locations of protected species during construction of the facility). Ratings were assigned for each subcomponent and the average taken to derive an overall composite rating. The most suitable sites had fewer species, lower quality habitat (e.g., cleared or developed areas), and encompass large areas that provide greater flexibility.

- The number of rare, threatened, and endangered terrestrial species that may occur in the host count (federally protected species), where the sub-rating metric was as follows:
  5 = < 10 species
  4 = < 20 species
  3 = < 30 species
  2 = < 40 species
  1 = ≥ 40 species

Because site specific aquatic habitat conditions are not generally known, the ratings for habitat were linked to species (more species indicator of higher quality aquatic habitat), except where noted in the discussion below. Because flexibility is difficult to quantify, especially related to aquatic habitat, the evaluation is subjective (e.g., length of shoreline), as described below, and the ratings based on best professional judgment.

Other factors and assumptions, based on best professional judgment, were considered in evaluating the three potential sites located outside customer property flexibility, where boundaries had not yet been identified (see results discussion below).

Discussion – The species common and scientific names and federal listing status for the host counties of the ORR and Redstone Arsenal sites are included in the tables below.

Roane (2, 3, 4, 5, 8, 10, and new O1) and Anderson (new O2) Counties, Tennessee

Scientific Name	Common Name	Federal Status
Fish		
Snail darter [Roane County only]	*Percina tanasi*	Threatened
Spotfin Chub	*Erimonax monachus*	Threatened
Slender chub	*Erimystax cahni*	Threatened
Yellowfin madtom	*Noturus flavipinnis*	Threatened
Blackside dace (Anderson County only)	*Phoxinus Cumberlandensis*	Threatened
Clams		
Purple bean	*Villosa pepurpurea*	Endangered
Green blossom (pearlymussel)	*Epioblasma torulosa gubernaculum*	Endangered
Turgid blossom (pearlymussel)	*Epioblasma turgidula*	Endangered
Alabama lampmussel	*Lampsilis virescens*	Endangered
Pink mucket (pearlymussel)	*Lampsilis abrupta*	Endangered
Birdwing pearlymussel	*Lemiox rimosus*	Endangered
Dromedary pearlymussel	*Dromus dromas*	Endangered
White wartyback (pearlymussel)	*Plethobasus cicatricosus*	Endangered
Finerayed pigtoe	*Fusconaia cuneolus*	Endangered
Rough pigtoe	*Pleurobema plenum*	Endangered
Shiny pigtoe	*Fusconaia cor*	Endangered
Orangefoot pimpleback (pearlymussel)	*Plethobasus cooperianus*	Endangered
Ring pink (mussel)	*Obovaria retusa*	Endangered

Scientific Name	Common Name	Federal Status
Rough rabbitsfoot	*Quadrula cylindrica strigillata*	Endangered
Spectaclecase (mussel)	*Cumberlandia monodonta*	Endangered
Cracking pearlymussel	*Hemistena lata*	Endangered
Fanshell	*Cyprogenia stegaria*	Endangered
Sheepnose Mussel	*Plethobasus cyphyus*	Endangered
Cumberland elktoe (Anderson County only)	*Alasmidonta atropurpurea*	Endangered
Snails		
Anthony's riversnail	*Athearnia anthony*	Endangered

There are also over 20 protected state-listed aquatic species in Anderson and Roane Counties, Tennessee.

Madison County, Alabama (12, 13, 14, 15, 16, 17, and new R1)

Scientific Name	Common Name	Federal Status
Fish		
Snail darter	*Percina tanasi*	Threatened
Spotfin Chub	*Erimonax monachus*	Threatened
Slackwater darter	*Etheostoma boschungi*	Threatened
Palezone shiner	*Notropis albizonatus*	Endangered
Spring pygmy sunfish	*Elassoma alabamae*	Threatened
Clams		
Alabama lampmussel	*Lampsilis virescens*	Endangered
Pale lilliput (pearlymussel)	*Toxolasma Cylindrellus*	Endangered
Pink mucket (pearlymussel)	*Lampsilis abrupta*	Endangered
Finerayed pigtoe	*Fusconaia cuneolus*	Endangered
Rough pigtoe	*Pleurobema plenum*	Endangered
Shiny pigtoe	*Fusconaia cor*	Endangered
Spectaclecase (mussel)	*Cumberlandia monodonta*	Endangered
Slabslide Pearlymussel	*Pleuronaia dolabelloides*	Endangered
Snuffbox mussel	*Epioblasma triquetra*	Endangered
Rabbitsfoot	*Quadrula cylindrica cylindrica*	Threatened

Scientific Name	Common Name	Federal Status
Sheepnose Mussel	*Plethobasus cyphyus*	Endangered
Crustaceans		
Alabama cave shrimp	*Palaemonias alabamae*	Endangered
Snails		
Anthony's riversnail	*Athearnia Anthony*	Endangered
Armored snail	*Pyrgulopsis (=Marstonia) Pachyta*	Endangered
Slender campeloma	*Campeloma decampi*	Endangered

There are also over 20 state protected state-listed aquatic species in Madison County, Alabama.

Both sets of sites (ORR and Redstone Arsenal) include a large number of federal and state protected aquatic species (i.e., 20 or more federally protected species alone), with host Roane and Anderson Counties having a few more protected aquatic species each than found in Madison County, Alabama. While there is site specific data available for many of the potential sites that would indicate protected aquatic species are not likely to occur at any of the sites, site-specific surveys have not been conducted to confirm the absence of rare aquatic species that potentially could occur there or in the reservoirs adjacent to those sites. Therefore, ratings are assigned based on the metric for total county species count (federal only) identified above. Information pertaining to overall aquatic habitat quality and flexibility is provided for each set of sites below.

ORR Sites 2, 3, 4, 5, 8, 10, O1 and O2

Waters from the ORR Sites reach the Tennessee River via the Clinch River, which forms the southern and western boundaries of ORR. Major surface water features bordering and on site of the ORR include the Clinch River arm of the Watts Bar Reservoir, Melton Hill Reservoir and their tributaries – Bear Creek, East Fork Poplar Creek, White Oak Creek, Melton Branch, Poplar Creek and Mitchell Branch. Sites 2, 3, and 4; Site O1 is set back a short distance from Watts Bar Reservoir. Sites 8 and 10 include shoreline along Melton Hill Reservoir, with Site O2 set further back from the Melton Hill Reservoir shoreline. Site O2 is the easternmost site and sits in Anderson County. The cold water released through Norris Dam upstream of ORR contributes to the relatively cool water characteristic of Melton Hill Reservoir. Site 3 and 8 are peninsulas that have relatively extensive shorelines. The Grassy Creek Watershed is found within Site 2 and Grassy Creek lies to the north of Sites 3 and 4. White Oak Creek lies to the north of Sites 5, 8 and 10.

A number of rare aquatic animal species, primarily mollusks, have been reported to occur in the reservoirs adjacent to the ORR. According to Baranski (2011), the mollusks listed in TVA's Natural Heritage database are primarily associated with the reservoirs and larger tributaries and no living specimens have been found in the ORR streams. An evaluation of Aquatic Natural Areas (ANA) and/or Aquatic Reference Areas (ARA) on the ORR identified Ish Creek (within

ORR 4) as one of the highest ranked ANAs (Baranski 2011). Thus, the aquatic habitat for Site 4 is considered to be more valuable than the other ORR Sites.

Site 3 borders the TVA Grassy Creek Habitat Protection Area (HPA) is a designated natural area that includes aquatic habitats and adjoins the northern boundary of Site 3. However, given the location and higher elevation of the HPA, construction activities at Site 3 would not be expected to adversely impact this protected habitat area. Although Site 3 includes some sensitive resource areas along the shoreline, the interior, developable portion of the site was previously cleared and partially developed as a proposed nuclear power plant site in the 1980s.

Site-specific aquatic habitat information is fairly limited for the ORR sites, therefore the habitat ratings are based on species counts in the reservoirs with the exception of Sites 3 and 4. Site 4 is given a slightly lower rating given the presence of a valuable ANA habitat onsite; and Site 3 is given a slightly higher rating given the previous site disturbance and absence of any listed species within the site boundary.

In terms of siting flexibility, the evaluation considered site size, proximity to water and shoreline length, where large size and longer shoreline length were assumed to provide the greatest flexibility in siting (greater ability to avoid sensitive aquatic resources). Site 3 is the largest site and located on a peninsula with the longest shoreline, therefore it is given a rating of 5. Site 8 is also on a peninsula and has the second longest shoreline; it is also fairly large (over three times required acreage for SMR development) and is given a rating of 4. Site 2 has a shorter shoreline than Site 5 but is larger in size than both Sites 5 and 8; Site 5 has a fairly large shoreline. Therefore, Sites 2 and 5 are both given a 3.5. Sites 4 and 10 are located on the reservoir, similar in size with similar, small shoreline length and are given a rating of 3. Sites O1 and O2 are likely to be small (i.e., assuming acquisition of O1 or O2 would be for minimum size for development) and both are inland with no shoreline. Therefore, Sites O1 and O2 are also given a conservative rating of 3.

Redstone Arsenal Sites 12, 13, 14, 15, 16, 17, R1

The principal aquatic resource at Redstone Arsenal is Wheeler Reservoir, an impoundment of the Tennessee River that forms the southern boundary of the installation. Approximately 14,560 acres are within the 100-year floodplain. Other aquatic habitats on the installation include manmade ponds (excavations for gravel and quarrying), streams, and springs. The largest streams within the installation are Indian Creek, McDonald Creek, and Huntsville Spring Branch.

Multiple aquatic species that are federally listed as endangered or threatened have the potential to occur in Madison County where Redstone Arsenal is located. A portion of the Wheeler National Wildlife Refuge also extends into the southwestern portion (Industrial Zone) of the Arsenal, and runs near all the Redstone Arsenal sites except R1. The refuge is designated as a waterfowl refuge that is also home to 115 species of fish, 38 species of freshwater mussels and 26 species of freshwater snails (https://www.fws.gov/refuge/Wheeler/about.html). Information from the TVA Natural Heritage database indicates that there are no known occurrences of federally or state-listed terrestrial species on or near Redstone Arsenal Sites 12, 14, and 15, however,

confirmation of this assessment would require site-specific surveys. The Redstone Arsenal sites appear to have a low potential to support rare aquatic species or habitats.

All of the potential Redstone Arsenal Sites are set back from the Wheeler Reservoir and therefore have no reservoir shoreline. Additionally, all sites are smaller in size, compared to the ORR Sites. Therefore, the Redstone sites are assumed to have less siting flexibility than the ORR Sites.

Results – As described above, overall site ratings include three components: species count, habitat and flexibility. Threatened and Endangered (T&E) species ratings are based on the number of federally protected species found in the host county, where more protected species reflected a less suitable site. Habitat ratings, in most instances, are tied to the T&E species abundance rating unless otherwise noted (see discussion above). Flexibility ratings are based on professional judgment, as tied to the amount of directly accessible shoreline and/or space available within a site area. Larger areas are more suitable because they provide greater flexibility in the ability to avoid known locations of protected species or habitat, while trying to optimize access to cooling water supply during construction of the intake, for example. None of the Redstone sites are located directly on a shoreline so flexibility is based on site size. Because they are all small (130 acres or less), they are rated lower for flexibility than the Oak Ridge sites. It is assumed that the R1 site, which would have to be acquired, would be similarly small (i.e., the minimum size necessary for SMR development) in order to avoid paying higher land costs. Site ratings are provided below.

Site	T&E Species (aquatic)	Habitat	Flexibility	Overall Rating
2 (547 acres)	3	3	3.5	3
3 (935 acres)	3	4	5	4
O1 and O2	3	3	3	3
4 (226 acres)	3	2	3	3
5 (225 acres)	3	3	3.5	3
10 (214 acres)	3	3	3	3
8 (424 acres)	3	3	4	3
12, 14, 15, 16, 17	3	3	2	3
13	3	4	2	3
R1	3	4	2	3

References

Baranski, Michael J. Aquatic Natural Areas Analysis and Evaluation. Oak Ridge Reservation. ORNL/TM-2011/13. April 2011. Available at: info.ornl.gov/sites/publications/files/Pub28011.pdf

US Fish and Wildlife Service:
http://ecos.fws.gov/ecp0/reports/speciesbycurrentrangecounty?fips=01089
http://ecos.fws.gov/ecp0/reports/speciesbycurrentrangecounty?fips=47001
http://ecos.fws.gov/ecp0/reports/speciesbycurrentrangecounty?fips=47145

State protected species:
Tennessee: http://environment-online.tn.gov:8080/pls/enf_reports/f?p=9014:3:1202193325492
Alabama: http://alnhp.org/submit_query.php

C.2.1.2 Bottom Sediment Disruption Effects

Objective – The objective of the criterion is to evaluate the potential short-term impacts to aquatic/marine resources resulting from construction-related dredging activities at the potential sites.

Evaluation approach – The criterion focuses on the amount of contaminated sediments near the potential sites and the grain size of sediments in the area. In general, sites with the lowest concentration of heavy metals and toxic organic compounds and the highest sediment grain size are considered to be the most suitable.

Little information exists regarding the site-specific level of sediment contamination that exists in water bodies near the potential sites. The majority of the available information was obtained from the EPA's National Sediment Quality Survey (2004). Information in the EPA report addresses sediment contamination levels as Tier I (adverse impacts to aquatic life are probable) and Tier II (adverse impacts to aquatic life are possible but infrequent). Using best professional judgment, the following evaluation considered the results of the EPA's Tier I/Tier II study results to determine the relative contamination potential for the potential sites.

No information regarding sediment grain size was obtained for the potential sites under consideration. Because sediment grain size is highly variable, even within a small area of coastline or river reach, the following evaluation of potential bottom sediment disruption effects was limited to available information regarding existing sediment contamination levels in principle water bodies at the potential sites.

Discussion/Results – A 2004 EPA study evaluated 2,874 sampling stations in the Southeast, and identified 12 water bodies as having the most significant sediment contamination in EPA Region 4. The Tennessee River is one of the water bodies having the most significant sediment contamination in EPA Region 4 (18 Tier I stations in watershed containing areas of probable concern (APCs) for sediment contamination). The Tennessee River is assumed to be the cooling water source for the Redstone Arsenal sites. In addition, Watts Bar Lake and the Upper Clinch River were identified as watersheds containing APC for sediment contamination (with Watts Bar Lake having 8 Tier 1 stations). Given this information and the history of activities that has occurred at or near each of the sites, all (ORR and Redstone sites) are assumed to have a probability of sediment contamination and are given a site rating of 2. The possible exceptions are Sites 8, 10, and O2 that are upstream of the ORR on Melton Hill Reservoir which are given a slightly higher, but still conservative rating of 3.

Site	Rating
2, 3, 4, 5, O1	2
8, 10, O2	3
12, 13, 14, 15, 16, 17, R1	2

References

The Incidence and Severity of Sediment Contamination in Surface Waters of the United States. National Sediment Quality Survey. Office of Science and Technology. EPA 823-R-04-007. November. Available at: http://www.clu-in.org/download/contaminantfocus/pcb/incidence-and-severity-2004nsqs2ed-complete.pdf.

C.2.2 Construction-Related Effects on Terrestrial Ecology

C.2.2.1 Disruption of Important Species/Habitats – Plant Site

Objective – The objective of this criterion is to evaluate the potential sites with respect to potential construction related impacts on important species and terrestrial ecology. Regulatory Guide 4.7 defines important plant and animal species if one or more of the following conditions apply.

- (1) the species is commercially or recreationally valuable;
- (2) the species is officially listed as endangered or threatened;
- (3) the species effects the well-being of another species within (1) or (2) above;
- (4) the species is a critical component of the structure and function of a valuable ecosystem; or
- (5) the species is a biological indicator of radionuclides in the environment.

Of particular concern are potential impacts to habitat areas used by important species. These areas include those used for:

- breeding and nursery;
- nesting and spawning;
- wintering; and
- feeding.

Evaluation approach – The following siting criteria are established in the EPRI siting guide.

- Exclusionary – Designated critical habitat of endangered species;
- Avoidance – Areas where threatened and endangered species are known to occur; and
- Suitability – Areas where limited potential impact is expected.

No information was obtained which would indicate that any of the sites under consideration would trigger the exclusionary or avoidance criteria relative to ecology. Therefore, the evaluation focused on the relative suitability of the site based on the number of areas where limited potential impact is expected. The number of potential impact areas was directly correlated to:

- The number of rare, threatened, and endangered terrestrial species that may occur in the host count (federally protected species), where the sub-rating metric was as follows:
  5 = 0 species
  4 = < 5 species
  3 = < 10 species
  2 = < 15 species
  1 = ≥15 species
- Habitat for these species (based on existing reports and professional judgment of the amount and quality of habitat available for species), where the more suitable sites would have lower quality habitat (e.g., cleared and developed areas). Presence of critical habitat and number of protected species is also a consideration in habitat ratings.
- Flexibility in locating plant components (professional judgment of the amount of space within the site boundary to avoid known locations of protected species during construction of the facility); sites of smaller areas were assumed to have less flexibility. The general metric for this sub-component, based on the breakdown of actual areas of the potential sites, is as follows:
  5 = > 800 acres
  4 = > 600 acres
  3 = > 400 acres
  2 = > 200 acres
  1 = < 200 acres
- Other factors and assumptions, based on best professional judgment, were considered in evaluating the three potential sites located outside customer property flexibility, where boundaries had not yet been identified (see results discussion below).

In summary, ratings for terrestrial T&E species are based on total number of species found in the host county, with habitat and flexibility sub-ratings based on professional judgment and other factors as discussed below.

The data source for protected federal species is the U.S. Fish and Wildlife Service (USFWS) listings for Tennessee and Alabama, by county. Observations relating to existing land uses (habitat) are based on satellite imagery (Google Earth), and site specific information where available. Note that site suitability evaluations with respect to wetlands, another important component of habitat value and species indicator, is evaluated and factored in separately (see Section C.2.2.3).

Federally protected terrestrial species that could occur within the host county of each potential site are listed below. Additional ecological information specific to terrestrial resources in the area and/or at each site is included in the full discussion below.

Discussion

Oak Ridge Reservation Sites [Anderson – Site O2; Roane - Sites 2, 3, 4, 5, 8, 10, and O1]

Three federally listed terrestrial species may be found in Anderson County (3 mammals) and five federally listed species in Roane County (3 mammals and 2 flowering plants).

Scientific Name	Common Name	Federal Status
Plants		
White fringeless orchid (Roane County only)	*Platanthera integrilabia*	Threatened
Virginia spiraea (Roane County only)	*Spiraea virginiana*	Threatened
Mammals		
Indiana bat	*Myotis sodalist*	Endangered
Gray bat	*Myotis grisescens*	Endangered
Northern Long-Eared Bat	*Myotis septentrionalis*	Threatened

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 terrestrial and aquatic species also are federally listed. Rare species with a state status occur within Sites 2, 5, and 8. Site 10 is not known to support listed terrestrial or wetland species.

A dominant ecological feature of the ORR is its large areas of mature eastern deciduous hardwood forest. Approximately 70 percent of the Reservation 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.

The ORR is jointly managed by Tennessee Wildlife Resources Agency (TWRA) and DOE as a Wildlife Management Area (WMA). A joint management agreement provides for protection and restoration of wildlife and habitat and for regulated public hunting. Within the Oak Ridge WMA, approximately 2,920 acres are managed by TWRA as the Three Bend Scenic and Wildlife Management Refuge Area along Melton Hill Reservoir on the eastern boundary of the ORR (Solway, Freels and Gallaher Bends between Sites O2 and 10). The refuge contains a rare combination of open fields, hedgerows, woodlots, wetlands and water that supports special habitat such as Chestnut Oak-Tuliptree-White Oak Hickory Forests, White Oak-Northern Red Oak-Hickory Forests, and Oak-Hickory-Ash Limestone Woodlands. It also includes state listed rare plants (e.g., Canada Lily and Tall Larkspur). Approximately 3,000 acres in the northwestern area of the ORR are included in the Black Oak Ridge Conservation Easement, located behind K25 on the far west side of Oak Ridge, less than 0.5 mile from the center point of Site O1. The area includes hiking and mountain biking trails through ridgetop woodlands, karst bluffs and Creekside habitats. The Conservation Easement is located within the ORR and managed by the TWRA and the Tennessee Department of Environment and Conservation (TDEC). Before the

SMR Project, the CRN site was also part of this WMA and TVA currently has an agreement with TWRA to allow managed hunts on the CRN Site.

In addition to the WMA, a variety of natural areas are recognized and classified on the ORR in several categories. Natural areas are considered to include managed areas (public lands managed to protect certain ecological and/or recreational features) and other ecologically significant sites. An analysis by the ORNL of the ecologically significant areas on the ORR identified numerous areas with a range of classifications that have been designated within the ORR, including 47 natural areas, 18 reference areas, and five conservation management areas. In addition, five state natural areas within the ORR have been proposed for future protection.

Sites 2, 5, 8, and 10 each overlap at least one designated natural area that includes terrestrial biological resources. Site 2 encompasses the 20-acre 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-acre linear area managed cooperatively among agencies for special purposes such as wildlife management). The central portion of Site 5 west of Highway 95 contains a 6-acre Reference Area, which was originally designated as a significant natural community due to the presence of a sweetflag marsh habitat. However, marsh habitat was not observed in this forested area during a site visit in August 2014. The portion of Site 5 east of Highway 95 is entirely within the southwest portion of the 519-acre Dry River Bluffs and Caves Natural Area, which supports four species with state status and includes a variety of mostly forest communities as well as caves, sinkholes, calcareous steep cliffs, outcrops, springs, and ponds. Approximately half of Site 8 encompasses most of the 293-acre 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. Site 10 encompasses Natural Area 30, the Health Physics Research Reactor Lake Bluffs, which are steep limestone bluffs along the reservoir shoreline, as well as a small portion of the Tower Shielding Bluffs Natural Area.

Site 3 is located adjacent to the southwestern boundary of the ORR on a peninsula created by a bend in the Clinch River arm of Watts Bar Reservoir. The site is owned by the federal government and managed by TVA. Sites 3 and 4 share a majority of the ecological characteristics described for the ORR, although Site 3 has been previously disturbed as part of its earlier development as a proposed nuclear plant site. Site 3 adjoins the TVA Grassy Creek Habitat Protection Area along the northern boundary of Site 3. The riparian zone along most of the shoreline of Site 3 was designated by TVA in the *Watts Bar Reservoir Land Management Plan* as Zone 3, Sensitive Resource Management. This designation was applied to this parcel for "protection of significant wetlands and cultural resources."

Site 2 is largely designated as a Potential Habitat Area and a Natural Area. Its hilly topography would limit opportunities to site an SMR such that these areas could be avoided. Site 3 is larger than required for the SMR facility and includes no known occurrences of rare species or designated natural areas. Approximately half of Site 5 is within a large Natural Area containing diverse habitats and landscape elements, and several rare species. ORR. Similarly, Site 8 is almost entirely within two large Natural Areas that include diverse communities and several rare

species. Mitigation effort would be moderate to large. Because Site 10 overlaps portions of two natural areas, each of which supports at least one rare species, terrestrial resource concerns are moderate for this Potential Site.

Site 4 is undeveloped, mostly forested and would appear to offer valuable habitat. Site O1 appears to be mostly cleared. Site O2 includes the 250-acre University of Tennessee Arboretum used for education and research; it is located within the larger 2,202-acre Oak Ridge Forest. The Arboretum has over 2,500 native and exotic woody plant specimens. It serves as an outdoor classroom and also as a place that provides a natural laboratory for research in plant uses, insect and disease control and management of natural resources. The facility is recognized as an official Wildlife Observation Area and part of the National Watchable Wildlife Program by the TWRA. It is also recognized as an official holly test garden by the Holly Society of America.

Redstone Arsenal Sites, Madison County, AL

Six federally listed terrestrial species: three mammals and three plants have the potential to occur in Madison County, Alabama (see Table below).

Scientific Name	Common Name	Federal Status
Plants		
White fringeless orchid	*Platanthera integrilabia*	Threatened
Price's potatobean	*Apios priceana*	Threatened
American hart's-tongue fern	(*Asplenium scolopendrium var. americanum*)	Threatened
Mammals		
Indiana bat	*Myotis sodalis*	Endangered
Gray bat	*Myotis grisescens*	Endangered
Northern Long-Eared Bat	*Myotis septentrionalis*	Threatened

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-listed as protected.

Redstone Arsenal is located in the Eastern Highland Rim of the Interior Plateau ecoregion of northern Alabama. This ecoregion is characterized by plateaus, irregular plains, and open hills. Streams in the area drain to the impounded Tennessee River (Wheeler Reservoir). Natural vegetation in the region is transitional between the oak-hickory forest type to the west and the mixed mesophytic forests of the Appalachian ecoregions to the east, with cedar glades in some areas.

In northern Alabama and at Redstone Arsenal, pines are also present in association with the hardwoods and in isolated stands. Forested habitats on Redstone Arsenal cover approximately 15,700 acres 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 8,500 acres. Hardwoods occur mainly in bottomland areas and in a few large stands on rocky slopes.

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. Caves also contribute to the richness of the bat fauna in the region. The community of other wildlife inhabiting the area comprises a diversity of species characteristic of the forest habitats of the region. Wheeler National Wildlife Refuge includes 4,085 acres within the Redstone Arsenal boundary. Refuge lands surround the shoreline of Wheeler Reservoir from the dam to the southwest portion of Redstone Arsenal and extend to encompass Huntsville Spring Branch within the central portion of the Arsenal (near Site 13). The Refuge is considered the eastern most national wildlife refuge of the Mississippi Flyway and it annually supports Alabama's largest concentration of wintering waterfowl.

Results

Ratings results are provided below. Additional explanation is provided for the habitat and flexibility ratings (greenfield sites) since they include a review of qualitative information and are based on professional judgment.

Reservation ORR Sites

Given the valuable habitat found on the ORR Sites, all sites are given a conservative rating of 3 with the exception of Sites 2, 3, and O1. Site O2 is given a slightly lower rating of 2 given it is managed as an Arboretum and includes valuable forested habitat. Much of Sites 3 and O1 have been cleared, and therefore have been given a slightly higher rating of 3.5.

In terms of flexibility, the larger sites are given higher ratings given there is more opportunity to avoid valuable habitat areas. Therefore, Site 3 is given the highest rating, followed by sites 2 and 8. The rest of the ORR Sites on customer property are given the lowest rating. Site O1 is given a rating of 3.5; while much of the land is cleared, it is assumed the site would be small (i.e., minimum size for SMR development) given it would have to be acquired. Site O2 is given a rating of 2 based on the Arboretum size of 250 acres; even if land outside the arboretum were developed instead, any development would impact the surrounding Oak Ridge Forest.

Redstone Arsenal Sites

Redstone Arsenal Sites 12, 15 and 16 are in upland areas on Redstone Arsenal that do not include wetlands and are entirely forested. Redstone Arsenal Site 15 encompasses two named caves. Each of these sites potentially could provide habitat for some terrestrial species that are federally or state-listed or have other special status designations in Alabama. Redstone Arsenal Site 14 is an open, flat area covered predominantly by grasses and forbs, with areas of emergent marsh and forest along the south margin. It is almost entirely within an active munitions firing range and has been frequently affected historically and currently by range activities that include explosives detonations, grass fires, mowing, and vehicle traffic. As a result, Redstone Arsenal Site 14 supports minimal biological diversity and is given the highest rating with respect to habitat. The likelihood of occurrence of such terrestrial species on these sites would need to be confirmed by contacting the Directorate of Environmental Management of Redstone Arsenal, the

Alabama Natural Heritage Program, and the USFWS for site-specific information. Redstone Arsenal Sites 12, 15 and 16 have the potential to support rare terrestrial species or habitats. However, information from the TVA Natural Heritage database indicates that there are no known occurrences of federally or state-listed terrestrial species on or near Redstone Arsenal Sites 12 and 15. Site 13 appears to include forested areas and the Wheeler NWR is found along its southern border. Site 17 is a forested area along the southern boundary of the Arsenal within a bend of the Wheeler Reservoir. Site R1, which is located just outside the eastern border of the Arsenal, includes open field surrounded by forest and high quality wetland areas.

Site 14 is given a rating of 4 since its habitat is the most disturbed. Site R1 is given the next highest rating of 3.5 because the area of interest includes a cleared area. The rest of the sites are given a conservative rating of 3 for habitat.

With respect to flexibility, all the sites located on the Arsenal are given low ratings of 1 given their significantly smaller sizes compared to the ORR Sites (except Site 1). The parcel(s) size of the new R1 site is unknown but the cleared portion is small and it is assumed that the Arsenal boundary to the west, development to the right, and adjacent wetlands directly surrounding the entire site (see Section C.2.2.3) would limit opportunity to acquire a very large site. Therefore, it is also given a flexibility rating of 1.

Site ratings based on Important Terrestrial Species/Habitat

Site	T&E Species (terrestrial)	Habitat	Flexibility	Overall Rating
2 (547 ac)	3	3	4	3
3 (935 ac)	3	3.5	5	4
4 (226 ac) 5 (255 ac) 10 (214 ac)	3	3	2	3
8 (424 ac)	3	3	3	3
O1 (unknown)	3	3.5	3.5	3
O2 (unknown)	4	2	2	3
12 (130 ac) 15 (124 ac) 16 (129 ac)	3	3	1	2
13 (122 ac)	3	3	1	2
14 (130 ac)	3	4	1	2
17 (128 ac)	3	3	1	2
R1 (unknown)	3	3.5	1	2

References

Black Oak Ridge Conservation Easement, at: http://tnlandforms.us/mtnbike/borce.html

Oak Ridge Reservation Wildlife Management, available at:
http://www.esd.ornl.gov/research/ecol_management/images/orrwildlifemgt.pdf

U.S. Fish and Wildlife Service:
http://ecos.fws.gov/ecp0/reports/speciesbycurrentrangecounty?fips=01089
http://ecos.fws.gov/ecp0/reports/speciesbycurrentrangecounty?fips=47001
http://ecos.fws.gov/ecp0/reports/speciesbycurrentrangecounty?fips=47145

State protected species:
Tennessee: http://environment-online.tn.gov:8080/pls/enf_reports/f?p=9014:3:1202193325492
Alabama: http://alnhp.org/submit_query.php

Baranski, Michael J., "Natural Areas Analysis and Evaluation, Oak Ridge Reservation," ORNL/TM-2009/201, Oak Ridge National Laboratory, U.S. Department of Energy, November, 2009.

Hart, Heather M., "Technical Report from Assessment of Natural Areas (Managed Areas and Sites) in the vicinity of the Clinch River Small Modular Reactor Site (SMR)," Tennessee Valley Authority, October 21, 2011.

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

University of Tennessee Arboretum at http://utarboretum.tennessee.edu/index.html

C.2.2.2 Disruption of Important Species/Habitats – Transmission Corridor

Objective – The objective of this criterion is to evaluate sites with regard to environmental characteristics associated with potential transmission corridors. This is consistent with NUREG 1555 which identifies land use, feasibility and resources affected as transmission corridor factors to be considered.

Evaluation Approach – Each site is evaluated and assigned a rating based on the environmental sensitivity of the route landscape between the site and the nearest transmission interconnection that could serve the site. Ratings are typically based on the following factors:

- Proximity / distance to a connection with the nearest power corridor (i.e., 345-kV or higher transmission line), where distance is a surrogate for the potential for environmental impact, and sites that are closest to existing transmission infrastructure would be the most suitable.
- Potential for environmental for disturbance, based on whether existing right-of-way is available or new construction/expanded land clearing would be required; sites with access through an existing right-of-way would be the most suitable.
- For those sites requiring a new or significantly widened ROW, current land uses, dedicated land status, and/or other ecological considerations should be considered, to the extent a general corridor route can be identified.

Ecological considerations require a more qualitative evaluation based on professional judgment to capture any other special ecological concerns within a given corridor, especially if there is no

differentiation in the protected species count between sites. Sites with transmission corridor routes that follow the shortest distance and with least impacts to undisturbed ecological habitat would be the most suitable.

Discussion – Data relating to proximity to transmission corridors was pulled from data compiled for the Transmission Access criterion evaluation, and ratings are based on the transmission access metric, both identified in C.4.2.4. In general, transmission is readily available to each site, with existing corridors found within the boundary of each ORR Site, and within 5 miles from all Redstone sites. Given the general close proximity to transmission, overall ecological impacts would be expected to be minimal from transmission corridor development and the ratings were based primarily on distance alone for this particular study, where distance also served as a surrogate for impacts to habitat.

Results – Ratings based on distance to the nearest power corridor, as pulled from C.4.2.4, are provided below.

Site ratings based on Important Terrestrial Species/Habitat

Site	Rating
2, 3, 4, 5, 8, 10, O1, O2	5
12	3
13	4
14	2
15	2
16	2
17	2
R1	2

C.2.2.3 Disruption of Wetlands

Objective – The objective of this criterion is to evaluate the potential sites with respect to potential construction-related impacts on wetlands.

Evaluation approach – The following sub-criteria were used to evaluate the potential sites with respect to wetlands impacts:

- Approximate acres of wetland as a percent of total site, with the following metric used (based on actual wetland conditions at the sites):
  5 = 0 wetlands
  4 = < 5 percent
  3 = < 10 percent
  2 = < 15 percent
  1 = > 15 percent

An additional point was deducted if extensive high quality wetland areas were found around the site, given the potential for impacts on these adjacent lands from construction activities as well.

- Coverage of high quality wetlands (i.e., forested /shrub wetlands) within site boundary (approximate percentage of site); same metric as above where the higher the percentage of high quality wetlands (e.g., forested) is found on a site, the lower the rating.
- Flexibility, or the ability to avoid wetlands during construction (based on total site area, overall wetland distribution within site and ability to avoid both onsite and offsite wetlands where wetlands are found adjacent to site boundary).

With respect to flexibility, the following metric was used:

5 = no/minimal wetlands on sites where wetlands could easily be avoided (based on site size and/or lack of wetlands) and no extensive wetland areas found adjacent to site
3 = no wetlands present on site but extensive wetlands found surrounding the site
2 = minimal (<5%) wetlands present on site but extensive wetlands found surrounding the site
1 = wetlands (>5%) found on site and extensive wetland areas found surrounding the site

Sites with greater wetland coverage and less flexibility to avoid wetlands are less suitable in terms of potential impacts on wetlands. Because sites differ in size, significantly in some instances, the comparison is based on percentage of site covered (rather than actual acreage where known) and overall ability for site development to avoid wetlands. Site specific wetland coverage was identified where available; coverage also based on mapped wetlands as indicated in the National Wetlands Inventory (NWI) database (i.e., through visual observation) where other site specific information was not readily available. NWI Wetlands Mapper information was also used to help evaluate wetlands quality and distribution within a given site boundary. Note that the use of the term "wetlands" is used solely as a descriptive term and is not used as a regulatory or jurisdictional term.

Discussion

Approximately 600 acres of wetlands have been identified within the ORR "in riparian zones of headwater streams and receiving streams and in the Clinch River embayments." The majority of wetlands, which range in size from several square feet to about 25 acres, are classified as forested palustrine, scrub/shrub, or emergent wetlands.

Site specific information is available for the following ORR Sites:

- Site 2: Emergent herbaceous and woody wetlands occupy approximately 3.8 percent of the site. Based on NWI wetlands mapper, presence seems to be mostly confined to isolated pocket of high quality wetland near the river.
- Site 3: Emergent herbaceous and woody wetlands occupy approximately 8.9 percent of the site. Based on NWI wetlands mapper, presence seems to be mostly confined to isolated pockets of high quality wetland near the river.

- Site 5: Emergent herbaceous and woody wetlands occupy approximately 2.6 percent of the Site. No wetlands identified on NWI Wetlands mapper for this site; it was assumed that the wetland is confined to isolated pocket of high quality wetland (forested) similar to the other ORR Sites for which site specific data provided.
- Site 8: Emergent herbaceous and woody wetlands occupy approximately 0.1 percent of the Site (assumed to be 0 percent).
- Site 10: Wetlands occupy approximately 0 percent of the Site.

Based on review of data on NWI wetlands mapper alone, the remaining ORR Sites are characterized as follows:

- Site 4: Small pocket of high quality/forested wetlands identified near the river (assumed to be less than 5%).
- Site O1: No wetlands identified on the site.
- Site O2: No wetlands identified on the site.

Wetlands cover over 20 percent of Redstone Arsenal. Based on distribution as shown on the NWI Wetlands Mapper, they all appear to be in the southern portion of the Arsenal where the sites are located.

Site specific information is available for the following Redstone Arsenal sites:

- Site 12: Emergent herbaceous and woody wetlands occupy approximately 1.5 percent of the site, however, an extensive area of forested wetlands is found to the south and west, so an additional point deduction was made to the total wetlands estimate sub-rating.
- Site 14: Emergent herbaceous and woody wetlands occupy approximately 1.6 percent of the site. However, based on the NWI mapper imagery, the site is surrounded by extensive areas of freshwater emergent and high quality forested wetlands to the northwest, east and south, so an additional point deduction was made to the total wetlands estimate sub-rating. In addition, because the NWI mapper shows extensive wetlands – all emergent – within the Site 14 boundary as well (presumably non-jurisdictional), the site was assigned a low rating for flexibility.
- Site 15: Wetlands occupy 0 percent of the site. However, based on the NWI mapper imagery, the site appears to be surrounded by extensive areas of high quality forested wetlands to the southeast and northwest so an additional point deduction was made to the total estimated wetlands sub-rating.

Based on review of data on NWI wetlands mapper alone, the remaining Redstone Arsenal sites are characterized as follows:

- Site 13: No wetlands were identified on site. However, based on the NWI mapper imagery, extensive areas of high quality forested wetlands appear to lie to the east and south, so an additional point deduction was made to the total estimated wetlands sub-rating.
- Site 16: No wetlands appear to be found within the site boundary. However, based on NWI mapper imagery, the site is surrounded on northwest, northeast and south by

high quality forested and emergent fresh water wetland areas so an additional point deduction was made to the total wetlands estimate sub-rating. In addition, because the NWI mapper shows emergent and forested wetlands within portions of the Site 16 boundary as well (presumably non-jurisdictional), the site was assigned lower rating for high quality wetlands and lowest rating for flexibility.

- Site 17: The NWI wetlands mapper imagery shows potentially large areas of high quality wetlands within the site boundary, concentrated mainly in the center (between 5 and 10% of the site), and surrounding the site too. Thus, an additional point deduction was made to the total wetlands estimate sub-rating.
- Site R1: No wetlands were identified on site. However, based on the NWI mapper imagery, extensive areas of high quality forested wetlands appear to completely surround the site. Therefore, an additional point deduction was made to the estimated total wetlands sub-rating. In addition, given the fact that the site boundary has not yet been identified and potential exists for some of the surrounding wetlands to also occur onsite, the site was assigned lower rating for high quality wetlands and lowest rating for flexibility.

Results

Taking into account the wetlands information identified above, the sites were given the following composite ratings:

Site ratings based on Wetlands

Site	Estimated Total Wetlands	Estimated High Quality Wetlands*	Flexibility	Overall Rating
2	4	4	5	4
3	3	3	5	4
4	4	4	5	4
5	4	4	5	4
8	5	5	5	5
10	5	5	5	5
O1	5	5	5	5
O2	5	5	5	5
12	3	4	2	3
13	4	5	3	4
14	3	4	1	3
15	4	5	3	4
16	4	4	1	3
17	3	3	2	3
R1	3	3	1	2

* forested/scrub-shrub wetlands

References

NWI website: http://wetlandsfws.er.usgs.gov/.

U.S. Army, "Environmental Assessment for Integration, Assembly, Test, and Checkout of National Missile Defense Components at Redstone Arsenal, Alabama," National Missile Defense Joint Program Office, February 22, 1999.

C.2.2.4 Dewatering Effects on Adjacent Wetlands

Objective – The objective of this criterion is to evaluate the sites with respect to potential impacts from construction-related dewatering activities on area wetlands. Wetlands provide valuable habitat to many species, and are especially important to many migrating bird species (e.g., waterfowl).

Evaluation approach – The evaluation included a review of information related to the depth of the water table and the distance to nearby wetlands. National Wetland Inventory maps were used for some sites as the basis for determining wetland percentages where no site specific information was available. Those maps can include numerous areas that do not represent jurisdictional wetlands under Section 404 of the Clean Water Act, which contributed to the difficulty in making an estimate of wetland acreage. Moreover, those maps were based primarily on interpretation of aerial photography, and the amount of field validation that was performed varies according to region of the country and local terrain. Overall site elevation is being used as an indicator of depth to groundwater.

Discussion/Results – Wetlands are evaluated in Section C.2.2.3 of this appendix; depth to groundwater for each site is being evaluated by proxy using site elevation as an indicator. Data pulled from the evaluation of groundwater pathways (C.1.3.2) indicate that the average depth to groundwater is 65 to 70 feet at the ORR Sites and 6 to 7 feet for the Redstone Arsenal sites. Potential hydraulic connections among wetlands via groundwater are not known. Sites with deeper groundwater are considered to be more suitable as groundwater levels are less likely to be affected by construction. As a result, the ORR Sites are rated higher than Redstone sites for groundwater depth. Because the depth to groundwater at the ORR Sites is less than 100, they are all given a conservative rating of 4. Because the groundwater at Redstone Arsenal is so much shallower, and the Wheeler NWR located near the sites supports an important population of migratory waterfowl (Section C.2.2.1) that are dependent on wetlands, these sites are given a conservative rating of 1.

In light of the previous ratings and groundwater information, the site ratings are as follows:

Site Ratings

Site	Estimated Total Wetlands	Estimated High Quality Wetlands*	Depth to Groundwater	Overall Rating
2	4	4	4	4
3	3	3	4	3

Site	Estimated Total Wetlands	Estimated High Quality Wetlands*	Depth to Groundwater	Overall Rating
4	4	4	4	4
5	4	4	4	4
8	5	5	4	5
10	5	5	4	5
O1	5	5	4	5
O2	5	5	4	5
12	3	4	1	3
13	4	5	1	3
14	3	4	1	3
15	4	5	1	3
16	4	4	1	3
17	3	3	1	2
R1	3	3	1	2

* = forested/scrub-shrub wetlands

C.2.3 Operational-Related Effects on Aquatic Ecology

C.2.3.1 Thermal Discharge Effects

Objective – The objective of this criterion is to address the relative suitability of the potential sites with respect to potential thermal impacts. Two specific thermal impact issues were considered:

- disruption of important species and habitats; and
- impact on water quality of the receiving water body.

Evaluation approach – In December 2001, the EPA published a final regulation, which affects the location, design, construction, and capacity of intake structures for new power plants (EPA 2001). The EPA rule strongly encourages the use of closed-cycle designs to reduce adverse cooling water system impacts, and the new nuclear reactors at the potential sites would include a closed-cycle cooling water system.

Ratings are based on surface water flow characteristics (i.e., available flow brought forward from cooling water evaluation in Section C.1.1.2.1),), where the size of the receiving water body [heat sink] was the primary factor in assigning ratings [highest rating given to the largest heat sink]; and on site ratings for disruption of aquatic species/habitat (i.e., potential presence of T&E species, as brought forward from Section C.2.1.1 of this appendix).

Discussion/Results –It was assumed that the source water body would also be the receiving water body for this evaluation. Sub-ratings were averaged to provide a consolidated rating for each site below.

Site(s)	Flow[1]	Presence of Important Aquatic Species[2]	Overall Rating
ORR – all sites	4	3	3
Redstone – all sites	5	2	3

[1] Flow rating from Cooling Water Evaluation, Section C.1.1.2.1.
[2] Important Species Rating from Section C.2.1.1.

An additional reduction of one point was made to the species component for the Redstone sites given the potential for impact on migrating waterfowl species within the Wheeler National Wildlife Refuge (i.e., rating lowered from 3 to 2).

C.2.3.2 Entrainment/Impingement Effects

Objective – The objective of this criterion is to address the relative suitability of the potential sites with respect to potential entrainment and impingement impacts.

When cooling water is pumped from water bodies, several environmental impacts can occur. Entrainment refers to the removal of small, drifting organisms with the cooling water. Small fish, fish eggs, phytoplankton, zooplankton, and other aquatic organisms (e.g., larval stages of mollusks such as clams and mussels) experience high mortality rates as they pass through cooling water pumps and heat exchangers. Impingement refers to larger organisms that are screened out of the cooling water at the intake structure. Impinged organisms can include large fish, crustaceans, and other aquatic organisms that cannot avoid high intake velocities near the intake structure and are trapped on the intake screens.

Evaluation approach – Concerns about entrainment and impingement losses are resource dependent and vary on a site-to-site basis. The EPA issued a final rule in December 2001 affecting the design of intake structures for new power plants (EPA 2001). These rules encourage the use of closed-cycle systems, which is the type of system assumed to be used by TVA at these sites. Developers of new power plants who choose certainty and faster permitting over greater design flexibility will be encouraged to limit intake water capacities and velocities and incorporate specific intake screen designs to reduce entrainment and impingement losses.

Discussion/Results – The potential sites were evaluated with respect to relative potential for entrainment and impingement impacts for the closed-cycle cooling water system. Proposed facilities at each site will include cooling towers that will reduce the amount of cooling water withdrawal required for plant operation. In addition, proper design of the water intake structure would minimize the potential adverse impacts. In NUREG 1437, NRC concludes that, with cooling towers and appropriate intake design, potential adverse impacts due to entrainment or impingement of aquatic organism are minor and do not significantly disrupt existing populations. Assuming a two-unit closed-cycle plant at the site, and 100 percent of the local plankton passing through the plant, it appears that there would be no discernible effect on the plankton population in existing rivers and reservoirs at each site. This is due to the very small volume of water used by the plant relative to the total volume in the river or reservoir at the site. Because of the low flow velocities of a closed cycle plant at the site, impingement of adult fish would be expected to

be minimal. Use of a deep water intake would have a minimal effect on entrainment of larval fish.

Another component of this criterion was the presence of important aquatic species.

Given the above information, all sites received consistent ratings in terms of intake design (conservative rating of 3). Because both sets of sites included 20 or more federally protected aquatic species in the host county, including numerous species of mussels, they also were given conservative ratings of 3.

Site	Presence of Important Aquatic Species	Regulatory/ Engineering Design (conservative)	Overall Rating
ORR Sites 2, 3, 4, 5, 8, 10, O1, O2	3	3	3
Redstone 12, 13, 14, 15, 16, 17, R1.	3	3	3

C.2.3.3 Dredging/Disposal Effects

Objective – The purpose of the section is to evaluate the sites for potential environmental impacts related to maintenance dredging at the intake structure. The following evaluation, therefore, is a summary of available information related to the relative suitability of the sites.

Evaluation approach – Sites with high levels of contaminated sediment deposition at the intake structure will experience higher maintenance costs for the removal and disposal of the dredged material. Two factors were considered in performing the evaluation:

- The level of upstream contamination; and
- The rate of sedimentation at the site.

All sites are assumed to have relatively low fine-sediment-deposition rates (which are preferred), so the ratings were based on potential for contamination.

As addressed in Section C.2.1.2 (Contaminated Sediments), no site-specific information about the level of sediment contamination at the sites was identified. Results in Section C.2.1.2 were based on EPA data, which addressed general trends in levels of contamination in the water bodies at the potential sites, and general water-quality information for the major water bodies on which the potential sites are located. The evaluation was further expanded to consider existing background radioactive contamination at the sites.

Discussion/Results

Several existing 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. 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. Mercury was not detected above its maximum contaminant level.

Two streams within Redstone Arsenal property 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 within the property boundaries. (253 U.S. Environmental Protection Agency 2013) It is assumed that such sediment contamination may have carried downstream and affect sediments in the Tennessee Rivers, where intake and discharge locations are expected to be. No sources of existing radionuclide loadings were identified for the Redstone sites.

Based on available information, the sites were rated according to the expected levels of contamination. No new information was identified that would alter the already conservative ratings assigned in C.2.1.2 and these were carried forward here as well. The results are provided in the table below.

Site	Rating
2, 3, 4, 5, O1	2
8, 10, O2	3
12, 13,14, 15, 16, 17, R1	2

C.2.4 Operational-Related Effects on Terrestrial Ecology

C.2.4.1 Drift Effects on Surrounding Areas

Objective – The objective of this criterion is to evaluate the relative suitability of the potential sites with respect to potential concerns with cooling tower drift effects. This evaluation considered the potential effects on surrounding areas and the suitability of the cooling water source.

Cooling Tower Drift

In every cooling tower, there is a loss of water to the environment in the form of pure water, which results from the evaporative cooling process. This evaporated water leaves the tower in a pure vapor state, and thus presents no threat to the environment. Drift, however, is the undesirable loss of liquid water to the environment, via small unevaporated droplets that become entrained in the exhaust air stream of a cooling tower. These water droplets carry with them

minerals, debris and microorganisms and water treatment chemicals from the circulating water, thus potentially impacting the environment. High drift losses are typically caused by fouled, inefficient or damaged drift eliminators, excessive exit velocities or imbalances in water chemistry.

Minimizing drift losses in a cooling tower reduces the risk of impacting the environment. The principle environmental concern with cooling tower drift impacts are related to the emission and downwind deposition of cooling water salts (EPA 1987). Salt deposition can adversely affect sensitive plant and animal communities through changes in water and soil chemistry.

Evaluation approach – Sites considered with the most sensitive environments were assigned lower rating values. Ratings from the evaluation of aquatic and terrestrial ecology (disruption of important aquatic and terrestrial species and habitat) and wetlands were brought forward to serve as a surrogate for sensitive environments. Cooling water makeup (e.g., fresh versus salt water) was also considered. Sites with highest concentrations of dissolved solids and other potential contaminants in cooling tower makeup were also assigned lower rating values. In total four sub-criteria were evaluated and an overall composite rating was assigned based on the average of the four sub-ratings.

Discussion/Results – Information regarding important terrestrial and aquatic plant and animal communities, habitats, and wetlands in the vicinity of the potential sites were previously addressed in Section C.2.1.1 (Disruption of Important Species/Habitats – Aquatic Ecology), Section C.2.2.1 (Disruption of Important Species/Habitats – Terrestrial Ecology), and Section C.2.4.1 (Wetlands). Cooling water makeup water quality was also taken into account.

Given all the above information, the following ratings were assigned:

Site	Important Species Habitat Areas – Aquatic	Important Species Habitat Areas – Terrestrial	Wetlands	Source Water[1]	Overall Rating
2	3	3	4	5	4
3	4	4	4	5	4
4	3	3	4	5	4
5	3	3	4	5	4
8	3	3	5	5	4
10	3	3	5	5	4
O1	3	4	5	5	4
O2	3	3	5	5	4
12	3	2	3	5	3
13	3	3	4	5	4
14	3	3	3	5	3
15	3	2	4	5	3
16	3	2	4	5	3
17	3	3	3	5	3
R1	3	3	4	5	4

[1] Fresh = 5, Primarily fresh + possible brackish = 4, Primarily brackish + possible fresh = 3, Brackish = 2, Ocean = 1

C.3 Socioeconomics Criteria

C.3.1 Socioeconomics – Construction Related Effects

Objective – The objective of this criterion is to evaluate the relative suitability of the site with respect to the number of construction workers who will move into the plant site vicinity with their families; and the capacity of the communities surrounding the plant site to absorb this new temporary (in-migrant) population.

Evaluation approach – The evaluation is based on estimating the in-migrating construction workforce (including their families) and determining whether the local communities have the available capacity to support the influx in population. Sites within commuting distance of populated areas that have the available workforce and necessary infrastructure to support an in-migrating population are considered the most suitable. Assigned ratings are based on best professional judgment. The methodology for determining the in-migrating workforce is outlined below.

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 (if any) workers will choose to relocate to the site vicinity. The capacity of communities to absorb an increase in population depends on the availability of sufficient resources, such as adequate housing and community services to support the influx.

The plant construction workforce is likely to be available at any of the sites under consideration. The issue in siting, therefore, is the potential socioeconomic impact associated with any temporary influx of construction workers who live too far away to commute daily from their residence. With respect to suitability of the sites under consideration by TVA, socioeconomic impacts of nuclear power plant construction are directly related to two factors:

- number of construction workers who will move into the plant site vicinity with their families; and
- capacity of the communities surrounding the plant site to absorb this new temporary (in-migrant) 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 (if any) workers would choose to relocate to the site vicinity. 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. Impacts to a small community located along the commuter route(s) (e.g., food, lodging, gas, and congestion) can also be significant and should be considered. The information that should be considered in rating sites from the perspective of construction impacts includes labor requirements, location of labor pool, number of immigrants, and the economic structure of affected communities.

Construction of a nuclear power plant is very labor-intensive, and skilled and unskilled construction workers would likely be needed over a 4 to 5-year period. The following assumptions were used in this analysis:

- Construction would require a peak construction workforce of 3,300 workers (2,200 onsite at one time with third shift of 1,100 workers not onsite)
- Analysis assumes that no other major construction project would occur in the site vicinity concurrently with plant construction and operation. Thus, the sites were rated without consideration of potential cumulative impacts of other potential demands for labor.

Available population and economic data were obtained from the US Census Bureau (Quick Facts and American Fact Finder) for each site. The data were collected by county to determine availability of an adequate labor force within commuting distance (based on an assumed location of the labor pool). Data relating to population and labor force (primarily construction industry) were compared with the construction labor requirement to determine availability of labor.

Sites were rated based on the following criteria: highest rating of 5 if peak construction related employment accounted for less than 5 percent of total study area employment; moderate rating of 3 if it accounted for 5 to 10 percent of total study area employment; and lowest rating of 1 if it accounted for more than 10 percent of total study area employment.

The study area for evaluating socioeconomic impacts from construction included the host county, adjacent counties and any other nearby counties with a major population center within a reasonable commuting distance from the site (i.e., 50 miles).

Discussion – The population and available work force data are presented in the following tables. Projected growth rates from 2016 to 2022 is assumed to be similar to the growth rates from 2010 to 2015, based on U.S. Census data; note that the population and workforce levels declined in some counties between 2010 and 2015.

ORR Sites 2, 3, 4, 5, 8, 10, O1, O2

County	Total Pop (2010)	Total Pop (2015)*	Total Civilian Employed Workforce Population (Ages 16 years plus) (2010 and 2014)	Total Construction Workforce (2010/2014)	Unemploy-ment % (2010/2014)
Roane	54,181	52,753 (-2.6%)	22,816 (2010) 20,986 (2014)	2259 (2010) 1766 (2014)	4.7 to 5.5
Anderson	75,126	75,749 (0.8%)	31,564 (2010) 31,618 (2014)	2704 (2010) 2229 (2014)	4.3 to 4.7
Knox	432,226	451,324 (4.4%)	209,556 (2010) 211,194 (2014)	13,398 (2010) 12,782 (2014)	3.6 to 4.4
Loudon	48,559	51,130 (5.4%)	20,122 (2010) 19,811 (2014)	1,789 (2010) 1,399 (2014)	5.3 to 5.7

County	Total Pop (2010)	Total Pop (2015)*	Total Civilian Employed Workforce Population (Ages 16 years plus) (2010 and 2014)	Total Construction Workforce (2010/2014)	Unemploy-ment % (2010/2014)
Morgan	21,987	21,498 (-2.2%)	8,210 (2010) 6,860 (2014)	937 (2010) 644 (2014)	4.3 to 3.9
Total	**632,079**	**652,454**	**292,268 (2010)** **290,469 (2014)**	**21,087 (2010)** **18,820 (2014)**	

Source: U.S. Census Bureau, http://quickfacts.census.gov/qfd/ for Tennessee Counties (population); American Factfinder (employment data): factfinder.census.gov

Redstone Arsenal Sites 12, 13, 14, 15, 16, 17, R1

County	Total Pop (2010)	Total Pop (2015)*	Total Civilian Employed Workforce Population (Ages 16 years plus) (2010 and 2014)	Total Construction Workforce (2010/2014)	Unemploy-ment %
Madison	334,811	353,089 (5.5%)	34,321 (2010) 32,835 (2014)	2390 (2010) 2311 (2014)	4.0 to 3.1
Morgan	119,490	119,565 (0.1%)	152,500 (2010) 152,294 (2014)	4756 (2010) 4698 (2014)	5.3 to 6.7
Jackson	53,227	52,419 (-1.5%)	22,247 (2010) 20,934 (2014)	1758 (2010) 1512 (2014)	4.2 to 5.7
Marshall	93,019	94,725 (1.8%)	39,115 (2010) 37,953 (2014)	3985 (2010) 2994 (2014)	3.8 to 5.4
Limestone	82,782	91,663 (10.7%)	34,257 (2010) 36,895 (2014)	3002 (2010) 2994 (2014)	4.5 to 4.9
Total	**683,329**	**711,461**	**282,440 (2010)** **280,911 (2014)**	**15,891 (2010)** **14,509 (2014)**	

Source: U.S. Census Bureau, http://quickfacts.census.gov/qfd/ for Alabama Counties (population); American Factfinder (employment data): factfinder.census.gov

Results – The area population and total employed work force is similar across both sets of sites; the total area construction workforce is slightly lower for the Redstone sites than the ORR Sites. The overall levels for all potential sites are sufficiently large such that the impact on study area employment from construction of new SMR units would be low at each site. This is based on conservative workforce levels using 2015 Census Bureau data (without expected increases in 2020). The ORR Sites show a percentage increase of just over one percent when compared to total employed workforce, and over 17 percent when compared to total study area construction workforce (2014). The Redstone Arsenal sites show a similar small percentage increase of just over one percent when compared to the total employed workforce, but a slightly higher increase of over 22 percent when compared to the total study area construction workforce.

Both sets of sites include a large population either within, or in close proximity to, their host county: Madison County for the Redstone Arsenal sites, and the heavily populated and easily accessible Knox County for the ORR Sites (i.e., within 25 miles and a 30 minute drive). In addition, both sets of sites already include major government facilities with large workforces. Nonetheless, there are also many special skill sets required for nuclear power plant construction that may not be available locally. TVA has identified an expected in-migrating portion of the construction work force to be 1115 workers. However, to conservatively assess potential impacts, it was assumed that only half of the construction workforce (approximately 1,650 workers) would commute from within the area to these sites.

Given the assumption that the other 1,650 workers would in-migrate, and the increase this number represents to the total construction workforce in both study areas (over 17 percent in Oak Ridge and over 20 percent at Redstone), an additional analysis was conducted to consider the impacts of workers in-migrating to the areas. We have identified the following assumptions to help address potential impacts on local community services and housing:

50% of workers will in-migrate (1,650 workers);
50% of these workers bring their families (2.5 additional persons per family) (2,060 family members);
Influx of direct workers also brings in influx of indirect workers (0.4 ratio of direct to indirect workers – in absence of site-specific information) pertaining to the Regional Industrial Multiplier System direct/indirect ratios calculated for each plant (as found in NUREG/CR-2749) (660 indirect workers); and
50% of these indirect workers bring their families (2.5 additional persons per family) (825 family members).

Thus an influx of 1,650 workers is predicted to result in a total population influx of 5,195 persons.

When this population influx is compared to the total population in 2015 for each study area, the increase is less than one percent for both sets of sites. When compared to the host counties (in the event in-migrating workers prefer to reside closer to the plant sites), it is just over one percent (1.5%) when compared the population of the host Madison County for the Redstone Arsenal sites, but between approximately 7 and 9 percent, respectively, when compared to the host Anderson and Roane counties for the ORR Sites. However, the Oak Ridge sites sit within easy commuting distance of the heavily populated Knox County, where an in-migrating population would result in an increase of only 1.2 percent. Therefore, assuming many of the families of the in-migrating Oak Ridge workforce would also find Knox County an acceptable place to live, the impact on housing and community services would be expected to be negligible in both areas.

Each study area appears to have sufficient population centers within commuting distance such that its public services sector would be able to absorb the population in-migration associated with plant construction with minimal impact.

Based on the results discussed above, all sites would experience only minor socioeconomic impacts during construction, and all sites were given a rating of 5.

Site	Rating
2, 3, 4, 5, 8, 10, O1, O2	5
12, 13, 14, 15, 16, 17, R1	5

C.3.2 Socioeconomics – Operation Related Effects

Socioeconomic impacts of operation would be similar in nature to construction impacts although much smaller due to the small operations workforce for an SMR. For both the ORR and Redstone Arsenal sites, their close proximity to large population centers (i.e., Knoxville for ORR sites and Huntsville, AL for the Redstone Arsenal site) would mean impacts of the operational workforce would be negligible. Other operational impacts relate primarily to the benefits afforded to local communities as a result of the plant's presence. However, these benefits (i.e., TVA payments made in-lieu of tax payments) cannot be quantified and compared across potential sites at this level of site selection. In accordance with guidance in the Siting Guide, site suitability scores were not developed.

C.3.3 Environmental Justice

Objective – The objective of this criterion is to evaluate site-specific differences in potential disproportionate adverse impacts to minority and low-income communities. Two key factors in this evaluation are:

- Presence of low-income and minority populations in the site vicinity, and
- Disproportionate impacts on these populations.

Evaluation approach – Sites are first compared based on population data for minorities and low-income populations across sites. Sites where minority and low-income populations are disproportionately high compared to the state average are considered less suitable since these populations have the potential to be more adversely affected from SMR development than other populations. Best professional judgment is used to assign ratings based on a comparison of population data.

The study area for evaluating environmental justice concerns included the host county and immediately surrounding counties. Population data are primarily for 2010 – as provided in U.S. Census Bureau website. With respect to the minority populations, the minority grouping includes the following: African American, American Indian and Alaskan Native, Asian, Native Hawaiian and other Pacific Islander, all reporting only one race; some other race and two or more races. The Hispanic or Latino population (of any race) – Hispanic Ethnicity – is included in other applicable race categories.

Discussion – With respect to the sites under consideration, relevant environmental justice information is summarized for each candidate area below. Because data are provided at the county level, the study area for each potential site within a given candidate area is identical. Environmental justice data for the potential sites are summarized below.

ORR Sites 2, 3, 4, 5, 8, 10, O2, O2 - Site Minority and Low Income Population/Percentages

County	Population (2010)	White alone (not Hispanic) (%)	Minority (%)	Low Income (% / pop)
Roane	54,181	94.4 (51,147)	5.6 (3034)	18 (9752)
Anderson	75,126	91.9 (69,041)	8.1 (6085)	15.6 (11,720)
Knox	432,226	85.6 (369,986)	14.4 (62,240)	17.7 (76,504)
Loudon	48,559	93.4 (45,354)	6.6 (3205)	13.6 (6604)
Morgan	21,987	94.4 (20,756)	5.6 (1231)	23.4 (5145)
Total	**632,079**	**556,284 88%**	**75,795 12%**	**109,725 17.4%**

Source: U.S. Census Bureau, http://quickfacts.census.gov/qfd/ for Tennessee

State average for minority and low income in Tennessee is 25.6% (77.6% white alone, not Hispanic) and 16.7% respectively. Largest Hispanic/Latino population found is found in Loudon County, TN (7%); the largest African American population found in Knox County (8.8%). African American was larger percentage of minority population in host Roane County (2.7%).

Redstone Arsenal Sites 12, 13, 14, 15, 16, 17, R1 - Minority and Low Income Population/Percentages

County	Population (2000)	White alone (not Hispanic) (%)	Minority (%)	Low Income (% / pop) [2010-2014]
Madison	334,811	68.2 (228,341)	31.8 (106,470)	14.2 (47,543)
Morgan	119,490	79.8 (95,353)	20.2 (24,137)	15 (17,923)
Jackson	53,227	90.8 (48,383)	9.1 (4844)	22 (11,710)
Marshall	93,013	87.6 (81,479)	12.4 (11,534)	22 (21,343)
Limestone	82,782	80.3 (66,474)	19.7 (16,308)	13.6 (11,258)

County	Population (2000)	White alone (not Hispanic) (%)	Minority (%)	Low Income (% / pop) [2010-2014]
Total	**683,329**	**520,030 76.1%**	**163,293 23.9%**	**109,777 16.1%**

Source: U.S. Census Bureau, http://quickfacts.census.gov/qfd/ for Alabama

The state average for minority and low income in Alabama is 33% (68.5% white alone, not Hispanic) and 18.5% respectively. The largest Hispanic/Latino population is found in Marshall County, AL (12.1%); the largest African American population is found in host Madison County, AL (24%).

The study area for each site included a minority population greater than 10%, with ORR Sites at 12% and the Redstone Arsenal sites at twice that (approximately 24%). However, the percentage of minority population at both sets of sites is less than the state average for each respective state.

The percentage of low-income population within each study area exceeds 15 percent, with the ORR Sites' study area slightly higher (17.4%) than the state average (16.7%); and the Redstone Arsenal sites' study area slightly lower than the state average (16.5% versus 18.5%).

Looking at the host counties alone, Madison County, Alabama, has the higher minority population (nearly 32%) which is just under the state average. In comparison, the minority population in Roane and Anderson Counties, Tennessee were significantly lower than the state average, (both between 5 and 10 percent); however, Roane County had the highest percentage of low income population, which is higher than the state average.

There are potential long term economic benefits to these populations from a new nuclear power plant in the region (e.g., jobs, improved infrastructure and services from additional revenue generated by the plant). Low-income populations in counties in the Southeast United States that currently host existing nuclear power plants (including the Grand Gulf plant in Mississippi) have directly benefited from economic impacts of the existing plant. Similar beneficial economic impacts could also occur at any of the sites with large minority or low income populations in Tennessee and Alabama related to development of the TVA SMR demonstration plant.

However, there is also potential for adverse impacts relating to short term construction activities (e.g., increased dust and air emissions, traffic congestion and noise) to minority and low income populations that may live near the site or along a commuter or delivery route. Such impacts have the potential to have a more adverse health effect on minority populations (e.g., greater incidence of asthma) than on the general population. In addition, there is uncertainty as to whether minority and low income populations would be able to take advantage of economic benefits from the plant (e.g., how many jobs minority or low income populations could find at the plant). Therefore, based on professional judgment in factoring in the above percentages found at each set of sites, the site ratings are as follows:

Site	Rating
2, 3, 4, 5, 8, 10, O1, O2	4
12, 13, 14, 15, 16, 17, R1	3

Redstone Arsenal sites were rated slightly lower than the ORR Sites given the higher minority population, particularly within the host county.

C.3.4 Land Use

Objective – The objective of this criterion is to evaluate the suitability of the potential sites with respect to potential conflicts with existing land uses at each site.

Evaluation Approach – The evaluation is based on the compatibility of a new nuclear plant with existing land uses, including existing and future land uses and zoning ordinances, as well as the potential for impact on any significant historic resources. Historic resources include those currently listed on the National Register of Historic Places (NRHP), or known (active) archaeological sites or Native American lands. Ratings are assigned based on a qualitative evaluation of the sensitivity of existing land uses, compatibility of existing land uses (for SMR development), and cultural resources, and on best professional judgment regarding the unique combination of each of these features that exists at each potential site.

Discussion – Special land use features, including proximity to NRHP sites and dedicated lands/special ecological areas are summarized for each site in the table below. The potential difficulty associated with development in areas classified as "Developable – Major Restrictions" on the Redstone Arsenal is unclear, so they were given a conservative rating of 3. SMR development of the ORR Sites is considered more consistent with DOE designated land use for the sites. Cultural resources/historic properties are present in both candidate areas and could be affected by SMR development. Additional information in support of the ratings is provided below.

Oak Ridge Reservation Sites

The ORR occupies approximately 34,000 ac in Anderson and Roane Counties, Tennessee. Existing land use at the ORR includes the following categories and facilities:

- Greenspace/Conservation/Research;
- Carbon Cycling and Management Research;
- Ecosystem Dynamics Research;
- Global Climate Change Research;
- Remediation Research and Monitoring (Three Bend Scenic and Wildlife Refuge Area and Black Oak Ridge Conservation Easement);
- Industrial/Commercial (ETTP, Y-12, Oak Ridge Institute for Science and Education, Office of Secure Transportation, Spallation Neutron Source Facility); and
- Security (firing ranges and training facility).

All the ORR Sites are largely undeveloped although several are located adjacent to existing facilities on the Reservation, as follows:

Sites 2, 4, 5, 8, and 10 are owned by the federal government and managed by DOE. All the sites are large undeveloped with limited infrastructure development and structures. Site 2 is located immediately adjacent to the East Tennessee Technology Park which would appear to make it more compatible with further development for a SMR, although Site 2 is also located immediately adjacent to the Wheat Community African Burial Ground.

Site 3 is a largely undeveloped brownfield site immediately adjacent to the ORR, owned by the federal government and managed by TVA. Limited infrastructure development and structures are present on the site from the early construction of a proposed nuclear plant in the 1980s. TVA currently manages Site 3, and the 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. There is sufficient area in Zone 2 for siting the project.

Most of the ORR Sites appear to include some important habitat or natural areas that may pose some challenges to SMR development (e.g., Sites 5, 8 and 10); see discussion in Section C.2.2.1). Sites 5, 8, and 10 are also currently designated in the ORR 10-Year Site Plan for future aquatic-terrestrial interface studies (419 U.S. Department of Energy Oak Ridge Office 2007). This future plan for ecological research would be incompatible with site development for SMRs and ORR would have to re-evaluate its 10-Year Site Planning activities.

Both Sites O1 and O2 are largely undeveloped greenfield sites located just outside the ORR boundary. Site O1 is mostly cleared land whose private owner has not been identified. Site O2 is heavily forested and appears to consist of a 250-acre Arboretum, a project of the University of Tennessee Forest Resources Research and Education Center, with a mission of public education and service. It features interpretive nature trails and ecological points of interest. The trails are part of the Tennessee Recreational Trail System. The Arboretum is found within the larger 2,202-acre Oak Ridge Forest, headquarters for the UT Forest Resources, AgResearch and Education Center (http://utarboretum.tennessee.edu/).

Site O2 is bordered on the south by Oak Ridge Memorial Park, a 120-acre non-profit, perpetual care cemetery.

Cultural Resources and Historic Properties

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 sites are as follows:

- Freels Bend Cabin;
- Graphite Reactor;

- New Bethel Baptist Church and Cemetery;
- Oak Ridge Turnpike Checking Station;
- George Jones Memorial Baptist Church and Cemetery; and
- Scarboro Road Checking Station.

No NRHP sites are located within any of the ORR Sites. The number of recorded and previously unrecorded archaeological sites that may be within the ORR Sites is not publicly available. Further information would be required to determine the potential effects to archaeological resources if any are selected as a Candidate Site.

An additional 35 NRHP sites are located within 10 mi of the ORR boundary. Sites O1 and O2 are located immediately outside the ORR boundary.

Site 3 has been extensively studied and a total of 59 recorded archaeological sites, four isolated finds, one non-site locality, and one cemetery have been identified within or immediately adjacent to Site 3. Some of these sites are solely prehistoric, some solely historic, and others contain both prehistoric and historic components. None of these archaeological sites are currently listed on the NRHP. One site is considered eligible for the NRHP. Additionally, a total of 16 of these sites are considered potentially eligible for listing on the NRHP and 42 are considered not eligible for the NRHP. A total of 26 NRHP listed properties are located within a 10-mi radius of Site 3.

Therefore, Sites 5, 8 and 10 are given a conservative rating of 3 given the presence of natural areas, which may present challenges to development, and the potential for discovery of archaeological sites. Site 4 is also given conservative rating of 3 given lack of site-specific information available for this site, and the potential for archaeological discoveries. Site 2 is also given a conservative rating of 3 given its proximity to a burial ground and the potential for archaeological discoveries. Site 3 would appear to have an advantage to development since a portion of the site has been previously disturbed and TVA has designated a large portion of it as developable. It has been given a higher rating of 4, but not a 5 given the large number of archaeological sites identified on the site, some of which may be difficult to avoid. Site O1 is a cleared site and located farther from the river so the potential for archaeological site may be smaller; however, it is still given a conservative rating of 3 since so little is known about the site. Site O2 received the lowest rating of 1. It is owned by the University of Tennessee and its current use as a research and education center would likely preclude development of the site for a SMR.

Redstone Arsenal

Redstone Arsenal occupies approximately 38,000 ac near Huntsville, Alabama. The majority of the installation is developed. Existing land use at Redstone Arsenal includes the following categories and facilities:

- Greenspace/Conservation (Wheeler NWR);
- Industrial/Commercial (NASA's George C. Marshall Space Flight Center; family housing, and commercial, recreational, and medical centers); and

- Military/Security (munitions in southern portion, missile/rocket test ranges, along with the associated range fans, test area safety fans, and explosive safety-quantity distance arcs, in the western and southern portions; training areas).

Approximately 12 percent of the installation's total area, or 4542 ac, is available for development. Proposed land use identified for this area is primarily administrative (47 percent) and training area and testing ranges (19 percent). Much of this limited undeveloped land is occupied by the Wheeler NWR, which includes 4085 ac within the Redstone Arsenal boundary.

All of the potential sites located inside the Redstone Arsenal boundary (12 through 17) are located in the southern portion of the Arsenal in the Industrial Zone. The sites themselves (and the immediately adjacent areas) are largely undeveloped, but they are located within the Military/Security zone where any development would include major restrictions given the military related actions that may occur in the area (see related discussion in Section C.1.1.4 on hazardous land uses). This would appear to present challenges to a change in use, 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 a Redstone Arsenal Site is selected as the preferred location for the SMR facility.

Potential site 12 is located very close to a residential area that lies less than 0.5 mile to the west. All sites except 17 (southernmost site) and R1 (eastern most site located just outside the eastern boundary) are also located near the Wheeler NWR that runs through the southern portion of the Arsenal. Potential Site R1 is undeveloped but located within a mile of a residential area that lies to the east.

Cultural Resources and Historic Properties

Approximately 1000 archaeological sites have been identified at Redstone Arsenal and approximately 418 of these sites are potentially eligible for listing on the NRHP. Four NRHP sites are present within the Redstone Arsenal boundary. These sites include:

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

No NRHP sites are located within Redstone Arsenal potential sites 12 through 17 or the new greenfield site R1. The number of recorded and previously unrecorded archaeological sites within potential sites 12 through 17 and R1 is not publicly available. Further information would be required to determine the potential effects to archaeological resources as a result of siting the SMRs if any of these Potential Sites are selected as a Candidate Site.

An additional 73 NRHP sites are located within 10 mi of the Redstone Arsenal boundary, which would encompass the new R1 greenfield located immediately adjacent to the eastern boundary of the Arsenal.

Given the major restrictions on future development and need for mission change to make selected site compatible (even with letter indicating willingness to do so, could still be challenging to implement), as well as the potential for discovery of archaeological sites, each site was assigned a rating of 3. It is assumed that cultural resources could be avoided and that most concerns could be mitigated with small design changes. Site R1 is given a similar rating. Even though it is located offsite and does not have the change in mission challenges, it is surrounded by high quality wetlands and residential area lies just to the east that reflect less land use compatibility.

Site Ratings based on Land Use

Site	Rating
3	4
2, 4, 5, 8, 10, O1	3
O2	1
12, 13, 14, 15, 16, 17, R1	3

References

Google Earth

Alabama and Tennessee Atlas & Gazetteer for general land use information for new sites.

National Register of Historic Places (NRHP) database, found at: http://www.nationalregisterofhistoricplaces.com/ [link to state and county] or through the National Park Service website: http://www.nps.gov/nr/research/ [link to NRHP database at http://nrhp.focus.nps.gov/natreghome.do?searchtype=natreghome and then specify state and county (for list by county)].

U.S. Department of Energy Oak Ridge Office, "Oak Ridge Reservation 10-Year Site Plan – Integrating Multiple Land Use Needs," DOE/ORO-TYSP2007, 2007.

Barrett, Jared, Hockersmith, Kelly, Karpynec, Ted, and McKee, Larry, "Phase I Archaeological Survey, TVA Clinch River Site Characterization Project, Roane County, Tennessee Draft Report," TRC Project # 181678, TRC Environmental Corporation, Nashville, Tennessee, Tennessee Valley Authority, February, 2011.

Barrett, Jared, Hockersmith, K., Karpynec, T., and McKee, L., "Phase I Archaeological Survey of the Clinch River Small Modular Reactors Project (SMR), Roane County, Tennessee Final Report," TRC Environmental Corporation, Nashville, Tennessee, Prepared for the Tennessee Valley Authority, September 20, 2011.

U.S. Environmental Protection Agency, NEPAssist, Oak Ridge NEPAssist Report, National Report, National Register of Historic Places, Website: http://nepassisttool.epa.gov/nepassist/entry.aspx, 2013.

Shaw Environmental, Inc., "Final Record of Decision for Surface Media at RSA-196, Test Stand and Cleaning Building, Operable Unit 10, Redstone Arsenal, Madison county, Alabama," Knoxville, TN, U.S. Army Corps of Engineers, Savannah District, August, 2009.

AGEISS Environmental Inc. and J. M. Waller Associates, "Final Environmental Assessment for Base Realignment and Closure, Installation Support, and Associated Future Master Planning Actions at Redstone Arsenal, Alabama," U.S. Army Corps of Engineers, Mobile District, November 7, 2006.

U.S. Fish and Wildlife Service, Wheeler National Wildlife Refuge, Website: http://www.fws.gov/wheeler/info/history.html, June 9, 2009.

C.4 Engineering and Cost-Related Criteria

C.4.1 Health and Safety Related Criteria

C.4.1.1 Water Supply

Objective – The purpose of this criterion is to evaluate relative site-related differences in the design and construction cost of developing water supply facilities.

Evaluation approach – Sites with local conditions that would require additional engineering costs to develop water supply capability (e.g., reservoirs to address water supply limitations or reliability issues such as low flow constraints) are rated lower than sites with no such requirements. Sites are characterized below in terms of the relative difficulty and expense of dealing with low-flow conditions at the sites, regardless of whether a reservoir or some other means of addressing drought conditions is adopted.

Discussion/Results –Site ratings are based on professional judgment – taking into account major river body flows (average annual and low flow/drought conditions) (see section C.1.1.2), as well as the size and extent of on-site tributaries (conceptual engineering and cost studies were not undertaken as part of the site selection screening). Sites with no anticipated low-flow constraints received a 5; other ratings relate to the likelihood that a reservoir or other means to address low-flow conditions would be required.

Site	Evaluation	Rating
2	The water supply for the proposed site is the Clinch River. No low-flow constraints are anticipated, and the need for reservoir construction is low.	5
3	The water supply for the proposed site is the Clinch River. No low-flow constraints are anticipated, and the need for reservoir construction is low.	5
4	The water supply for the proposed site is the Clinch River. No low-flow constraints are anticipated, and the need for reservoir construction is low.	5
5	The water supply for the proposed site is the Clinch River. No low-flow constraints are anticipated, and the need for reservoir construction is low.	5
8	The water supply for the proposed site is the Clinch River. No low-flow constraints are anticipated, and the need for reservoir construction is low.	5
10	The water supply for the proposed site is the Clinch River. No low-flow constraints are anticipated, and the need for reservoir construction is low.	5
O1	The water supply for the proposed site is the Clinch River. No low-flow constraints are anticipated, and the need for reservoir construction is low.	5
O2	The water supply for the proposed site is the Clinch River. No low-flow constraints are anticipated, and the need for reservoir construction is low.	5

Site	Evaluation	Rating
12	The water supply for the proposed site is the Tennessee River. No low-flow constraints are anticipated, and the need for reservoir construction is low.	5
13	The water supply for the proposed site is the Tennessee River. No low-flow constraints are anticipated, and the need for reservoir construction is low.	5
14	The water supply for the proposed site is the Tennessee River. No low-flow constraints are anticipated, and the need for reservoir construction is low.	5
15	The water supply for the proposed site is the Tennessee River. No low-flow constraints are anticipated, and the need for reservoir construction is low.	5
16	The water supply for the proposed site is the Tennessee River. No low-flow constraints are anticipated, and the need for reservoir construction is low.	5
17	The water supply for the proposed site is the Tennessee River. No low-flow constraints are anticipated, and the need for reservoir construction is low.	5
R1	The water supply for the proposed site is the Tennessee River. No low-flow constraints are anticipated, and the need for reservoir construction is low.	5

References

USGS: Annual Water Data Reports, http://wdr.water.usgs.gov/.

USGS Topographic Maps.

C.4.1.2 Pumping Distance

Objective – The purpose of this criterion is to evaluate relative differences in the operational costs associated with pumping plant water intake from the source water body to the plant.

Evaluation approach – Sites located large distances from their plant water intake supply source are rated lower than those located adjacent to the source. In general, the cost differential is expected to be a linear function of distance from the water source.

5 = Site located < 1 mile from cooling water source;
4 = Site located 1-2 miles from cooling water source;
3 = Site located 2-4 miles from cooling water source;
2 = Site located 4-8 miles from cooling water source; and
1 = Site located > 8 miles from cooling water source.

Discussion/Results – Precise intake and discharge locations have not yet been determined for potential sites as final plant locations have yet to be determined. It is assumed that cooling facilities will be located as close to the water supply as possible.

Site	Evaluation	Rating
2	The water supply for the potential site is the Clinch River. The Clinch River is located adjacent to the potential site. Pumping costs required to deliver the water supply are anticipated to be low.	5
3	The water supply for the potential site is the Clinch River. The Clinch River is located adjacent to the potential site. Pumping costs required to deliver the water supply are anticipated to be low.	5
4	The water supply for the potential site is the Clinch River. The Clinch River is located adjacent to the potential site. Pumping costs required to deliver the water supply are anticipated to be low.	5
5	The water supply for the potential site is the Clinch River. The Clinch River is located adjacent to the potential site. Pumping costs required to deliver the water supply are anticipated to be low.	5
8	The water supply for the potential site is the Clinch River. The Clinch River is located adjacent to the potential site. Pumping costs required to deliver the water supply are anticipated to be low.	5
10	The water supply for the potential site is the Clinch River. The Clinch River is located adjacent to the potential site. Pumping costs required to deliver the water supply are anticipated to be low.	5
O1	The water supply for the potential site is the Clinch River. The Clinch River is located within 1 mile of the potential site. Pumping costs required to deliver the water supply are anticipated to be low.	5
O2	The water supply for the potential site is the Clinch River. The Clinch River is located within 1 mile of the potential site. Pumping costs required to deliver the water supply are anticipated to be low.	5
12	The water supply for the potential site is the Tennessee River. The Tennessee River is located within 3 miles of the potential site. Pumping costs required to deliver the water supply are anticipated to be moderately low.	3
13	The water supply for the potential site is the Tennessee River. The Tennessee River is located within 3 miles of the potential site. Pumping costs required to deliver the water supply are anticipated to be moderately low.	3
14	The water supply for the potential site is the Tennessee River. The Tennessee River is located within 2 miles of the potential site. Pumping costs required to deliver the water supply are anticipated to be moderately low.	4

Site	Evaluation	Rating
15	The water supply for the potential site is the Tennessee River. The Tennessee River is located within 2 miles of the potential site. Pumping costs required to deliver the water supply are anticipated to be moderately low.	4
16	The water supply for the potential site is the Tennessee River. The Tennessee River is located within 2 miles of the potential site. Pumping costs required to deliver the water supply are anticipated to be moderately low.	4
17	The water supply for the potential site is the Tennessee River. The Tennessee River is located within 1 mile of the potential site. Pumping costs required to deliver the water supply are anticipated to be moderately low.	5
R1	The water supply for the potential site is the Tennessee River. The Tennessee River is located within 4 miles of the potential site. Pumping costs required to deliver the water supply are anticipated to be moderately low.	3

References

USGS Topographic Maps (1:100,000 and 1:24,000 scale).

C.4.1.3 Flooding

Objective – The purpose of this criterion is to rate sites with respect to differential costs associated with construction of flood protection structures necessary to address probable maximum floods at the sites under consideration.

Evaluation approach – Sites with the largest differences between site-grade elevation and likely flood elevations (and thus the lowest flood protection costs) are rated highest; sites with plant grade at or near flood level are rated lowest. Professional judgment was applied to the combination of these factors to rate sites on the basis of the magnitude of flood protection structure works that would be required at each site.

Discussion/Results – Although final plant layout locations have not been set for potential sites, an initial comparison of potential site locations with floodplain information indicate that some proposed plant facilities may require protection from flooding.

Site	Evaluation	Rating
2	Site elevation = approx. 900 ft. Clinch River elevation = approx. 739 ft. Difference = 161 ft. Site is located in Flood Zone X (outside of 500-year flood zone), area base flood elevations = 747 ft. If required, construction of flood protection structures would be minimal.	5

Site	Evaluation	Rating
3	Site elevation = approx. 800 ft. Clinch River elevation = approx. 739 ft. Difference = 61 ft. Site is located in Flood Zone X (outside of 500-year flood zone), area base flood elevations = 748 ft. Construction of flood protection structures may be necessary, but would be minimal.	4
4	Site elevation = approx. 800 ft. Clinch River elevation = approx. 739 ft. Difference = 61 ft. Site is primarily located in Flood Zone X (outside of 500-year flood zone), but areas of site include a drainage from an unnamed stream and are within Flood Zone AE (within 100-year flood zone). Area base flood elevations = 749-750 ft. Construction of flood protection structures may be necessary, but would be minimal.	4
5	Site elevation = approx. 900 ft. Clinch River elevation = approx. 739 ft. Difference = 161 ft. Site is located in Flood Zone X (outside of 500-year flood zone), area base flood elevations = 751 ft. If required, construction of flood protection structures would be minimal.	5
8	Site elevation = approx. 950 ft. Clinch River elevation = approx. 801 ft. Difference = 149 ft. Site is located in Flood Zone X (outside of 500-year flood zone), area base flood elevations = 796 ft. If required, construction of flood protection structures would be minimal.	5
10	Site elevation = approx. 1,100 ft. Clinch River elevation = approx. 801 ft. Difference = 299 ft. Site is located in Flood Zone X (outside of 500-year flood zone), area base flood elevations = 796 ft. If required, construction of flood protection structures would be minimal.	5
O1	Site elevation = approx. 800 ft. Clinch River elevation = approx. 739 ft. Difference = 61 ft. Site is located in Flood Zone X (outside of 500-year flood zone), between areas with base flood elevations = 747 ft. Construction of flood protection structures may be necessary, but would be minimal.	4

Site	Evaluation	Rating
O2	Site elevation = approx. 1,050 ft. Clinch River elevation = approx. 801 ft. Difference = 249 ft. Site is located in Flood Zone X (outside of 500-year flood zone), between areas with base flood elevations = 796 ft. If required, construction of flood protection structures would be minimal.	5
12	Site elevation = approx. 650 ft. Tennessee River elevation = approx. 555 ft. Difference = 95 ft. Site is located in Flood Zone X (outside of 500-year flood zone), adjacent to areas in Flood Zone A (within 100-year flood zone). Construction of flood protection structures may be necessary, but would be minimal.	4
13	Site elevation = approx. 571 ft. Tennessee River elevation = approx. 555 ft. Difference = 16 ft. Site is located in Flood Zone X (outside of 500-year flood zone), adjacent to areas in Flood Zone A (within 100-year flood zone). Construction of flood protection structures is likely to be necessary.	2
14	Site elevation = approx. 571 ft. Tennessee River elevation = approx. 555 ft. Difference = 16 ft. Site is located in on the border of Flood Zone X (outside of 500-year flood zone) and Flood Zone A (within 100-year flood zone). Construction of flood protection structures is likely to be necessary.	2
15	Site elevation = approx. 640 ft. Tennessee River elevation = approx. 555 ft. Difference = 85 ft. Site is located in on the border of Flood Zone X (outside of 500-year flood zone) and Flood Zone A (within 100-year flood zone). Construction of flood protection structures is likely to be necessary.	2

Site	Evaluation	Rating
16	Site elevation = approx. 625 ft. Tennessee River elevation = approx. 555 ft. Difference = 70 ft. Site is located in on the border of Flood Zone X (outside of 500-year flood zone) and Flood Zone A (within 100-year flood zone). Construction of flood protection structures is likely to be necessary.	2
17	Site elevation = approx. 625 ft. Tennessee River elevation = approx. 555 ft. Difference = 70 ft. Site is located in on the border of Flood Zone X (outside of 500-year flood zone) and Flood Zone A (within 100-year flood zone). Construction of flood protection structures is likely to be necessary.	2
R1	Site elevation = approx. 610 ft. Tennessee River elevation = approx. 555 ft. Difference = 55 ft. Site is located in on the border of Flood Zone X (outside of 500-year flood zone) and Flood Zone A (within 100-year flood zone). Area base flood elevations = 576 ft. Construction of flood protection structures is likely to be necessary.	2

References

FEMA Digital Flood Insurance Rate Maps, http://www.msc.fema.gov.

Google Earth, http://earth.google.com.

NOAA Stream and Flood Data, http://www.weather.gov/ahps/.

USGS Topographic Maps (1:100,000 and 1:24,000 scale).

U.S. Flood Hazard Areas, http://www.esri.com/hazards/makemap.html.

C.4.1.4 Vibratory Ground Motion

The objective of this criterion is to provide a relative measure of cost associated with designing and constructing a plant to address different seismic requirements at different sites. Because all of the sites under consideration are expected to meet the site parameters for seismic design of the SMR designs under consideration, no cost differentials for vibratory ground motion are expected, and accordingly this criterion is not applicable to the TVA site selection process for this project.

C.4.1.5 Civil Works

Objective – The objective of this criterion is to rate sites according to differences in the cost of civil works (e.g., non-flood related berms, stabilizing of graded slopes and banks) necessary to prepare the site for nuclear plant development.

Evaluation approach – Sites are rated highest to lowest according to the relative level of expected cost of civil works required at each site.

Discussion/Results – Landslides are commonly defined as the downward and outward movement of earth materials on a slope. Typically, landslides involve the falling, sliding, or flowing of rock and/or soil. Causes of landslides may include earthquakes, reservoir draw-downs, heavy precipitation, and floods. Sites are rated highest to lowest according to the estimated level of cost of civil works required at each site based on past incidence and future susceptibility of area landslides.

Site	Evaluation	Rating
2	Site is in an area moderately susceptible to landslides. Oak Ridge Reservation is located in an area of relatively low to moderately low sinkhole density. Compounded with moderate area sloping, costs associated with civil works (slope stability) are estimated to be low.	4
3	Site is in an area moderately susceptible to landslides. Oak Ridge Reservation is located in an area of relatively low to moderately low sinkhole density. Compounded with minimal area sloping, costs associated with civil works (slope stability) are estimated to be low.	4
4	Site is in an area moderately susceptible to landslides. Oak Ridge Reservation is located in an area of relatively low to moderately low sinkhole density. Compounded with moderate area sloping, costs associated with civil works (slope stability) are estimated to be low.	4
5	Site is in an area moderately susceptible to landslides. Oak Ridge Reservation is located in an area of relatively low to moderately low sinkhole density. Compounded with minimal area sloping, costs associated with civil works (slope stability) are estimated to be low.	4
8	Site is in an area moderately susceptible to landslides. Oak Ridge Reservation is located in an area of relatively low to moderately low sinkhole density. Compounded with moderate area sloping, costs associated with civil works (slope stability) are estimated to be low.	4

Site	Evaluation	Rating
10	Site is in an area moderately susceptible to landslides. Oak Ridge Reservation is located in an area of relatively low to moderately low sinkhole density. Compounded with minimal area sloping, costs associated with civil works (slope stability) are estimated to be low.	4
O1	Site is in an area moderately susceptible to landslides. Oak Ridge Reservation is located in an area of relatively low to moderately low sinkhole density. Compounded with minimal area sloping, costs associated with civil works (slope stability) are estimated to be low.	4
O2	Site is in an area moderately susceptible to landslides. Oak Ridge Reservation is located in an area of relatively low to moderately low sinkhole density. Compounded with minimal area sloping, costs associated with civil works (slope stability) are estimated to be low.	4
12	Site is in an area of low susceptibility to landslides. Redstone Arsenal is located in an area of relatively high sinkhole density. Compounded with minimal area sloping, costs associated with civil works (slope stability) are estimated to be low.	4
13	Site is in an area of low susceptibility to landslides. Redstone Arsenal is located in an area of relatively high sinkhole density. Compounded with minimal area sloping, costs associated with civil works (slope stability) are estimated to be low.	4
14	Site is in an area of low susceptibility to landslides. Redstone Arsenal is located in an area of relatively high sinkhole density. Compounded with minimal area sloping, costs associated with civil works (slope stability) are estimated to be low.	4
15	Site is in an area of low susceptibility to landslides. Redstone Arsenal is located in an area of relatively high sinkhole density. Compounded with minimal area sloping, costs associated with civil works (slope stability) are estimated to be low.	4
16	Site is in an area of low susceptibility to landslides. Redstone Arsenal is located in an area of relatively high sinkhole density. Compounded with minimal area sloping, costs associated with civil works (slope stability) are estimated to be low.	4

Site	Evaluation	Rating
17	Site is in an area of low susceptibility to landslides. Redstone Arsenal is located in an area of relatively high sinkhole density. Compounded with minimal area sloping, costs associated with civil works (slope stability) are estimated to be low, but higher than some sites.	4
R1	Site is in an area of low susceptibility to landslides. Redstone Arsenal is located in an area of relatively high sinkhole density. Compounded with minimal area sloping, costs associated with civil works (slope stability) are estimated to be low, but higher than some sites.	4

C.4.2 Transportation or Transmission-Related Criteria

C.4.2.1 Railroad Access

Objective – The purpose of this criterion is to rate sites according to the relative costs associated with providing rail access.

Evaluation approach – Sites are rated from highest to lowest in accordance with the length of additional or new rail spur construction required to provide rail access. Sites having rail access within 1 mile receive a rating of 5; sites with rail access between 11 and 55 miles away receive a rating of 4, sites with rail access between 5 and 10 miles away receive a rating of 3; sites with rail access between 10 and 20 miles away receive a rating of 2; and sites with rail access greater than 20 miles away receive a rating of 1. Issues complicating rail access construction may result in a reduced rating.

The site-specific condition of abandoned rail lines is unknown and could range from removed/revegetated to present and operable with minimal upgrade. Therefore, distances used in this analysis are to the nearest rail line in service and assume abandoned rail lines have been removed/revegetated. Should rail access become a sensitive criterion for site selection, site-specific conditions of abandoned rail lines should be more fully evaluated.

Ratings were assigned on the following scale, based on distance to the nearest rail line:

Within 1 mile of the site = 5
1 mile – 5 miles = 4
5– 10 miles = 3
10 – 20 miles = 2
Greater than 20 miles = 1

An additional point was deducted if access from the site to the nearest rail line is complicated by existing development.

Discussion/Results – Assuming that (1) passenger lines may be used for a one-time delivery of plant equipment to the site, (2) abandoned lines have been removed/revegetated, and (3) costs are based on a straight linear scale of costs for construction of rail spurs to the sites from these lines, ratings for the sites are assigned in the table below.

Site	Evaluation	Rating
2	Rail is located in the immediate vicinity of the potential site (operated by Norfolk Southern, CSX Transportation has trackage rights). A rail spur from the main line serves the ORNL K-25 plant site.	5
3	Rail is located ~ 2.1 miles northwest of the potential site (operated by Norfolk Southern, CSX Transportation has trackage rights). A rail spur from the main line serves the ORNL K-25 plant site.	4
4	Rail is located ~ 2.0 miles northwest of the potential site (operated by Norfolk Southern, CSX Transportation has trackage rights). A rail spur from the main line serves the ORNL K-25 plant site.	4
5	Rail is located ~ 4.4 miles northwest of the potential site (operated by Norfolk Southern, CSX Transportation has trackage rights). A rail spur from the main line serves the ORNL K-25 plant site.	4
8	Rail is located ~ 4.8 miles northwest of the potential site (operated by Norfolk Southern, CSX Transportation has trackage rights). A rail spur from the main line serves the ORNL K-25 plant site.	4
10	Rail is located ~ 6.2 miles west of the potential site (operated by Norfolk Southern, CSX Transportation has trackage rights). A rail spur from the main line serves the ORNL K-25 plant site.	3
O1	Rail is located ~ 2.1 miles east of the potential site (operated by Norfolk Southern, CSX Transportation has trackage rights). A rail spur from the main line serves the ORNL K-25 plant site.	4
O2	Rail is located ~ 2.8 miles north of the potential site (operated by CSX Transportation). Construction of rail access could be complicated due to residential development between the potential site and the active rail line.	3
12	Rail is located ~ 5.0 miles north of the potential site (operated by Norfolk Southern).	4
13	Rail is located ~ 6.3 miles northwest of the potential site (operated by Norfolk Southern).	3
14	Rail is located ~ 6.5 miles north of the potential site (operated by Norfolk Southern).	3
15	Rail is located ~ 6.3 miles north of the potential site (operated by Norfolk Southern).	3

Site	Evaluation	Rating
16	Rail is located ~ 6.8 miles north of the potential site (operated by Norfolk Southern).	3
17	Rail is located ~ 6.4 miles east of the potential site (operated by Huntsville and Madison County RR Authority).	3
R1	Rail is located ~ 1.8 miles east of the potential site (operated by Huntsville and Madison County RR Authority).	4

References

North American Railroad Map, version 3.0, http://www.RailroadMap.com.

USGS Topographic Maps (1:100,000 and 1:24,000 scale).

C.4.2.2 Highway Access

Objective – The purpose of this criterion is to rate sites according to the relative costs associated with providing highway access.

Evaluation approach – Sites are rated from highest to lowest in accordance with the length of additional or new highway construction required to provide car and truck access.

Ratings were assigned on the following scale, based on distance to the nearest highway:

Immediate site vicinity to 2.5 miles = 5
2.5 miles – 5 miles = 4
6 – 10 miles = 3
10 – 20 miles = 2
Greater than 20 miles = 1

Discussion/Results – The following table evaluates the existing roads serving the site areas. All sites are located near existing roads, and construction of site access is predicted to be minimal.

Site	Evaluation	Rating
2	Potential site is located immediately southeast of Highway 58 and ~ 4 miles northeast of I-40.	5
3	Potential site is located ~ 2 miles southeast of Highway 58 and ~ 3 miles west of Highway 95, both of which have access ramps to I-40 and provide access to Site ..	5
4	Potential site is located ~ 2 miles southeast of Highway 58 and ~ 2 miles west of Highway 95.	5
5	Potential site is located adjacent to Highway 95 and ~ 1 mile northeast of I-40.	5

Site	Evaluation	Rating
8	Potential site is located adjacent to Highway 95 (via dam access road).	5
10	Potential site is located ~ 2 miles east of Highway 95.	5
O1	Potential site is located ~ 3 miles west of Highway 58 and ~ 3 miles south of Highway 61.	4
O2	Potential site is located adjacent to Highway 170.	5
12	Potential site is located ~ 5 miles south of I-565.	4
13	Potential site is located ~ 6 miles south of I-565.	3
14	Potential site is located ~ 6 miles south of I-565.	3
15	Potential site is located ~ 6 miles south of I-565.	3
16	Potential site is located ~ 6 miles south of I-565.	3
17	Potential site is located ~ 9 miles south of I-565.	3
R1	Potential site is located ~ 2 miles west of Highway 231.	5

References

Rand McNally Road Atlas.

USGS Topographic Maps (1:100,000 and 1:24,000 scale).

C.4.2.3 Barge Access

Objective – The purpose of this criterion is to rate sites according to the relative costs associated with providing barge access.

Evaluation approach – A rating of 5 is applied to sites where navigation allows access to a barge receiving facility near the site. Lower ratings are assigned with increasing difficulty in providing navigable access to the site vicinity.

Discussion/Results – The following table evaluates the area geography permitting barge access to the potential sites.

Site	Evaluation	Rating
2	The Clinch River is a navigable waterway, and the Melton Hill Dam has a navigation lock, which permits navigation up to Norris Dam. Area barge access is available or can be constructed.	5
3	The Clinch River is a navigable waterway, and the Melton Hill Dam has a navigation lock, which permits navigation up to Norris Dam. Area barge access is available or can be constructed.	5

Site	Evaluation	Rating
4	The Clinch River is a navigable waterway, and the Melton Hill Dam has a navigation lock, which permits navigation up to Norris Dam. Area barge access is available or can be constructed.	5
5	The Clinch River is a navigable waterway, and the Melton Hill Dam has a navigation lock, which permits navigation up to Norris Dam. Area barge access is available or can be constructed.	5
8	The Clinch River is a navigable waterway, and the Melton Hill Dam has a navigation lock, which permits navigation up to Norris Dam. Area barge access is available or can be constructed.	5
10	The Clinch River is a navigable waterway, and the Melton Hill Dam has a navigation lock, which permits navigation up to Norris Dam. Area barge access is available or can be constructed.	5
O1	The Clinch River is a navigable waterway, and the Melton Hill Dam has a navigation lock, which permits navigation up to Norris Dam. Area barge access is available or can be constructed.	5
O2	The Clinch River is a navigable waterway, and the Melton Hill Dam has a navigation lock, which permits navigation up to Norris Dam. Area barge access is available or can be constructed.	5
12	The Tennessee River is a navigable waterway, and barge access is available or can be constructed in the vicinity of the potential site.	5
13	The Tennessee River is a navigable waterway, and barge access is available or can be constructed in the vicinity of the potential site.	5
14	The Tennessee River is a navigable waterway, and barge access is available or can be constructed in the vicinity of the potential site.	5
15	The Tennessee River is a navigable waterway, and barge access is available or can be constructed in the vicinity of the potential site.	5
16	The Tennessee River is a navigable waterway, and barge access is available or can be constructed in the vicinity of the potential site.	5
17	The Tennessee River is a navigable waterway, and barge access is available or can be constructed in the vicinity of the potential site.	5
R1	The Tennessee River is a navigable waterway, and barge access is available or can be constructed in the vicinity of the potential site.	5

References

Navigation on the Tennessee River. https://jobs.tva.com/river/navigation/index.htm.

USGS Topographic Maps (1:100,000 and 1:24,000 scale).

C.4.2.4 Transmission Cost

Objective – The purpose of this criterion is to rate sites according to the relative costs associated with transmission access.

Evaluation approach – Sites are rated from highest to lowest in accordance with the length of additional or new transmission lines and corridors required to provide transmission access. Sites having transmission access within the site boundary receive a rating of 5; sites with transmission access between within 1 mile of the site receive a rating of 4; sites with transmission access between 1 and 3 miles away receive a rating of 3; sites with transmission access between 3 and 5 miles away receive a rating of 2; sites with transmission access greater than 5 miles away receive a rating of 1. Issues complicating transmission construction may result in a reduced rating.

Discussion/Results – Costs are based on length to transmission access to the sites from transmission lines, and ratings for the sites are assigned in the table below.

Site	Evaluation	Rating
2	Access to 3 transmission lines within site boundary.	5
3	Access to 2 transmission lines within site boundary.	5
4	Access to 1 transmission line within site boundary.	5
5	Access to 1 transmission line within site boundary.	5
8	Access to 1 transmission line within site boundary.	5
10	Access to 1 transmission line within site boundary.	5
O1	Access to 1 transmission line within site boundary.	5
O2	Access to 1 transmission line within site boundary.	5
12	Access to transmission lines within 1 - 3 miles of site.	3
13	Access to transmission lines within 1 mile of site.	4
14	Access to transmission lines within 3 - 5 miles of site.	2
15	Access to transmission lines within 3 - 5 miles of site.	2
16	Access to transmission lines within 3 - 5 miles of site.	2
17	Access to transmission lines within 3 - 5 miles of site.	2
R1	Access to transmission lines within 3 - 5 miles of site.	2

References

Satellite imagery of the areas was viewed using Google Earth® (http://earth.google.com/).

C.4.3 Criteria Related to Land Use and Site Preparation

C.4.3.1 Topography

Objective – The purpose of this criterion is to rate sites according to the relative costs associated with site grading and earth-moving necessary to prepare the site for construction of a nuclear power plant.

Evaluation approach – Ratings are based on the amount of topographic relief currently found at the site, with the most severe relief resulting in the highest estimated grading costs and therefore the poorest rating. Sites are rated from highest to lowest in accordance with estimated grading costs. Ratings were assigned as follows, based on the level of topographic relief at each potential site:

Minimal relief (less than 100 ft) = 5
Moderate relief (100 – 250 ft) = 3
Severe relief (≥ 250ft) = 1

Discussion/Results – Topography varies within and between the candidate areas, and costs associated with topography adjustment range from relatively low to moderate.

Site	Evaluation	Rating
2	The site is located in an area with moderate relief, with a ridge and drainage on the site. Costs associated with site preparation are expected to be moderate. Approximate relief = 240 feet (750 ft – 990 ft).	3
3	The site is located in an area with minimal relief. Costs associated with site preparation are expected to be relatively low. Approximate relief = 75 feet (775 ft – 850 ft).	5
4	The site is located in an area with minimal relief. Costs associated with site preparation are expected to be relatively low. Approximate relief = 75 feet (775 ft – 850 ft).	5
5	The site is located in an area with moderate relief, with a ridge and drainage on the site. Costs associated with site preparation are expected to be moderate. Approximate relief = 150 feet (900 ft – 1,050 ft).	3
8	The site is located in an area with moderate relief, with a ridge and drainage on the site. Costs associated with site preparation are expected to be moderate. Approximate relief = 150 feet (950 ft – 1,050 ft).	3
10	The site is located in an area with moderate relief, with a ridge and drainage on the site. Costs associated with site preparation are expected to be moderate. Approximate relief = 250 feet (950 ft – 1,200 ft).	1

Site	Evaluation	Rating
O1	The site is located in an area with minimal relief. Costs associated with site preparation are expected to be relatively low. Approximate relief = 50 feet (775 ft – 825 ft).	5
O2	The site is located in an area with moderate relief, with ridges and drainages on the site. Costs associated with site preparation are expected to be moderate. Approximate relief = 175 feet (1,000 ft – 1,175 ft).	3
12	The site is located in an area with minimal relief. Costs associated with site preparation are expected to be relatively low. Approximate relief = 60 feet (590 ft – 650 ft).	5
13	The site is located in an area with minimal relief. Costs associated with site preparation are expected to be relatively low. Approximate relief = 40 feet (615 ft – 655 ft).	5
14	The site is located in an area with minimal relief. Costs associated with site preparation are expected to be relatively low. Approximate relief = 20 feet (550 ft – 570 ft).	5
15	The site is located in an area with moderate relief, with a ridge on the site. Costs associated with site preparation are expected to be moderate. Approximate relief = 165 feet (650 ft – 815 ft).	3
16	The site is located in an area with minimal relief. Costs associated with site preparation are expected to be relatively low. Approximate relief = 20 feet (550 ft – 570 ft).	5
17	The site is located in an area with minimal relief. Costs associated with site preparation are expected to be relatively low. Approximate relief = 50 feet (590 ft – 640 ft).	5
R1	The site is located in an area with minimal relief. Costs associated with site preparation are expected to be relatively low. Approximate relief = 60 feet (560 ft – 620 ft).	5

References

USGS Topographic Maps (1:100,000 and 1:24,000 scale).

C.4.3.2 Land Rights

Objective – The purpose of this criterion is to rate sites according to the relative costs associated with purchasing land required to construct and operate a nuclear plant on the site.

Evaluation approach –Sites are rated from highest to lowest using best professional judgment, based on ownership, estimated land costs (for privately owned sites), and other potential conflicts based on general knowledge of site ownership and selection process. Local land costs are based on U.S. Census of Agriculture data (value of land, farmland) for 2012. Sites with a willing seller (or lessor) and lower land costs are considered the most suitable.

Discussion/Results – Results are provided below; the rationale for each rating is also provided.

Site	Comments and Discussion	Rating
O1	Ownership: Privately owned; Number of potential owners and potential challenges of acquisition not known, but assumed to be small based on observed land use patterns from satellite imagery. Estimated Land Cost (2012): Roane County: $5085 per acre (O1) Size: No potential conflicts associated with ORR activities or mission, although site potentially located adjacent to Black Oak Ridge Conservation Easement which is managed by TWRA and TDEC and may pose challenges in acquisition.. Lower rating assigned based on unknowns related to ownership, willingness to sell/lease, and land costs (compared to R1)	1

Site	Comments and Discussion	Rating
O2	Ownership: Owned by the University of Tennessee for the UT Forest Resources Research and Education Center. Includes Arboretum used for education and research and part of larger Oak Ridge National Forest. Estimated Land Cost (2012): Anderson County: $5856 per acre (O2) Size: Acreage/size not defined but undeveloped area appears to be sufficient to support development of SMR. No potential conflicts associated with ORR activities or mission, but current ownership and use by University of Tennessee would appear to preclude chance to acquire and develop as SMR. Lower rating based on assumed opposition to development and willingness (unwilling to sell/lease.).	1
2	Ownership: Owned by the federal government and managed by DOE. Estimated Land Costs: Not Applicable. Assume arrangement has been established between DOE and TVA for site development and use, and that any associated costs and challenges to SMR development would be comparable across all sites, regardless of size. Size: various as follows. Extent to which pricing may be a factor in acquisition of government site is not clear; have assumed for purposes of evaluation that there would be no significant cost difference between sites based on size. Site 2 – 547 acres Because still some unknowns, given conservative rating of 3.	3

Site	Comments and Discussion	Rating
5, 8, 10	Ownership: Owned by the federal government and managed by DOE. Estimated Land Costs: Not Applicable. Assume arrangement has been established between DOE and TVA for site development and use, and that any associated costs and challenges to SMR development would be comparable across all sites, regardless of size Sites 5, 8 and 10 are currently designated in the ORR 10-Year Site Plan for future ecological research, which would pose potential conflict with and challenges for SMR development; this has been reflected in a slightly lower rating for these 3 sites. Size: various as follows. Extent to which pricing may be a factor in acquisition of government site is not clear; have assumed for purposes of evaluation that there would be no significant cost difference between sites based on size. Site 5 – 255 acres Site 8 – 424 acres Site 10 – 214 acres	2
3	Ownership: Owned by federal government and managed by TVA; Estimated Land Costs: None. TVA management of site is assumed to provide a significant advantage in terms of overall land acquisition and development. Size: 935 acres	5
4	Ownership: Owned by federal government and managed by DOE Estimated Land Costs: Not Applicable. Assume arrangement has been established between DOE and TVA for site development and use, and that any associated costs and challenges to SMR development would be comparable across all sites, regardless of size Size: 226 acres Other: Perceived land use conflict as site is within a surface danger zone associated with the ORR Central Training Facility.	1

Site	Comments and Discussion	Rating
12, 14, 15, 16, 17	Ownership: Federally owned by U.S. Army/DOD but serves as base of operation for multiple US Army/DOD Divisions as well as NASA's Marshall Space Flight Center. Estimated Land Cost: Not Applicable. Presumably A has Redstone permission [letter from Redstone Arsenal] that mission would be modified to meet land use requirements; assume this would apply to all sites located within Redstone Arsenal boundary. Therefore, assume any associated [leasing?] costs and challenges to SMR development would be comparable across all sites Size: All sites between 122 and 130 acres; according to initial TVA Siting Study, 13 adjacent land is not sufficient to support site development (e.g., staging and laydown); this is reflected in a lower rating for 13 Because still potential concerns with conflicting uses, sites given conservative rating of 3 (slightly lower than Site 2 because potential conflicts and potential challenges with site development at Redstone Arsenal considered to be greater given the overall mission and type of activities performed there.	3
13	The evaluation of sites 12, 14, 15, 16, and 17 applies here. However, site 13 is rated even lower because of concerns associated with proximity to Arsenal population located immediately north of the site.	2
R1	Ownership: Privately owned; number of potential owners not known, but assumed to be small based on observed land use patterns from satellite imagery Estimated Land Cost: $3715 (2012 data Madison County) Acreage/size not defined but undeveloped area appears to be sufficient to support development of SMR. No potential conflicts associated with Redstone Arsenal activities or mission. Lower rating assigned based on unknowns related to ownership and land costs (compared to R1)	1

References

https://quickstats.nass.usda.gov/

Appendix D Federal Direct-Served Customer Area Descriptions

D.1 Oak Ridge Reservation, Tennessee

The approximately 34,000 ac Oak Ridge Reservation (ORR) is located in eastern Tennessee, south of the City of Oak Ridge and north of Interstate 40. The ORR is located in the Tennessee Ridge and Valley geographic province and consists of generally hilly terrain. The majority of the site consists of forested and other undeveloped areas. Based on remote-sensing analysis, in 1994 about 70 percent of the ORR was forested and about 20 percent was undeveloped areas such as agricultural fields, old fields, cutover forest, roadsides, and utility corridors (Parr and Hughes 2006). The Clinch River, including the Melton Hill Dam, Melton Hill Reservoir, and the upper end of the Watts Bar Reservoir, borders the southern and eastern boundaries of the reservation.

The ORR includes three DOE campuses with distinct missions: the Oak Ridge National Laboratory (ORNL), the Y-12 National Security Complex (Y-12 Complex), and the East Tennessee Technology Park (ETTP). The ORNL is the DOE's largest multi-purpose laboratory conducting research in advanced materials exploration, alternative fuels, climate change, and supercomputing. Two of ORNL's more significant facilities include the Spallation Neutron Source facility, the world's foremost center for neutron science research, and the High Flux Isotope Reactor, an 85-MW high flux reactor-based source of neutrons. The Y-12 Complex mission includes modernizing defense systems and reducing nuclear stockpiles worldwide. The ETTP is located on the former uranium enrichment complex, which is currently being remediated, revitalized, and transitioned into a private sector business/industrial park.

Figure D-1 provides an aerial map of the Oak Ridge Reservation.

D.2 Redstone Arsenal, Alabama

Redstone Arsenal is a 38,000 ac U.S. Army garrison located in the northern part of the State of Alabama, west of the City of Huntsville. The facility is bounded to the north by I-565 and to the south by the Wheeler Reservoir. The topography at Redstone Arsenal is flat to gently rolling terrain with the elevation ranging between 560 feet (ft) and 700 ft above mean sea level (msl); however, there are two steep hills in the northern part of the site. Less than approximately 13 percent of the installation is undeveloped land and the majority of that area is forested.

The primary mission of Redstone Arsenal is explosives training and research. The installation is a garrison for the following:

- U.S. Army Aviation and Missile Command
- U.S. Army Materiel Command
- U.S. Department of Defense (DoD) Missile Defense Agency
- U.S. Army Space and Missile Defense Command
- Aviation & Missile Research, Development and Engineering Center

Redstone Arsenal is divided into four major zones: Residential Zone, City Center, Professional Zone, and Industrial Zone. The Industrial Zone comprises the majority of the garrison property, covering the lower half and northwest corner of the property. Industrial and explosives operations, test areas, warehousing, and ammunition storage, which support the primary mission, are located within the Industrial Zone. A portion of the Wheeler National Wildlife Refuge (NWR) and recreational areas associated with the Tennessee River (Wheeler Reservoir) are also located in the Industrial Zone. (U.S. Army 2013) Additionally, the National Aeronautics and Space Administration's (NASA) Marshall Space Flight Center occupies approximately 1,800 ac within the Redstone Arsenal reservation.

Figure D-2 provides an aerial map of Redstone Arsenal.

D.3 Fort Campbell, Kentucky

Fort Campbell is one of the largest installations managed by the U.S. Army. The installation occupies approximately 105,000 ac in portions of four counties: Montgomery and Stewart Counties in Tennessee and Christian and Trigg Counties in Kentucky. The site is bounded on the east by Fort Campbell Boulevard and on the south by US 79. The site is roughly bounded on the west by State Highway 139/South Road, on the northwest by State Highway 164/Roaring Springs Road, on the north-central by the City of Lafayette, and on the northeast by State Highway 117/Herndon Oak Grove Road. Hopkinsville, Kentucky to the north and Clarksville, Tennessee to the east are the closest major towns to Fort Campbell. Elevations range from approximately 400 ft to over 700 ft msl (United States Geological Survey 2014). A comparatively flat area is present along the eastern boundary and approximately 5,000 ac of steep, highly dissected, hilly land is present along the western boundary. On the 105,000 ac installation, the majority of facilities occupy 15,000 ac along the eastern boundary. The remaining 90,000 ac (approximately 86 percent of the installation) is primarily undeveloped land. The undeveloped land includes areas used as ranges, impact areas, and maneuver areas dedicated to training. (EDAW/AECOM and Monrad Engineering 2009)

Fort Campbell is home to the following:

- U.S. Army's 101st Airborne Division (Air Assault)
- Two Special Operations Command units:
  - 5th Special Forces Group (Airborne)
  - 160th Special Operations Aviation Regiment (Airborne)
- 86th Combat Support Hospital
- 716th Military Police Battalion
- Additional medical and dental activities

Additionally, Fort Campbell provides training and mobilization support for Army National Guard and Reserve units. The units based out of and supported by Fort Campbell represent the contingency forces deployed most frequently to locations around the world. Thus, Fort Campbell is a major maneuver installation for the U.S. Army and the DoD supporting the training and deployment of over 30,000 soldiers and a total of 50,000 personnel. (EDAW/AECOM and Monrad Engineering 2009)

Fort Campbell's primary mission is to "advance the combat readiness of the 101st Airborne Division (Air Assault) and the other non-divisional units posted at the installation through training, mobilization, and deployment" (EDAW/AECOM and Monrad Engineering 2009). Fort Campbell's garrison mission is to "support expeditionary forces and power projection [military force deployment] capabilities; to sustain, transform, and modernize the installation; to enhance well-being for the military community; to transform business processes to become effective, efficient, and equitable; and to develop and sustain an innovative, highly capable, mission focused workforce". (EDAW/AECOM and Monrad Engineering 2009)

Figure D-3 provides an aerial map of Fort Campbell.

D.4 Arnold Air Force Base, Tennessee

Arnold Air Force Base (AFB) is located in Coffee and Franklin Counties in central Tennessee. The installation is located east of the City of Tullahoma, southwest of I-24, and northeast of Tullahoma Highway. Arnold AFB occupies approximately 39,000 ac; 30,000 ac are designated as a Wildlife Management Area (WMA). No significant topographic features exist on Arnold AFB and elevations generally range from 1,000 ft to 1,100 ft msl. Approximately 88 percent of land on Arnold AFB is undeveloped. These unimproved grounds are comprised of wetlands, open water (Woods Reservoir), cultivated pine forests, hardwood forests, and grasslands and early-successional habitat within utility rights-of way (DoD Environment, Safety and Occupational Health Network and Information Exchange (DENIX) 2005).

Arnold AFB is the home of the Arnold Engineering Development Center (AEDC), the largest and most advanced complex of flight simulation test facilities in the world. The center operates 43 aerodynamic and propulsion wind tunnels, rocket and turbine engine test cells, space environmental chambers, arc heaters, ballistic ranges and other specialized units. The AEDC occupies 3,600 ac roughly in the center of Arnold AFB. These 43 facilities can simulate flight conditions from sea level to 300 miles (mi) elevation and from subsonic velocities to Mach 20. Of the facilities on Arnold AFB, 27 are the only test units of their kind in the United States, and 14 are the only facilities of their kind in the world. (U.S. Air Force 2012) The University of Tennessee Space Institute is adjacent to Arnold AFB.

Figure D-4 provides an aerial map of Arnold AFB.

D.5 Naval Support Activity Mid-South, Tennessee

The 1479 ac. Naval Support Activity (NSA) Mid-South is located in Millington, Tennessee approximately 20 mi north of downtown Memphis. NSA Mid-South is bordered on the south by Highway 385, and roughly on the west by railroad tracks that parallel Highway 51. The installation is relatively flat with elevations ranging from 260 to 300 ft msl. The site consists of mostly developed land such as parking lots, buildings, and landscaped open spaces. The facility is the headquarters for the following:

- Navy Human Resources Center of Excellence
- Naval Personnel Command
- Navy Recruiting Command

- Navy Manpower Analysis Center
- U.S. Army Corps of Engineers Finance Center

NSA Mid-South employs more than 7,500 military, civilian, and contract personnel. (Commander, Navy Installations Command 2013)

Figure D-5 provides an aerial map of Naval Support Activity Mid-South.

D.6 Columbus AFB, Mississippi

Columbus AFB is located in Lowndes County in northeastern Mississippi, 9 mi north of the City of Columbus. The installation is bounded on the east by Highway 45 and on the west by Barton Ferry Road. The topography is relatively flat, with an elevation of approximately 220 ft msl. The installation occupies 4,931 ac, of which 4,408 ac are federally owned. Approximately 16 percent of the site is undeveloped, including 190 ac of wetlands (Columbus Air Force Base 1993).

Columbus AFB is the home of the 14th Flying Training Wing of Air Education and Training Command, and its primary mission is to train Air Force pilots (Columbus Air Force Base 2013).

Figure D-6 provides an aerial map of Columbus Air Force Base.

Figure D-1. Oak Ridge Reservation Aerial Map

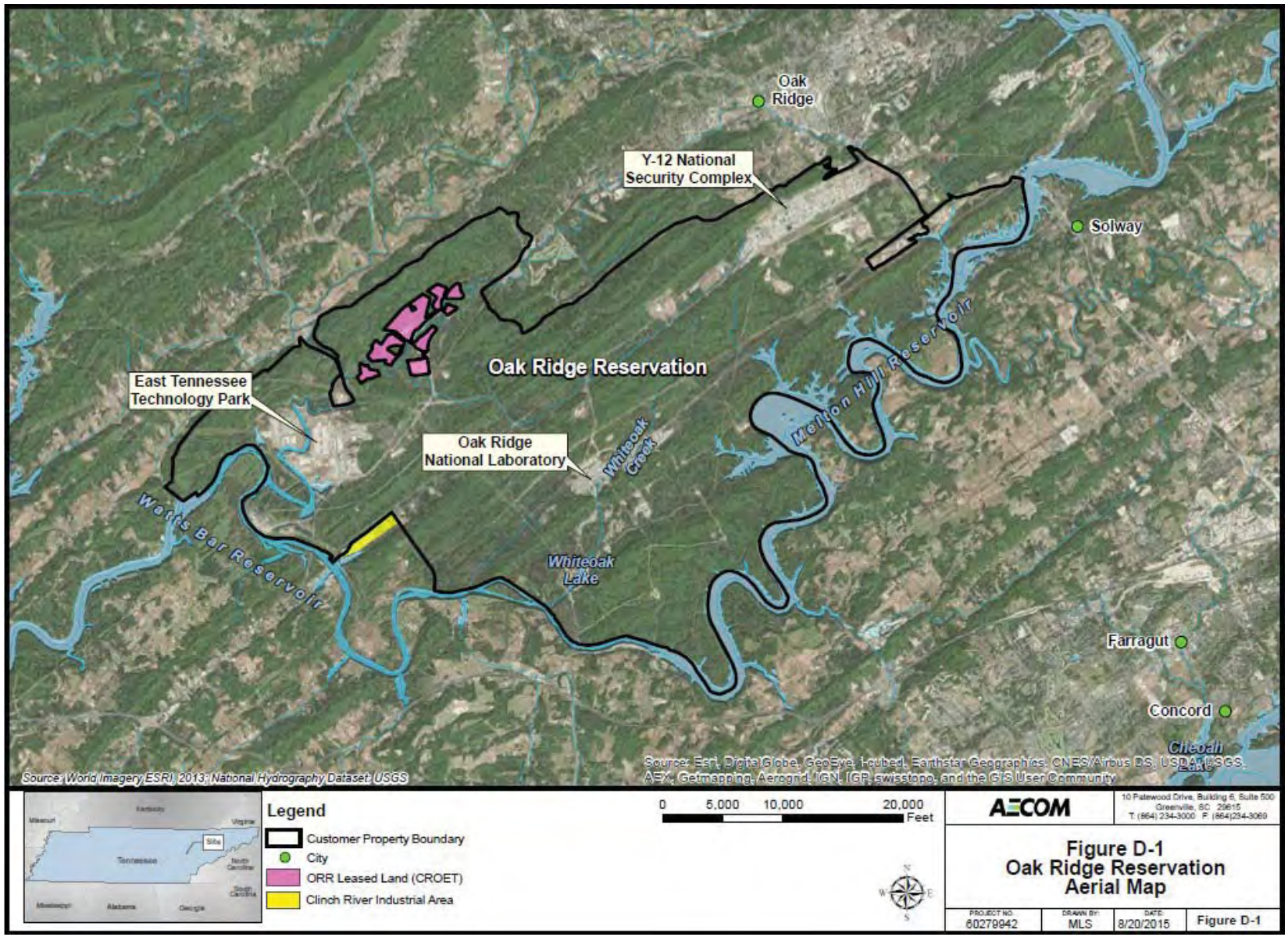


Figure D-2. Redstone Arsenal Aerial Map

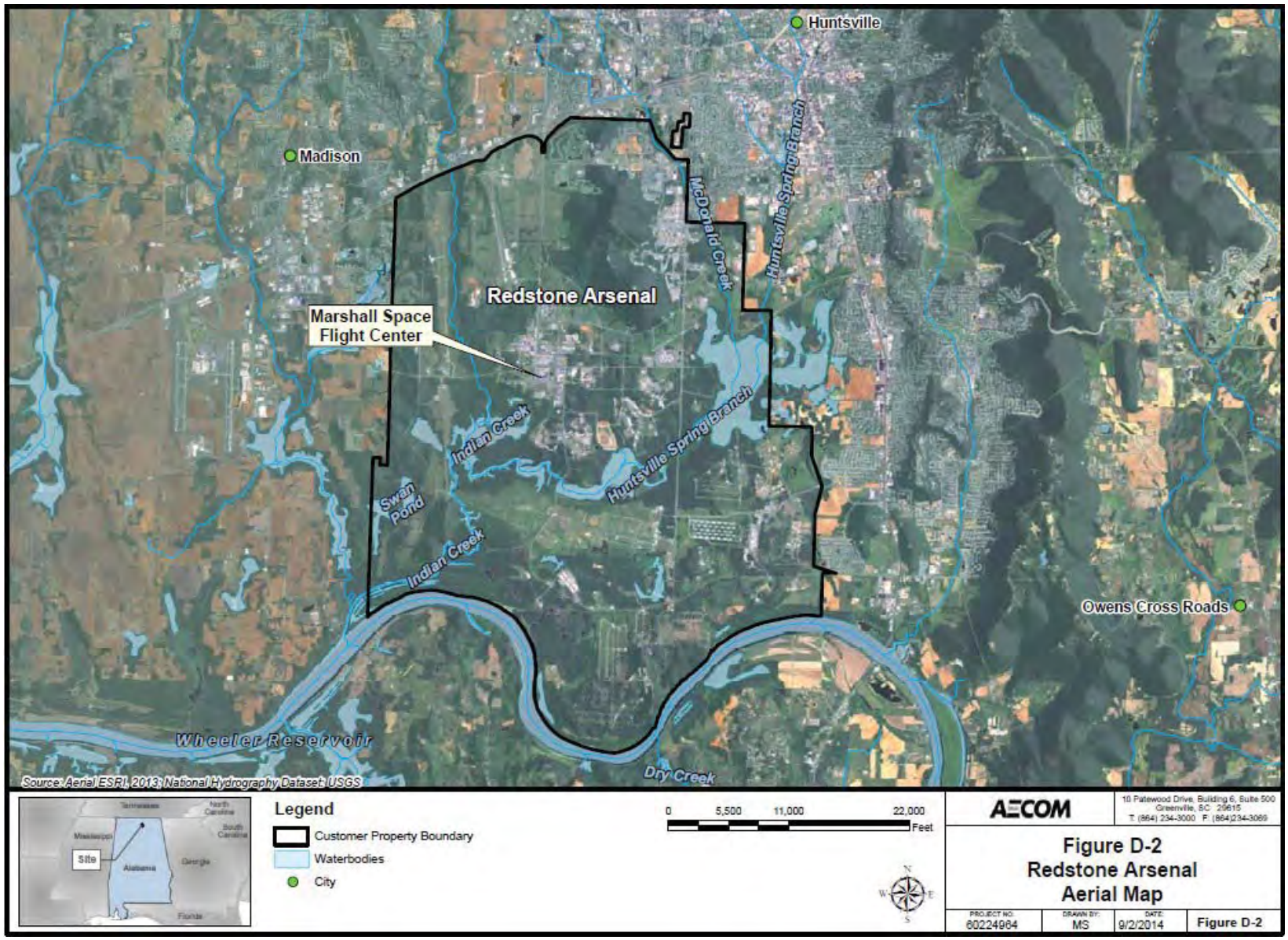


Figure D-3. Fort Campbell Aerial Map

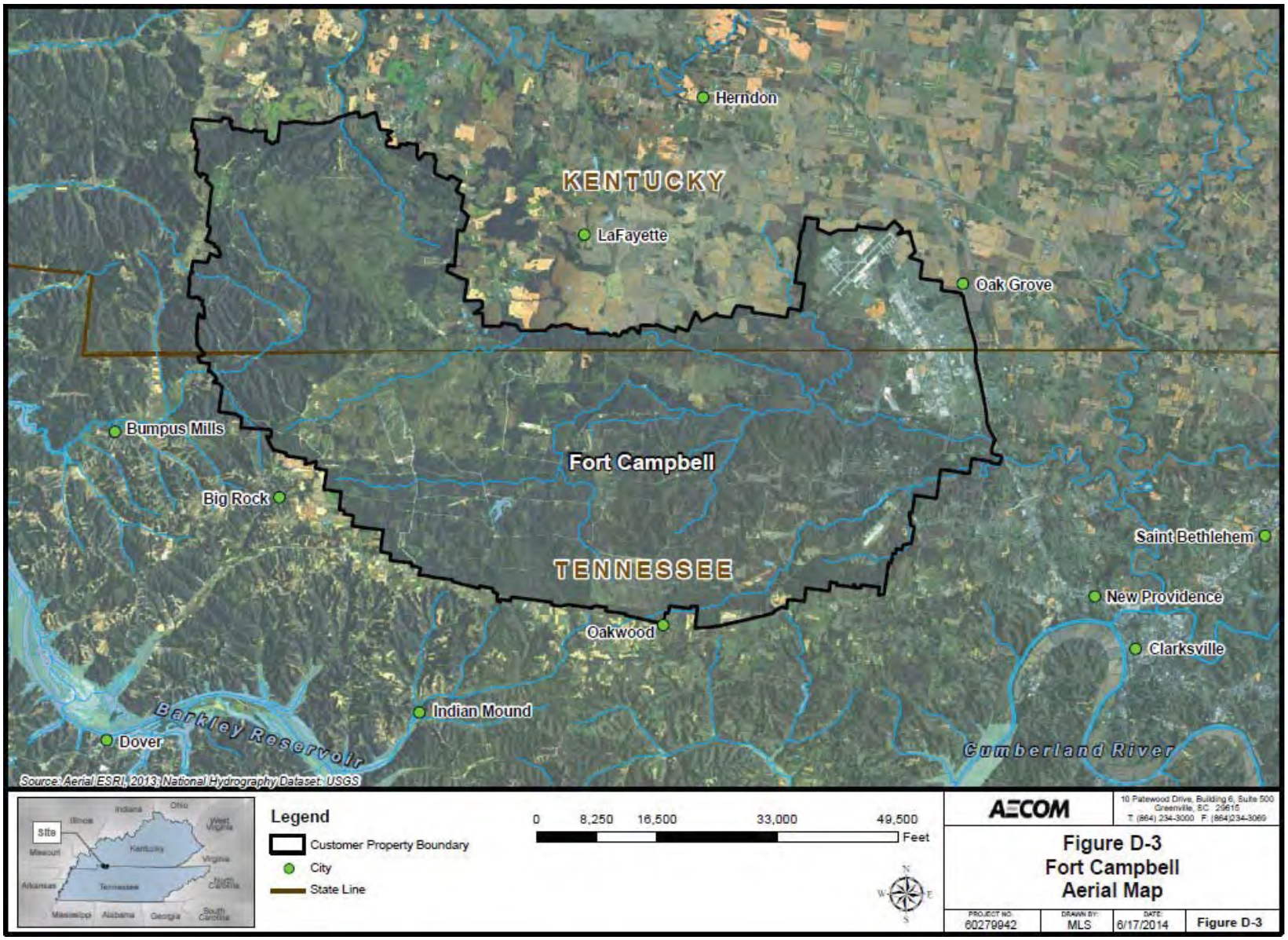


Figure D-4. Arnold Air Force Base Aerial Map

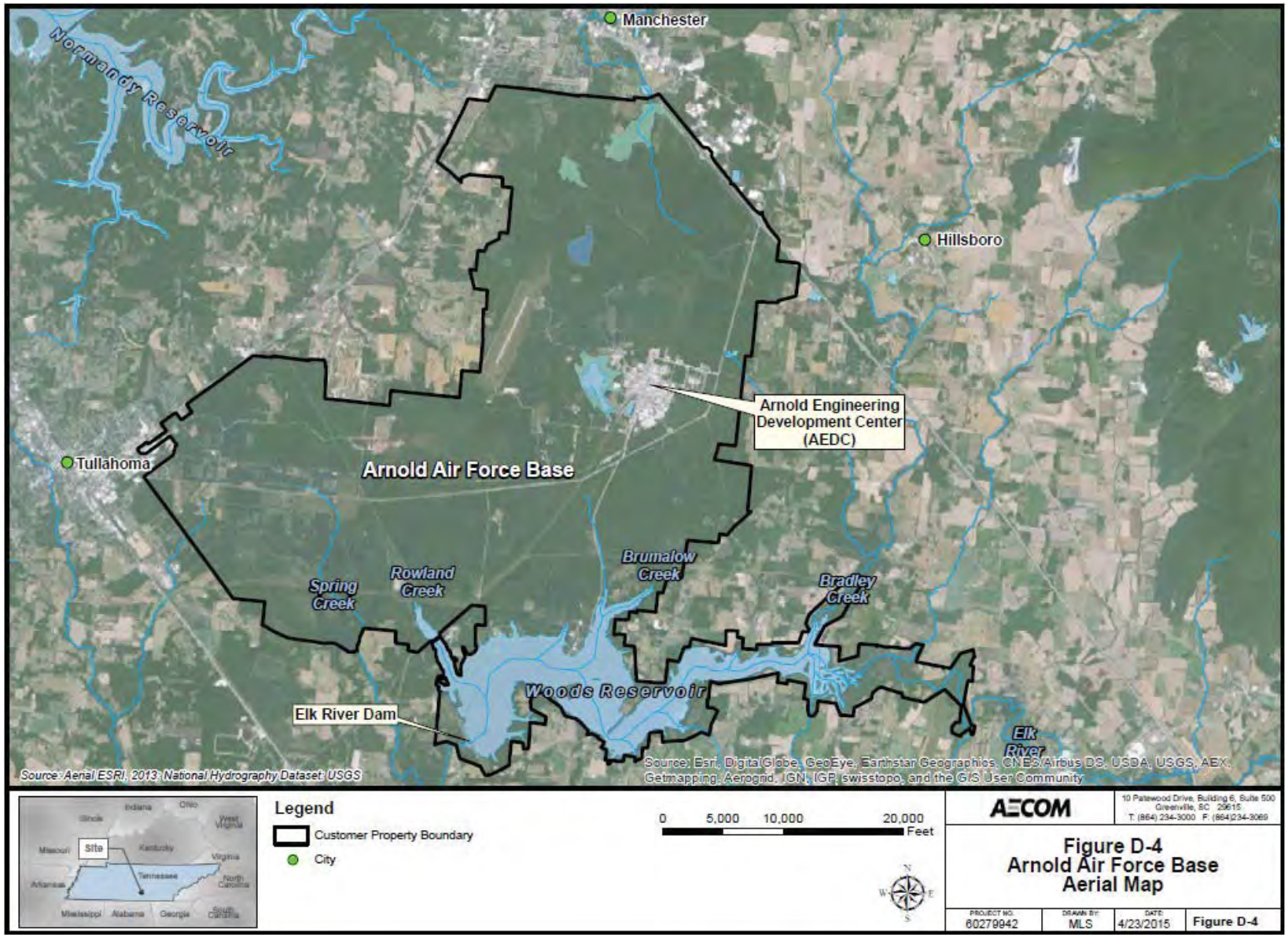


Figure D-5. Naval Support Activity Mid-South Aerial Map

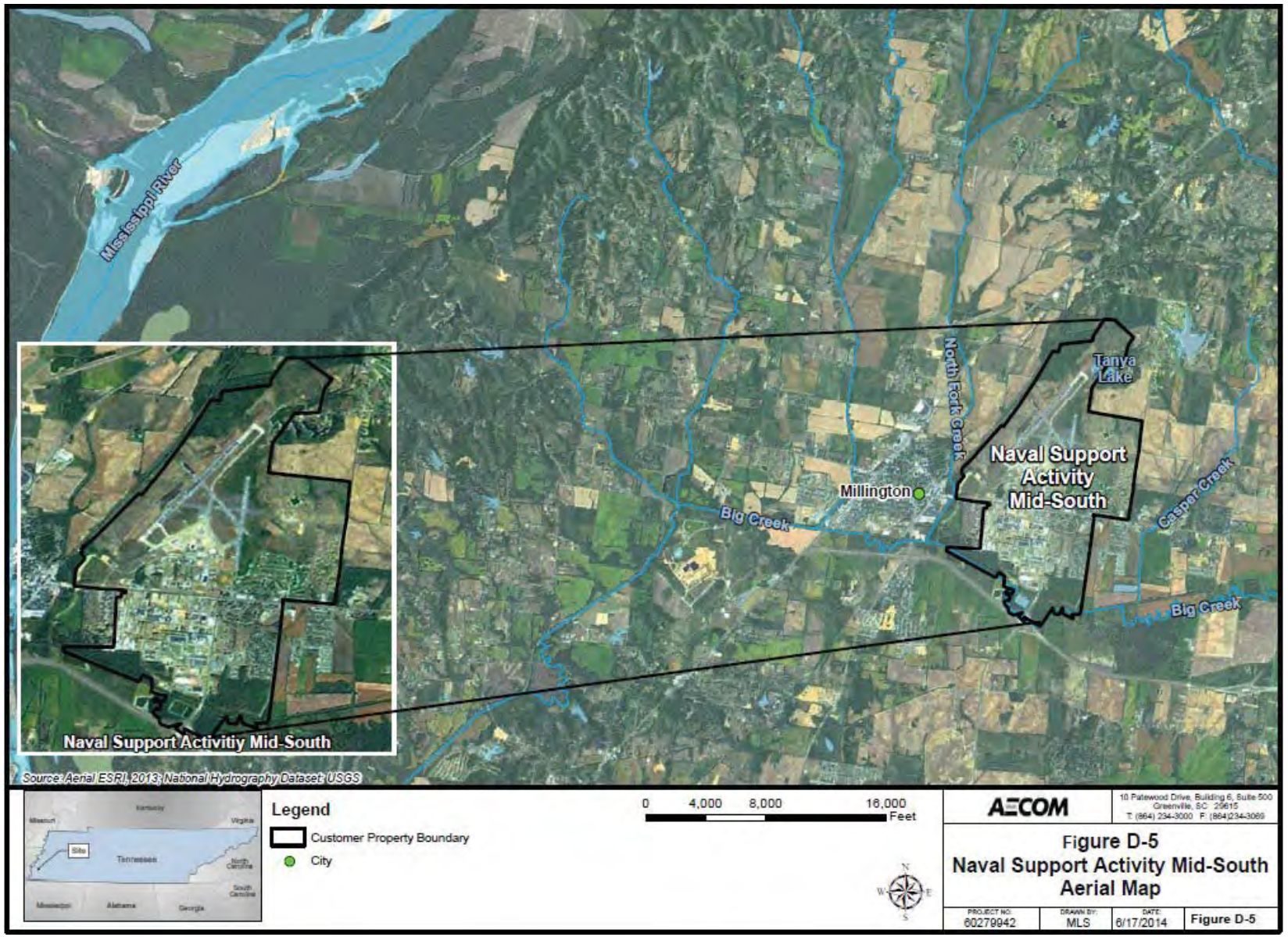
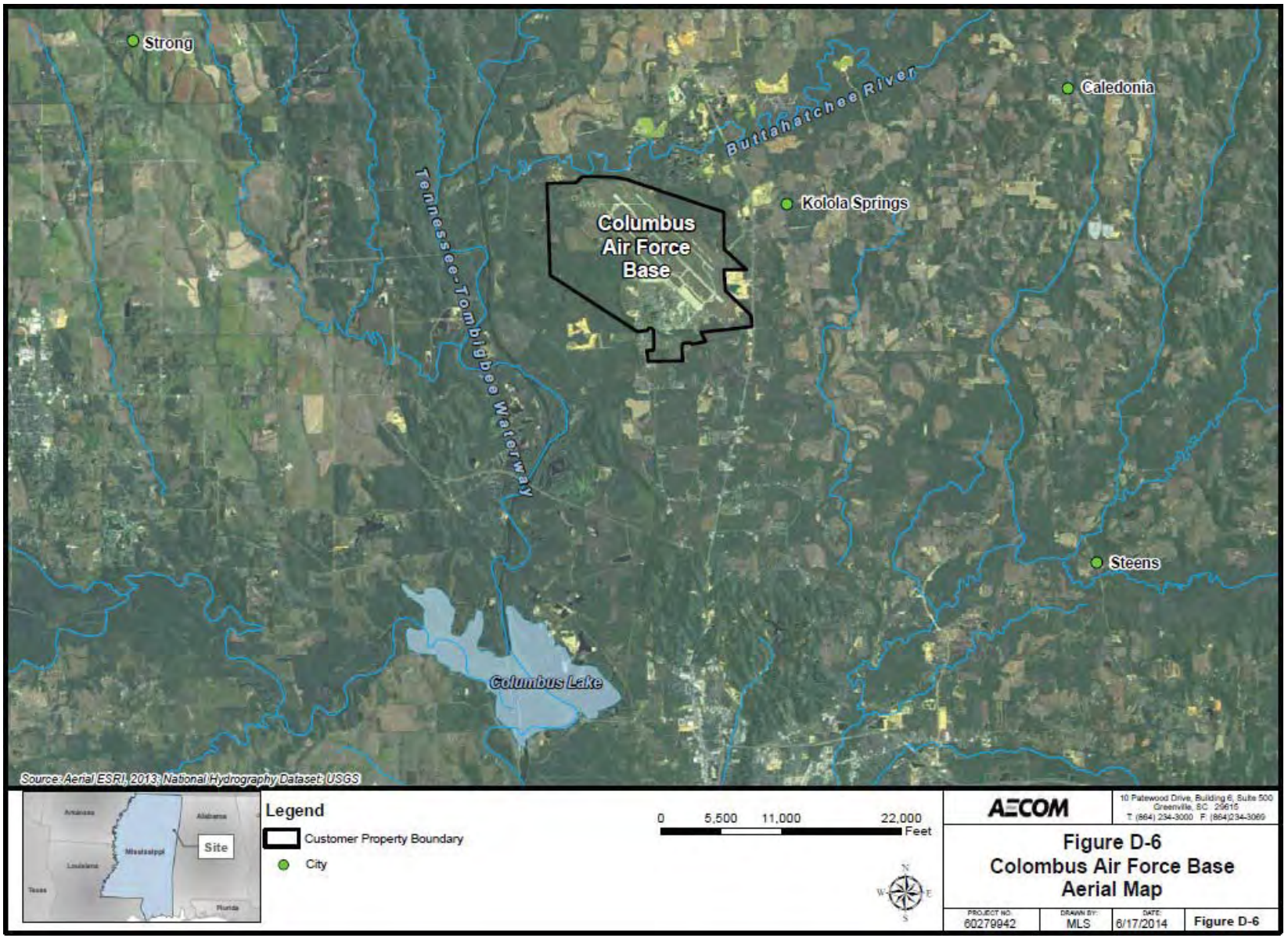


Figure D-6. Columbus Air Force Base Aerial Map



ATTACHMENT 2

Clinch River Nuclear Early Site Permit Application, Part 3,
Environmental Report Section 9.3, "Alternative Sites"

The Clinch River Nuclear (CRN) Early Site Permit Application (ESPA), Part 3 Environmental Report (ER) Section 9.3, "Alternative Sites," is replaced in its entirety with the following pages. The table provides below provides a numerical correlation of the revised subsections of the Section 9.3.

Old Subsection #	Old Title	New Subsection #	New Title
9.3.1	The Site-Comparison Process	9.3.1	Identification of Candidate Areas
9.3.2	General Description of the Preliminary Candidate Areas	9.3.2	Identification of Potential Sites
9.3.3	Candidate Area Evaluation Process	9.3.3	Evaluation of Potential Sites and Identification of Candidate Sites
9.3.3.1	Process for Identification of Potential Sites		Combined Discussion into single 9.3.3 section
9.3.3.2	Process for Evaluation of Potential Sites		
9.3.4	Generic Issues for Alternative Sites		**DELETED**
9.3.5	Alternative Site Review	9.3.4	Alternative Site Review
9.3.5.1	Safety Criteria		**DELETED**
9.3.5.2	Environmental Criteria	9.3.4.1	Environmental Criteria
9.3.5.2.1	Land Use	9.3.4.1.1	Land Use
9.3.5.2.2	Water Supply, Use, and Flood Hazard	9.3.4.1.2	Water Use and Quality
9.3.5.2.3	Terrestrial Ecology	9.3.4.1.3	Terrestrial Ecology
9.3.5.2.4	Aquatic Ecology	9.3.4.1.4	Aquatic Ecology
9.3.5.2.5	Socioeconomics	9.3.4.1.5	Socioeconomics
9.3.5.2.6	Environmental Justice	9.3.4.1.6	Environmental Justice
9.3.5.2.7	Historic and Cultural Resources	9.3.4.1.7	Historic and Cultural Resources
9.3.5.2.8	Waste Management	9.3.4.1.8	Waste Management
9.3.5.2.9	Postulated Accidents	9.3.4.1.9	Postulated Accidents
9.3.5.3	Cumulative Impacts	9.3.4.2	Cumulative Impacts
9.3.5.3.1	Cumulative Land Use Impacts	9.3.4.2.1	Cumulative Land Use Impacts
9.3.5.3.2	Cumulative Water Use Impacts	9.3.4.2.2	Cumulative Water Use Impacts
9.3.5.3.3	Cumulative Ecological Impacts	9.3.4.2.3	Cumulative Ecological Impacts
9.3.5.3.4	Cumulative Socioeconomics and Environmental Justice Impacts	9.3.4.2.4	Cumulative Socioeconomic Impacts
9.3.5.3.5	Environmental Justice Impacts	9.3.4.2.5	Environmental Justice Impacts
9.3.5.3.6	Cumulative Impacts to Historic and Cultural Resources	9.3.4.2.6	Cumulative Impacts to Historic and Cultural Resources
9.3.5.3.7	Postulated Accidents	9.3.4.2.7	Postulated Accidents
9.3.5.3.8	Fuel Cycle/Transport/Decommissioning	9.3.4.2.8	Fuel Cycle/Transport/Decommissioning
9.3.6	Conclusions	9.3.5	Conclusions
9.3.7	References	9.3.6	References

Old Table #	Old Title	New Table #	New Title
9.3-1	Sales Volumes of TVA Federal Direct-Served Customers FY2014		**DELETED**
9.3-2	Summary of Impact Evaluations for Environmental and Socioeconomic Criteria	9.3-1	Summary of Preconstruction, Construction, and Operation Impact Evaluations for Environmental and Socioeconomic Criteria
9.3-3	Land Area (Acreage) to be Affected by Development of the Candidate Sites		**DELETED**
	New Table	9.3-2	ORR Site 2 Land Use/Land Cover
	New Table	9.3-3	ORR Site 8 Land Use/Land Cover
	New Table	9.3-4	Redstone Arsenal 12 Land Use/Land Cover
9.3-4	Minority and Low-Income Populations within Redstone Arsenal Site 12 50-mi Radius	9.3-5	Minority and Low-Income Populations within Redstone Arsenal Site 12 50-mi Radius
9.3-5	Summary of Past, Present and Reasonably Foreseeable Projects Considered in the Cumulative Analysis	9.3-6	Summary of Past, Present and Reasonably Foreseeable Projects Considered in the Cumulative Analysis
9.3-6	Summary of Potential Incremental Cumulative Impacts of Construction and Operation to Environmental and Socioeconomic Criteria by Site	9.3-7	Summary of Potential Cumulative Impacts of Construction and Operation to Environmental and Socioeconomic Criteria by Site

Old Figure #	Old Title	New Figure #	New Title
9.3-1	Proposed and Alternative Candidate Site Screening Methodology	9.3-1	Proposed and Alternative Candidate Site Screening Methodology
9.3-2	SMR Preliminary Candidate Areas	9.3-2	TVA Service Area and Direct Serve Federal Customers
9.3-3	ORR Location Map		**DELETED**
	New Figure	9.3-3	General Site Criteria Evaluation Results
9.3-4	ORR Topographic Map		**DELETED**
9.3-5	ORR Aerial		**DELETED**
9.3-6	Redstone Arsenal Location Map		**DELETED**
9.3-7	Redstone Arsenal Topographic Map		**DELETED**
9.3-8	Redstone Arsenal Aerial		**DELETED**
9.3-9	Fort Campbell Location Map		**DELETED**
9.3-10	Fort Campbell Topographic Map		**DELETED**
9.3-11	Fort Campbell Aerial		**DELETED**
9.3-12	Arnold Air Force Base Location Map		**DELETED**
9.3-13	Arnold Air Force Base Topographic Map		**DELETED**
9.3-14	Arnold Air Force Base Aerial		**DELETED**
9.3-15	Naval Support Activity Mid-South Location Map		**DELETED**
9.3-16	Naval Support Activity Mid-South Topographic Map		**DELETED**

9.3-17	Naval Support Activity Mid-South Aerial		**DELETED**
9.3-18	Columbus Air Force Base Location Map		**DELETED**
9.3-19	Columbus Air Force Base Topographic Map		**DELETED**
9.3-20	Columbus Air Force Base Aerial		**DELETED**
9.3-21	ORR Candidate Sites	9.3-4	ORR Candidate Sites
9.3-22	Redstone Arsenal Candidate Sites	9.3-5	Redstone Arsenal Candidate Sites
9.3-23	ORR Proposed Site Layout Site 2	9.3-6	ORR Site 2 - Potential Layout
9.3-24	ORR Proposed Site Layout Site 8	9.3-7	ORR Site 8 - Potential Layout
9.3-25	Redstone Arsenal Proposed Site Layout Site 12	9.3-8	Redstone Arsenal Site 12 - Potential Layout
9.3-26	Peak Horizontal Acceleration with 10-Percent Probability of Exceedance in 50 Years		**DELETED**
9.3-27	ORR Site 3 (CRN Site) Flood Hazard Map	9.3-9	ORR Site 3 (CRN Site) Flood Hazard Map
9.3-28	ORR Site 2 Flood Hazard Map	9.3-10	ORR Site 2 Flood Hazard Map
9.3-29	ORR Site 8 Flood Hazard Map	9.3-11	ORR Site 8 Flood Hazard Map
9.3-30	Redstone Arsenal Site 12 Flood Hazard Map	9.3-12	Redstone Arsenal Site 12 Flood Hazard Map
9.3-31	Minority Population Block Groups within 50 Miles of the Redstone Arsenal Candidate Site	9.3-13	Minority Population Block Groups within 50 Miles of the Redstone Arsenal Candidate Site
9.3-32	Low-Income Population Block Groups within 50 Miles of the Redstone Arsenal Candidate Site	9.3-14	Low-Income Population Block Groups within 50 Miles of the Redstone Arsenal Candidate Site
	New Figure	9.3-15	Redstone Arsenal Past, Present and Reasonably Foreseeable Projects Considered in the Cumulative Analysis

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 power block, 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 power block, 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 power block 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, 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, 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, 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.

<u>CRN Site and ORR Sites 2 and 8</u>

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, at approximately 79 mgd. 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.

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). 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. 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 of approximately 3300 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.

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 SMRs 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 construction workforce (3300 workers) plus the operation workforce (conservatively assumed to be the 500 workers for full plant operation) for an estimated total onsite workforce of 3800 workers.

It is assumed that 50 percent of the 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 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 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 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 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 3800 represents 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 and 8. Preconstruction and construction traffic would typically access ORR Site 2 via Oak Ridge Turnpike (TN 58) and/or Bear Creek Road. Construction traffic would typically access ORR Site 8 from TN 95. 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 500 workers) and traffic during the overlap period between preconstruction/construction and operation (based on 3800 workers). For ORR Site 8; TN 95 would have sufficient capacity to accommodate the preconstruction, construction, and operation traffic; however it is likely that additional turn lanes, signals, or other modifications would be necessary to accommodate the traffic flow off of TN 95 into ORR Site 8. It is assumed these modifications would require similar materials and construction as those for the CRN Site and ORR Site 2.

The area surrounding the CRN Site and ORR Sites 2 and 8 appears to have suitable accessibility for road, rail, and barge traffic. However, 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 (the operation of 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 (operation of individual users is not substantially affected) for the CRN Site and ORR Site 2. For ORR Site 8, it is assumed necessary road modifications would be similar in nature to those needed for the CRN Site and ORR Site 2, and resulting impacts to traffic during preconstruction and construction 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.

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 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 at the CRN Site. This would result in a population increase of 2765 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 451 school-aged children would relocate within the geographic area of interest. This represents an increase of 0.5 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 3800 would in-migrate, the resulting population increase of 9424 (3800 workers x 2.48 persons per household = 9424 persons) would represent approximately 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 3800 represents 1.3 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 1.3 to 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. A traffic assessment study would be conducted to determine the nature of the necessary improvements which would include potential additional widening at I-565 and Rideout Road, potential changes to the highway interchanges, and/or administrative controls to limit construction vehicle access during high peak traffic hours that coincide with the base traffic and that address any site security/gate access delays and 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 500 workers) and overlap of preconstruction/construction and operation traffic (based on 3800 workers).

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 9.3-74).

As presented in Subsection 4.4.2.7, the peak onsite construction workforce of 3300 workers for the SMR Project would require 165,000 gallons per day (gpd), or 0.17 mgd, of potable water. During the period of peak construction, an estimated 1115 workers would migrate into the geographic area of interest accompanied by 1650 family members, for a population increase of 2765. This represents an increased offsite demand of approximately 0.28 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 0.17 mgd represents 0.3 percent of Huntsville Utilities excess capacity. The offsite potable water usage of 0.28 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 onsite 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 of the construction process, a maximum of 165,000 gpd of wastewater would be produced onsite based on 3300 construction workers and a wastewater production rate of 50 gpd per worker. An estimated 1115 workers would migrate into the geographic area of interest accompanied by 1650 family members, for a population increase of 2765. The 3300 construction workers represent approximately 9 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.

<u>CRN Site and ORR Sites 2 and 8</u>

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 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 for the ORR geographic area of interest and Table 9.3-6 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.

<u>CRN Site and ORR Sites 2 and 8</u>

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 3800 represents 1.2 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

[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.

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 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.

9.3.6 References

Reference 9.3-1. United States Congress, "Tennessee Valley Authority Act," 1933.

Reference 9.3-2. The White House, "Executive Order 13636 - Improving Critical Infrastructure Cybersecurity," EO 13636, February 19, 2013.

Reference 9.3-3. The White House, "Executive Order 13693 - Planning for Federal Sustainability in the Next Decade," EO 13693, March 19, 2015.

Reference 9.3-4. The White House Council on Environmental Quality, "Implementing Instructions for Executive Order 13693 Planning for Federal Sustainability in the Next Decade," June 10, 2015.

Reference 9.3-5. Tennessee Valley Authority, "Tennessee Valley Authority Site Selection Report," November, 2016.

Reference 9.3-6. Tennessee Valley Authority, "Final Environmental Impact Statement Watts Bar Reservoir Land Management Plan Loudon, Meigs, Rhea, and Roane Counties, Tennessee," February, 2009.

Reference 9.3-7. U.S. Department of Energy Oak Ridge Office, "Oak Ridge Reservation 10-Year Site Plan - Integrating Multiple Land Use Needs," DOE/ORO-TYSP2007, 2007.

Reference 9.3-8. Tennessee Valley Authority, "Summary of Information for the Clinch River Breeder Reactor Site," June, 2008.

Reference 9.3-9. Tennessee Valley Authority, Melton Hill Reservoir, Website: http://www.tva.gov/sites/meltonhill.htm, 2013.

Reference 9.3-10. Tennessee Valley Authority, "Clinch River Small Modular Reactor Site Regional Surface Water Use Study - Revision 2," April 24, 2015.

Reference 9.3-11. Tennessee Valley Authority, Managing River System Flows, Website: http://www.tva.com/river/lakeinfo/systemwide.htm, 2013.

Reference 9.3-12. Tennessee Valley Authority, Watts Bar Reservoir Ecological health rating, Website: http://www.tva.gov/environment/ecohealth/wattsbar.htm, 2010.

Reference 9.3-13. Tennessee Valley Authority, Melton Hill Reservoir Ecological health rating, Website: http://www.tva.gov/environment/ecohealth/meltonhill.htm, 2010.

Reference 9.3-14. U.S. Department of Energy, Oak Ridge Reservation Water Resources Restoration Program and Water Quality Program, Website: http://www.oakridge.doe.gov/External/LinkClick.aspx?fileticket=Fs_fcEwqWpQ%3D&tabid=658&mid=1846, March 24, 2010.

Reference 9.3-15. Oak Ridge National Laboratory, Y-12 National Security Complex, and URS/CH2M Oak Ridge LLC, "Oak Ridge Reservation Annual Site Environmental Report for 2011," DOE/ORO/2418, U.S. Department of Energy, U.S. Department of Energy, September, 2012.

Reference 9.3-16. Harper, Michael J. and Turner, Billy G., Estimated Use of Water in Alabama in 2010, Website: http://adeca.alabama.gov/Divisions/owr/Documents/AL2010Report.pdf, 2010.

Reference 9.3-17. Tennessee Valley Authority, Wheeler Reservoir Ecological Health Rating, Website: http://www.tva.com/environment/ecohealth/wheeler.htm, 2013.

Reference 9.3-18. U.S. Environmental Protection Agency, NEPAssist, Redstone Arsenal NEPAssist Report, National Report, Water Quality, Website: http://nepassisttool.epa.gov/NEPAssist/nepamap.aspx?action=searchloc&wherestr=redstone%20arsenal, 2013.

Reference 9.3-19. Cook, Marlon R., Jennings, Stephen P., Smith, K. M., Moss, Neil E., Rogers, Alana, and Norman, Ralph, Geological Survey of Alabama - Characterization of Hydrogeology and Regional Groundwater Movement in Madison County and Redstone Arsenal, Alabama, Website: http://www.gsa.state.al.us/downloads/SGAP/Redstone/Redstone%20GSA%20Hydrogeologic%20Assessment%202015.pdf, 2015.

Reference 9.3-20. Shaw Environmental, Inc., "Final Interim Record of Decision, Interim Remedial Action for Installation-Wide Groundwater, Redstone Arsenal, Madison County, Alabama," U.S. Army Corps of Engineers, Savannah District, September, 2007.

Reference 9.3-21. U.S. Environmental Protection Agency, Ecoregions of Tennessee, Website: http://www.epa.gov/wed/pages/ecoregions/tn_eco.htm, May 24, 2012.

Reference 9.3-22. Griffen, Neil R., Evans, James W., and Parr, Patricia D., "Wildlife Management Plan for the Oak Ridge Reservation," ORNL/TM-2012/387, Oak Ridge National Laboratory, Department of Energy, September, 2012.

Reference 9.3-23. Baranski, Michael J., "Natural Areas Analysis and Evaluation, Oak Ridge Reservation," ORNL/TM-2009/201, Oak Ridge National Laboratory, U.S. Department of Energy, November, 2009.

Reference 9.3-24. Griffith, Glenn E., Omernik, James M., Cornstock, Jeffrey A., Lawrence, Steve, Martin, George, Goddard, Art, Hulcher, Vickie J., and Foster, Trish, U.S. EPA Western Ecology Division, Ecoregions of Alabama and Georgia, Website: http://www.epa.gov/wed/pages/ecoregions/alga_eco.htm, 2001.

Reference 9.3-25. Bryant, William S., McComb, William C., and Fralish, James S., "Oak-Hickory Forests (Western Mesophytic/Oak-Hickory Forests)," In Biodiversity of the Southeastern United States, Upland Terrestrial Communities, Martin WH, Boyce SG, and Echternacht AC eds, John Wiley & Sons, Inc., New York, p. 143-202, 1993.

Reference 9.3-26. U.S. Army, "Natural Resources Management Plan for Redstone Arsenal, Part III - Forest Management," April, 2002.

Reference 9.3-27. U.S. Army, "Environmental Assessment for Integration, Assembly, Test, and Checkout of National Missile Defense Components at Redstone Arsenal, Alabama," National Missile Defense Joint Program Office, February 22, 1999.

Reference 9.3-28. U.S. Fish and Wildlife Service, "Wheeler National Wildlife Refuge Complex: Comprehensive Conservation Plan and Environmental Assessment," August, 2007.

Reference 9.3-29. U.S. Fish and Wildlife Service, Wheeler National Wildlife Refuge, Website: http://www.fws.gov/wheeler/info/history.html, June 9, 2009.

Reference 9.3-30. Alabama Natural Heritage Program, Auburn University, Rare, Threatened, & Endangered Species & Natural Communities Documented in Madison County, Alabama, Website: http://www.alnhp.org/query_results.php, September 18, 2012.

Reference 9.3-31. Tennessee Valley Authority, River System Information, Website: http://www.tva.gov/lakes/streams.htm, May 22, 2013.

Reference 9.3-32. Baranski, Michael J., "Aquatic Natural Areas Analysis and Evaluation, Oak Ridge Reservation," ORNL/TM-2011/13, Oak Ridge National Laboratory, April, 2011.

Reference 9.3-33. U.S. Army, "Natural Resources Management Plan for Redstone Arsenal, Part IV - Fish and Wildlife Management," April, 2002.

Reference 9.3-34. U.S. Department of the Interior, "Compilation of Records of Surface Waters of the United States, October 1950 to September 1960," Geological Survey Water-Supply Paper 1726, United States Government Printing Office, Washington, D.C., 1964.

Reference 9.3-35. Agency for Toxic Substances & Disease Registry, "Public Health Assessment for Redstone Army Garrison/Marshall Space Flight Center, Huntsville, Alabama, EPA Facility ID: AL7210020742," July 12, 2005.

Reference 9.3-36. U.S. Fish and Wildlife Service, "Snail Darter (*Percina tanasi*) Five-Year Review: Summary and Evaluation," March, 2013.

Reference 9.3-37. U.S. Census Bureau, State & County QuickFacts, Oak Ridge, TN, Website: http://quickfacts.census.gov/qfd/states/47/4755120.html, 2013.

Reference 9.3-38. U.S. Census Bureau, State & County QuickFacts, Knoxville, TN, Website: http://quickfacts.census.gov/qfd/states/47/4740000.html, 2013.

Reference 9.3-39. U.S. Census Bureau, Census of Population and Housing 2010. Table P1. Total Population, Census Summary File 1, Website: http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t, 2010.

Reference 9.3-40. Tennessee Advisory Commission on Intergovernmental Relations, Population Projections for the State of Tennessee, Website: http://www.state.tn.us/tacir/population.html, 2014.

Reference 9.3-41. U.S. Bureau of Economic Analysis, CA25N. Total full-time and part-time employment by NAICS industry. Anderson County, Tennessee, Website: http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=5#reqid=70&step=1&isuri=1, November 26, 2012.

Reference 9.3-42. U.S. Bureau of Economic Analysis, CA25N. Total full-time and part-time employment by NAICS industry. Roane County, Tennessee, Website: http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=5#reqid=70&step=1&isuri=1, November 26, 2012.

Reference 9.3-43. U.S. Bureau of Economic Analysis, CA25N. Total full-time and part-time employment by NAICS industry. Knox County, Tennessee, Website: http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=5#reqid=70&step=1&isuri=1, November 26, 2012.

Reference 9.3-44. U.S. Bureau of Economic Analysis, CA25N, Total full-time and part-time employment by NAICS industry. Loudon County, Tennessee, Website: http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=5#reqid=70&step=1&isuri=1, November 26, 2012.

Reference 9.3-45. U.S. Bureau of Labor Statistics, Labor Force Data by County, 2011 Annual Averages, Website: http://www.bls.gov/lau/laucnty11.txt; April 19, 2013.

Reference 9.3-46. Tennessee Comptroller of the Treasury, County Revenues, Transparency and Accountability for Governments in Tennessee (TAG), FY 2010 through FY 2014, Website: http://www.comptroller.tn.gov/TAG/CountyMatrix.aspx?RevExp=R, 2015.

Reference 9.3-47. City of Oak Ridge, Tennessee, 2013 State and Federal Legislative Agenda, Website: http://www.oakridgetn.gov/images/uploads/Documents/Featured%20Projects/2013%20State%20%20Federal%20Agenda%20final.pdf, January 14, 2013.

Reference 9.3-48. Minton, Larry and Shearin, Mark, Southern Freight Logistics, LLC, Southern Freight Logistics Fact Sheet, Website: http://www.ettpreuse.com/sfl.html, 2013.

Reference 9.3-49. Tennessee Valley Authority, Tennessee and Cumberland River Terminal Directory, Website: http://www.tva.com/river/navigation/pdf/terminal_list.pdf, 2013.

Reference 9.3-50. Tennessee Valley Authority, Reservoir Operations Study, Website: http://www.tva.gov/environment/reports/ros_eis/, 2013.

Reference 9.3-51. Tennessee Valley Authority, Navigation on the Tennessee River, Website: http://www.tva.gov/river/navigation/index.htm, 2013.

Reference 9.3-52. Heritage Center, Heritage Center - Access to the Nation's Rail System, Website: http://www.heritagectr.com/heritage-railroad; 2013.

Reference 9.3-53. Tennessee Department of Transportation, Office of Rail and Water, Shortlines Across Tennessee - Shortline Railroad Directory, Website: http://www.tdot.state.tn.us/publictrans/docs/shortline_railroad.pdf; November, 2005.

Reference 9.3-54. Norfolk Southern Railway Company, System Map, Website: http://www.nscorp.com/nscorphtml/pdf/system-map.pdf; January, 2011.

Reference 9.3-55. U.S. Environmental Protection Agency, "Clinch River NEPAssist, Railroads Map," 2013.

Reference 9.3-56. URS Corporation and LW Redstone Company LLC, "Final Environmental Assessment For the North Rideout Road Enhanced Use Lease Site Development at Redstone Arsenal, Alabama," Department of the Army, December, 2008.

Reference 9.3-57. U.S. Environmental Protection Agency, Green Book: Areas With the 1-hour Standard Revoked April 15, 2009 or November 20, 2008, Website: http://www.epa.gov/air/oaqps/greenbk/, June 15, 2013.

Reference 9.3-58. U.S. Environmental Protection Agency, EPA's Regional Haze Program, Visibility, Website: http://www.epa.gov/airquality/visibility/program.html, May 31, 2012.

Reference 9.3-59. U.S. Census Bureau, State & County QuickFacts, Huntsville, AL, Website: http://quickfacts.census.gov/qfd/states/01/0137000.html, 2013.

Reference 9.3-60. U.S. Census Bureau, State & County QuickFacts, Madison (city), Alabama, Website: http://quickfacts.census.gov/qfd/states/01/0145784.html, 2013.

Reference 9.3-61. U.S. Army, Redstone Arsenal, Alabama, Website: http://www.garrison.redstone.army.mil/#, 2013.

Reference 9.3-62. University of Alabama and Center for Business and Economic Research, Alabama County Population 2000-2010 and Projections 2015-2040, Website: http://cber.cba.ua.edu/edata/est_prj.html, 2012.

Reference 9.3-63. U.S. Census Bureau, DP-1 Profile of General Population and Housing Characteristics: 2010 Demographic Profile Data - Alabama, Website: http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_SF1_SF1DP1&prodType=table, 2010.

Reference 9.3-64. U.S. Census Bureau, QT-H1 - General Housing Characteristics: 2010, 2010 Census Summary File 1, Madison County, Tennessee, Website: http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_SF1_QTH1&prodType=table, 2010.

Reference 9.3-65. U.S. Census Bureau, QT-H1 - General Housing Characteristics: 2010, 2010 Census Summary File 1, Morgan County, Tennessee, Website: http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_SF1_QTH1&prodType=table, 2010.

Reference 9.3-66. U.S. Bureau of Economic Analysis, CA25N. Total full-time and part-time employment by NAICS industry. Madison County, Alabama., Website: http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=5#reqid=70&step=1&isuri=1, November 26, 2012.

Reference 9.3-67. U.S. Bureau of Economic Analysis, CA25N. Total full-time and part-time employment by NAICS industry. Morgan County, Alabama., Website: http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=5#reqid=70&step=1&isuri=1, November 26, 2012.

Reference 9.3-68. Alabama Department of Revenue, "State of Alabama Department of Revenue 2014 Annual Report," Montgomery, AL, 2014.

Reference 9.3-69. City of Huntsville Planning Division, "Final Year 2035 Transportation Plan, Huntsville Area Transportation Study," February, 2013.

Reference 9.3-70. Alabama Department of Transportation, Alabama Traffic Data, Website: http://algis.dot.state.al.us/atd/, 2014.

Reference 9.3-71. Florida Department of Transportation, 2012 Generalized Service Volume Tables, Website: http://www.dot.state.fl.us/planning/systems/programs/sm/los/pdfs/fdot%202012%20generalized%20service%20volume%20tables.pdf, December 18, 2012.

Reference 9.3-72. U.S. Army Garrison - Redstone Arsenal, Redstone Arsenal Public Water System Materials Evaluation, Website: http://www.garrison.redstone.army.mil/uploads/LeadAndCopperMaterialsEvaluation.pdf, April, 2016.

Reference 9.3-73. U.S. Army Garrison - Redstone Arsenal, Final Environmental Assessment for Implementation of the Integrated Natural Resources Management Plan at Redstone Arsenal, Alabama, Website: http://www.garrison.redstone.army.mil/uploads/INRMP_EA_FINAL_2013.pdf, January, 2013.

Reference 9.3-74. U.S. Census Bureau, State & County QuickFacts, Huntsville, AL, Website: http://www.census.gov/quickfacts/table/PST045215/0137000,00, 2015.

Reference 9.3-75. Executive Order 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, February 11, 1994).

Reference 9.3-76. AECOM, "Final Clinch River Site Land Use and Recreation Technical Report - Revision 2," Greenville, SC, Tennessee Valley Authority, October, 2014.

Reference 9.3-77. Agency for Toxic Substances and Disease Registry, "Public Health Assessment Y-12 Uranium Releases, Oak Ridge Reservation (USDOE), Oak Ridge, Anderson County, Tennessee, EPA Facility ID: TN1890090003," January 30, 2004.

Reference 9.3-78. Rebitzke, Jeffrey, "Environmental Justice Case Study: DDT Contamination," University of Michigan Environmental Justice Group, 2015.

Reference 9.3-79. Johnson, Hunter, "Cultural Resources Information, Small Modular Reactor (SMR) Alternative Sites Project Covering the Tennessee Valley Authority (TVA) Oak Ridge Reservation (ORR) Sites 2, 5, and 8 in Roane County, Tennessee and Redstone Site 12 in Madison County, Alabama," Tennessee Valley Archaeological Research, Tennessee Valley Authority, June 15, 2016.

Reference 9.3-80. U.S. Army Environmental Command, Redstone Preserves Local History, Website: http://aec.army.mil/usaec/newsroom/news/news42.pdf, February 15, 2008.

Reference 9.3-81. National Oceanic and Atmospheric Administration, 2013 Local Climatological Data Annual Summary with Comparative Data - Oak Ridge, Tennessee, Website: http://www.ncdc.noaa.gov/IPS/lcd/lcd.html, 2015.

Reference 9.3-82. National Oceanic and Atmospheric Administration, 2014 Local Climatological Data Annual Summary with Comparative Data - Huntsville, AL, Website: http://www.ncdc.noaa.gov/IPS/lcd/lcd.html, 2015.

Reference 9.3-83. U.S. Environmental Protection Agency, 30-mile radius around Redstone Arsenal Site 12 (NEPAssist), Website: http://nepassisttool.epa.gov/nepassist/nepamap.aspx?action=searchloc&wherestr=redstone%20arsenal%2C%20alabama, 2016.

Reference 9.3-84. Redstone Arsenal, Redstone Arsenal Archaeological Program, Website: http://www.garrison.redstone.army.mil/uploads/ARCHAEOLOGICAL%20PROGRAM.pdf, 2015.

Reference 9.3-85. U.S. Army, Installation History - 1941, Website: http://history.redstone.army.mil/ihist-1941.html, 2015.

Reference 9.3-86. U.S. Army, Installation History - 1942, Website: https://history.redstone.army.mil/ihist-1942.html, 2015.

Reference 9.3-87. U.S. Army, Installation History - 1945, Website: https://history.redstone.army.mil/ihist-1945.html, 2015.

Reference 9.3-88. U.S. Army, Installation History - 1950-1952, Website: https://history.redstone.army.mil/ihist-1950.html, 2015.

Reference 9.3-89. Redstone Arsenal, History of Redstone, Website: http://www.garrison.redstone.army.mil/#, 2015.

Reference 9.3-90. Redstone Arsenal, Redstone Arsenal Basic Facts, Website: http://www.garrison.redstone.army.mil/#, 2015.

Reference 9.3-91. Redstone Gateway, Welcome to Redstone Gateway, Website: http://redstonegateway.us/, 2015.

Reference 9.3-92. Redstone Gateway, Redstone Gateway Location, Website: http://redstonegateway.us/location/overview-map/, 2015.

Reference 9.3-93. AL.com, Redstone Arsenal to be home to the largest solar power array in Alabama, Website: http://www.al.com/business/index.ssf/2014/09/contracts_due_sept_30_on_large.html, September 30, 2014.

Reference 9.3-94. U.S. Army, Garrison Meets Mission in Era of Constrained Resources, Website: http://www.army.mil/article/140674/Garrison_Meets_Mission_In_Era_Of_Constrained_Resources_/?from=RSS, 2015.

Reference 9.3-95. Huntsville Area Metropolitan Planning Organization, "FINAL Year 2040 Transportation Plan," 2015.

Reference 9.3-96. City of Huntsville, "Huntsville Development Review 2014," 2014.

Reference 9.3-97. City of Madison, Alabama, "Madison Growth Plan," 2011.

Reference 9.3-98. Town of Triana, Future, Website: http://66.208.176.181/about-triana/future/, 2015.

Reference 9.3-99. Town of Triana, The Town of Triana Applies for grant to do a Community Comprehensive Plan, Website: http://66.208.176.181/2015/05/27/the-town-of-triana-applies-for-grant-to-do-a-community-comprehensive-plan/, 2015.

Reference 9.3-100. City of Arab, City of Arab, AL Zoning Map, Website: http://www.arabcity.org/assets/public/pdf/Arab_Zoning.pdf, July 23, 2013.

Reference 9.3-101. City of Arab, Alabama, Arab Strategic Plan 2012, Website: http://www.arabcity.org/assets/public/pdf/Strategic%20Plan.pdf, April 16, 2012.

Reference 9.3-102. City of Decatur Planning Commission, Decatur 2010 Comprehensive Master Plan, Website: http://www.decaturalabamausa.com/departments/planningdept/2010plan.html, April 27, 1999.

Reference 9.3-103. Decatur Downtown Redevelopment Authority, Forward Decatur Strategic Plan, Website: http://decaturdowntown.org/strategic-plan, 2015.

Reference 9.3-104. City of Decatur, Alabama, State of the City, Website: http://www.decaturalabamausa.com/pdf/2015_StateOfTheCity_TableCard.pdf2015.

Reference 9.3-105. Martin, Mac, A Vision of Athens: A Future Land Use and Development Plan, Website: http://www.athensalabama.us/images/Public_Works/flup/Athens_Future_Land_Use_Development_Plan_Adopted.pdf, December 17, 2013.

Reference 9.3-106. Huntsville Utilities, Huntsville Utilities - Water, Website: https://www.hsvutil.org/learning-center/212-2/, 2015.

Reference 9.3-107. Limestone County Water and Sewer Authority, 2014 Consumer Confidence Report, Website: http://www.limestonecountywater.com/2014%20Consumer%20Confidence%20Report.pdf, 2014.

Reference 9.3-108. Decatur Utilities, 2015 Annual Water Quality Report, Website: http://www.decaturutilities.com/images/UPDATED%202015%20CCR%20Document%20Final2.pdf, February, 2015.

Reference 9.3-109. U.S. Global Change Research Program, "Climate Change Impacts in the United States," October, 2014.

Reference 9.3-110. U.S. Environmental Protection Agency, Waterbody Quality Assessment Report, Website: http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=AL06030002-0, December 28, 2015.

Reference 9.3-111. U.S. Geological Survey, "Water Quality in the Lower Tennessee River Basin, 1999-2001," Circular 1233, 2004.

Reference 9.3-112. Madison Utilities, 2013 Annual Drinking Water Quality Report, Website: http://madisonutilities.org/images/PDFs/WQR2013.pdf, 2013.

Reference 9.3-113. U.S. Environmental Protection Agency, U.S. Army Redstone Arsenal NPL Site Summary, Website: http://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0405545, July 11, 2014.

Reference 9.3-114. U.S. Environmental Protection Agency, Contaminants of Concern at U.S. Army/NASA Redstone Arsenal, Website: http://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.contams&id=0405545, December 15, 2015.

Reference 9.3-115. Tennessee Valley Authority, Finding of No Significant Impact - Limestone County Water and Sewer Authority Easement, Website: https://www.tva.com/file_source/TVA/Site%20Content/Environment/Environmental%20Stewardship/Environmental%20Reviews/Limestone%20County%20Water%20and%20Sewer%20Authority%20Easement/lcwsa_fonsi.pdf, April 22, 2013.

Reference 9.3-116. U.S. Environmental Protection Agency, Current Nonattainment Counties for All Criteria Pollutants, Website: http://www3.epa.gov/airquality/greenbk/ancl.html, January 30, 2015.

Reference 9.3-117. U.S. Department of Energy, "Oak Ridge Reservation Annual Site Environmental Report for 2014," DOE/ORO/2502, U.S. Department of Energy, September, 2015.

Reference 9.3-118. Region 8 WAFF 48, Polaris facility construction underway in Limestone Co., Website: http://www.kait8.com/story/29574815/polaris-facility-construction-underway-in-limestone-co, August 14, 2015.

Reference 9.3-119. Alabama Department of Transportation, Five Year Plan, Website: http://cpmsweb2.dot.state.al.us/TransPlan/FiveYearPlan/FiveYearPlan.aspx, September 30, 2015.

Reference 9.3-120. U.S. Energy Information Administration, Alabama Nuclear Profile, Website: http://www.eia.gov/nuclear/state/2008/alabama/al.html, September, 2010.

Reference 9.3-121. U.S. Nuclear Regulatory Commission, Browns Ferry Nuclear Plant - License Renewal Application, Website: http://www.nrc.gov/info-finder/reactors/, November 2, 2015.

Reference 9.3-122. U.S. Department of Energy, Oak Ridge Site, Website: http://energy.gov/em/oak-ridge-site, 2016.

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
On-site 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 Road1 (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 Projects Considered in the Cumulative Analysis

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.	3.01 mi SW Zierot Road	Inactive nonNPL 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.	3.32 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	2.8 mi SW	Final NPL site.
Redstone Arsenal	US Army Garrison Ballistics, chemical weapons, and missile research.	3.67 mi NE	Operational since 1941.
Marshall Space Flight Center	NASA center for propulsion analysis and development.	3.07 mi NE	Operational since 1960.
Guntersville Dam	Hydroelectric generation on Tennessee River. Impounds Wheeler Reservoir (67,900 ac).	23.0 mi SE (near New Hope, Marshall County)	Operational since 1939. 140,400 kilowatt (kW) generating capacity.
Wheeler Dam	Hydroelectric generation on Tennessee River. Impounds Wheeler Reservoir (67,070 ac).	40.1 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.	45.1 mi NE (Jackson County)	Built 1980. Withdrawn.
Brown's Ferry Nuclear Power Plant	Units 1, 2, and 3 (boiling water reactors).	23.6 mi NW (Limestone County)	Operational since 1974. License renewed 2006.
Sequoyah Nuclear Power Plant	Units 1 and 2 (pressurized water reactors).	100.0 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.	131.0 mi NE (Spring City, Tennessee)	Operational since 1996.
Joseph M. Farley Nuclear Power Plant	Two unit pressurized water reactors.	251.0 mi SE Columbia, Alabama	Operational since 1974. License renewed 2005.
Redstone Gateway	468 acre mixed use and office park.	5.69 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.	10.0 mi NE	Current.

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

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.	5.62 mi NW	Current.
City of Arab	Revitalization and expansion of downtown.	25.0 mi SE	Planned.
City of Hartselle	Small town.	17.8 mi SW	
City of Decatur	Highly planned, tightly zoned growth and development.	15.4 mi W	Current.
Decatur Education and Technology Business Park	Planned establishment to help cement development of Decatur Downtown Commons.	15.2 mi W	Planned development by 2019.
Decatur Railroad Depot	Restoration and enhancement.	16.0 mi W	Planned development.
Decatur Depot - Renovation	Expansion of jail.	16.0 mi W	Current.
Decatur - Alabama Center for the Arts	Phase 2 construction.	16.0 mi W	Current.
City of Athens	Highly detailed development plan emphasizing infill and redevelopment of exiting areas.	19.3 mi NW	Current.
Wheeler Reservoir / Tennessee River System	Much of water supply for City of Huntsville and Madison County.	30.3 mi NW	45 mgd to customers.
Various surface water treatment facilities	Facilities located within 6 county area.	Within 60.0 mi	Current.
Huntsville – South Parkway Treatment Plant	Tennessee River plant for Huntsville Utilities.	9.01 mi SE Whitesburg Bridge	Operational since 1964 35 mgd.
Huntsville – Southwest Treatment Plant	Huntsville Utilities.	4.67 mi SW (Triana Highway)	Operational since 1988. 35 mgd.
North Limestone Treatment Facility	Surface water pumped from Elk River.	29.7 mi NW (5 mi north of Elkmont)	2788 mgd (2724 mgd flow through).
Decatur Utilities	Surface water pumped from Wheeler Reservoir.	15.8 mi SW	119 mgd.
Arab Water Works	Surface water pumped from Brown's Creek Embayment, Lake Guntersville, Marshall County.	25.0 mi SE	1065 mgd (1044 mgd flow through).
Huntsville - Southeast Water Treatment Plant	Tennessee River plant under construction for Huntsville Utilities.	21.3 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.	37.2 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 Projects Considered in the Cumulative Analysis

Project Name	Summary of Project	Relative Location (from center of Redstone Arsenal Site 12)	Status
Lincoln and Dallas Well Treatment Plant	Huntsville Utilities.	11.3 mi NE	Operational since 1992.
Hampton Cove Well Treatment Plant	Huntsville Utilities.	13.7 mi E	Operational since 1996.
Williams Well	Huntsville Utilities.	1.19 mi NW	Operational since 1971.
Wheeler Dam and hydroelectric facility	Generates electricity and impounds Wheeler Reservoir.	40.1 mi NW	Operational since 1936.
Madison County – anticipated development	Madison County anticipates between 38 and 50% will be developed by 2020.	5.62 mi NW	Current.
Limestone County – proposed connection to Decatur Water Treatment Plant	30 inch pipeline across Wheeler Reservoir supplying water to Limestone County.	29.8 mi NW	Seeking FONSI status to allow construction.
Polaris Facility	450 acre production facility for all terrain vehicles.	7.74 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.	8.80 mi NW	Estimated completion: 2016.
Madison - 1500 ac Industrial Megasite	Sewell Farm. Pre-certified as TVA Megasite for industrial development.	8.83 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.	3.75 mi NW	Established 1967.
Huntsville – Jetplex Industrial Park and Jetplex South Park	1470 ac adjacent to HSV (Jetplex Supplier Park).	2.85 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.	6.53 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.

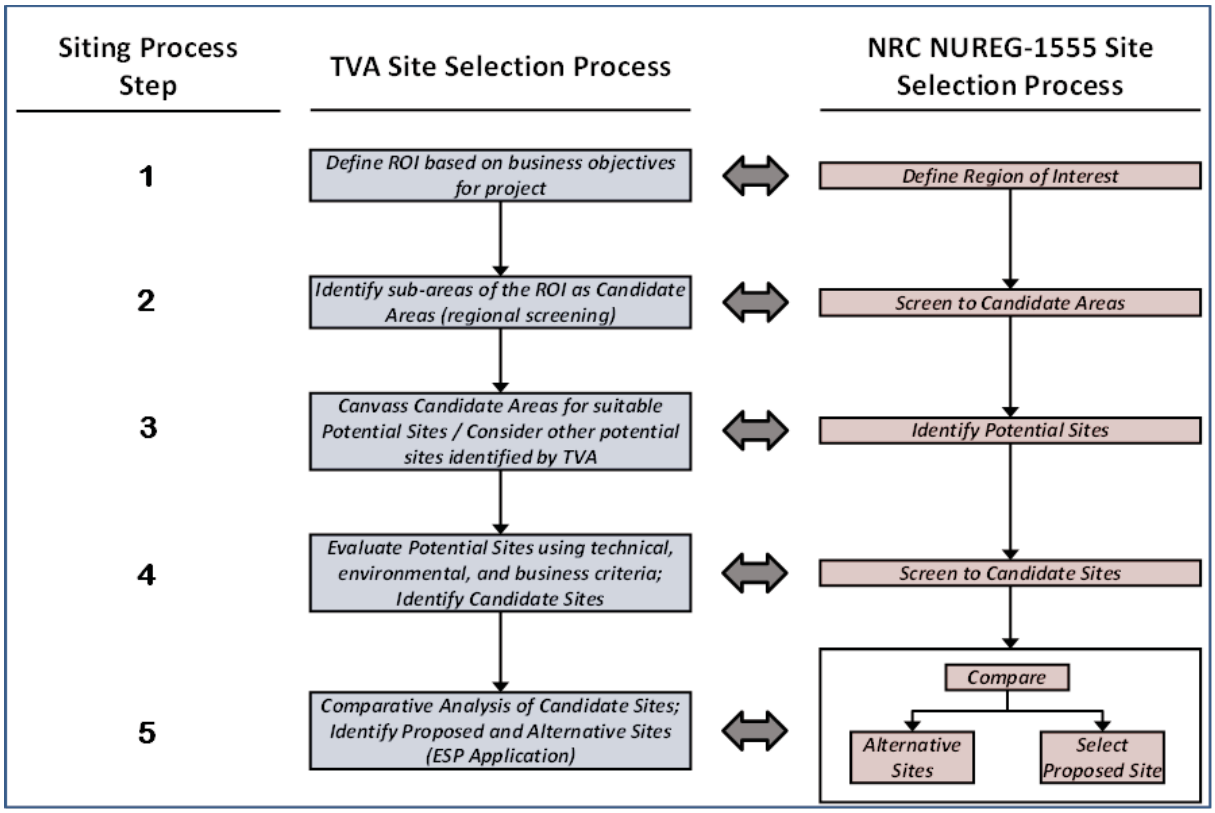


Figure 9.3-1. Proposed and Alternative Candidate Site Screening Methodology

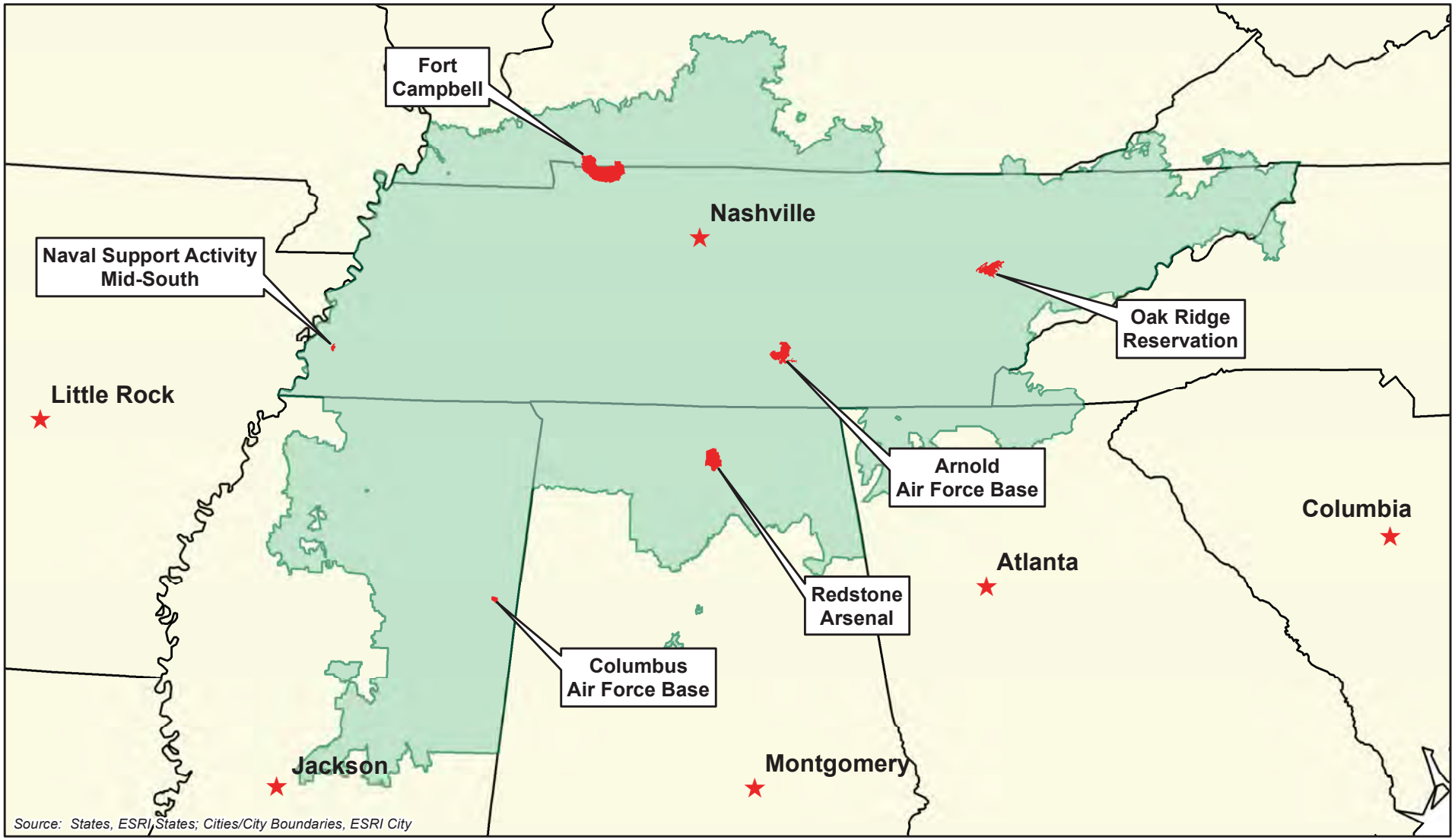


Figure 9.3-2. TVA Service Area and Direct Serve Federal Customers

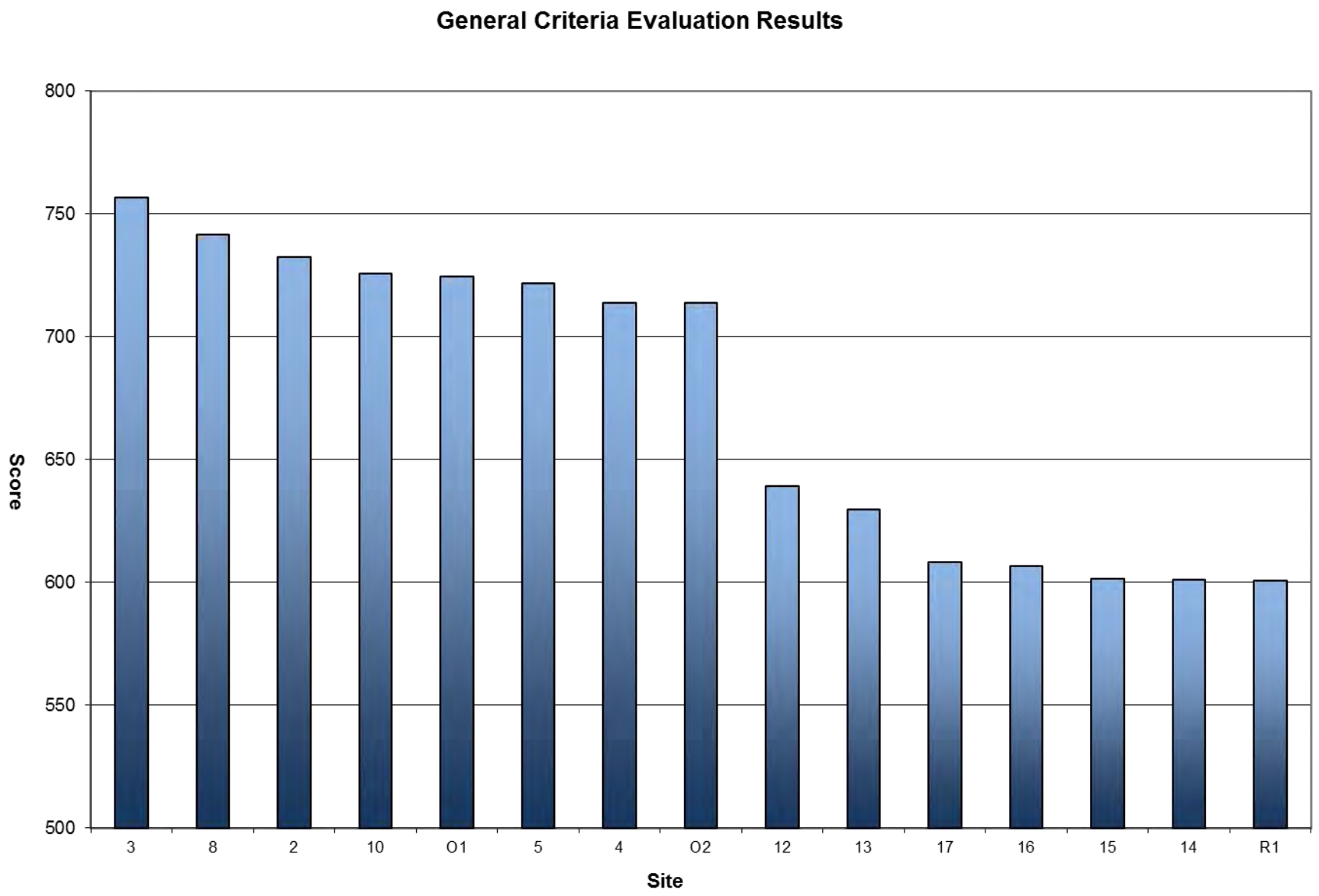
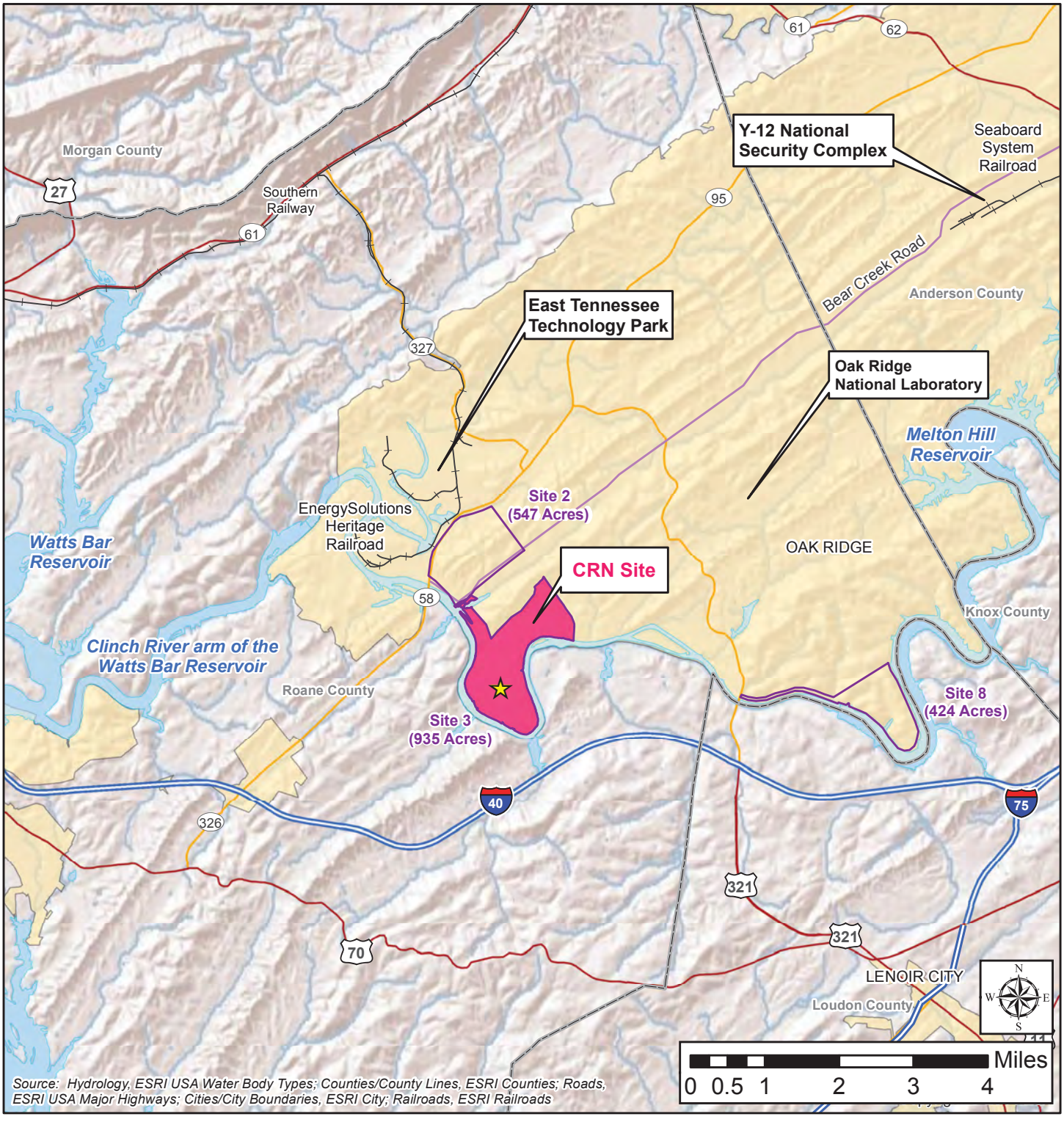


Figure 9.3-3. General Site Criteria Evaluation Results



Legend

- CRN Site Center Point
- CRN Site
- Candidate Sites
- City/Town Boundaries
- Counties
- Railroad
- Bear Creek Road
- Interstate
- Highway
- Major Road

Figure 9.3-4. ORR Candidate Sites

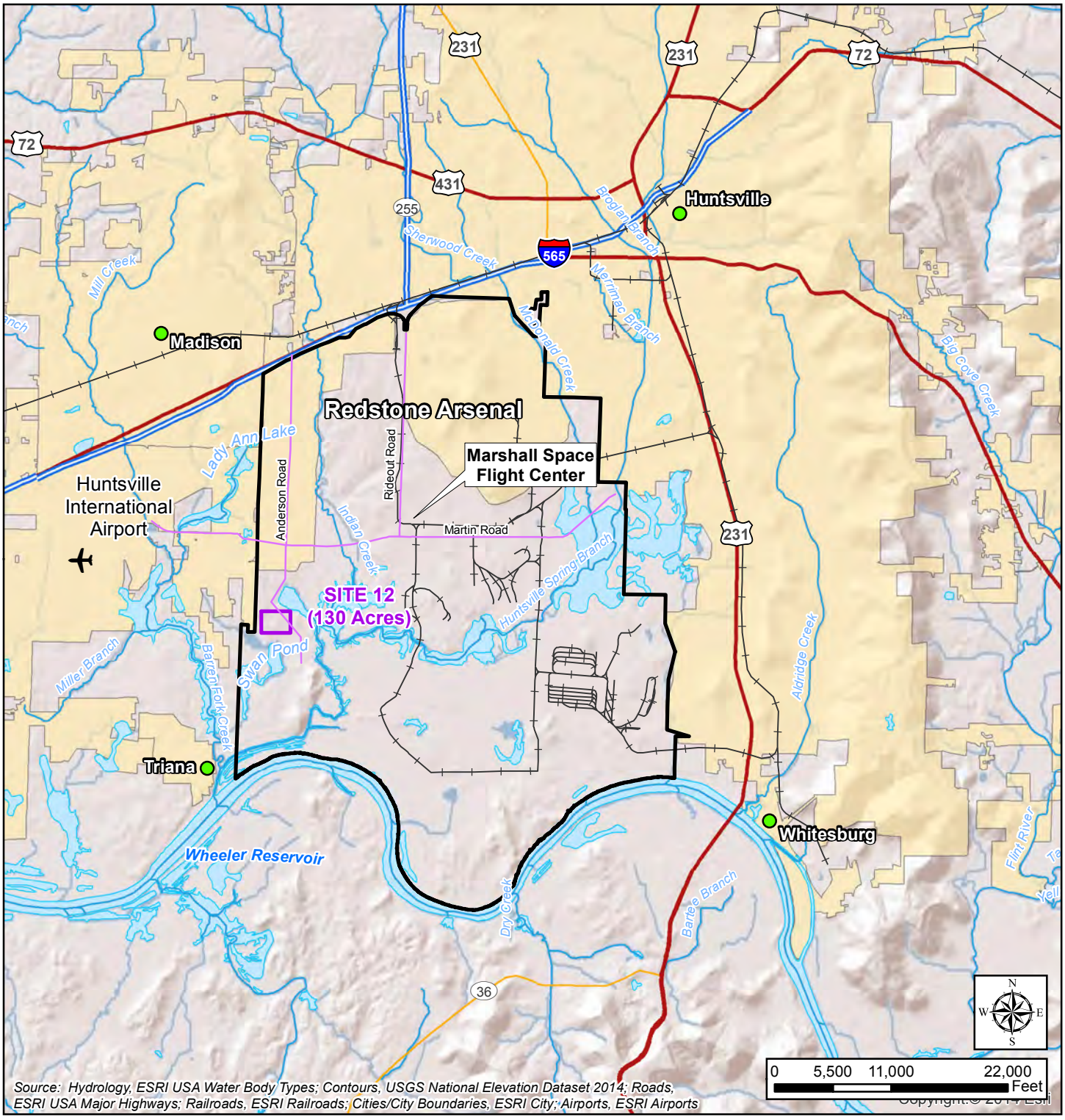


Figure 9.3-5. Redstone Arsenal Candidate Sites

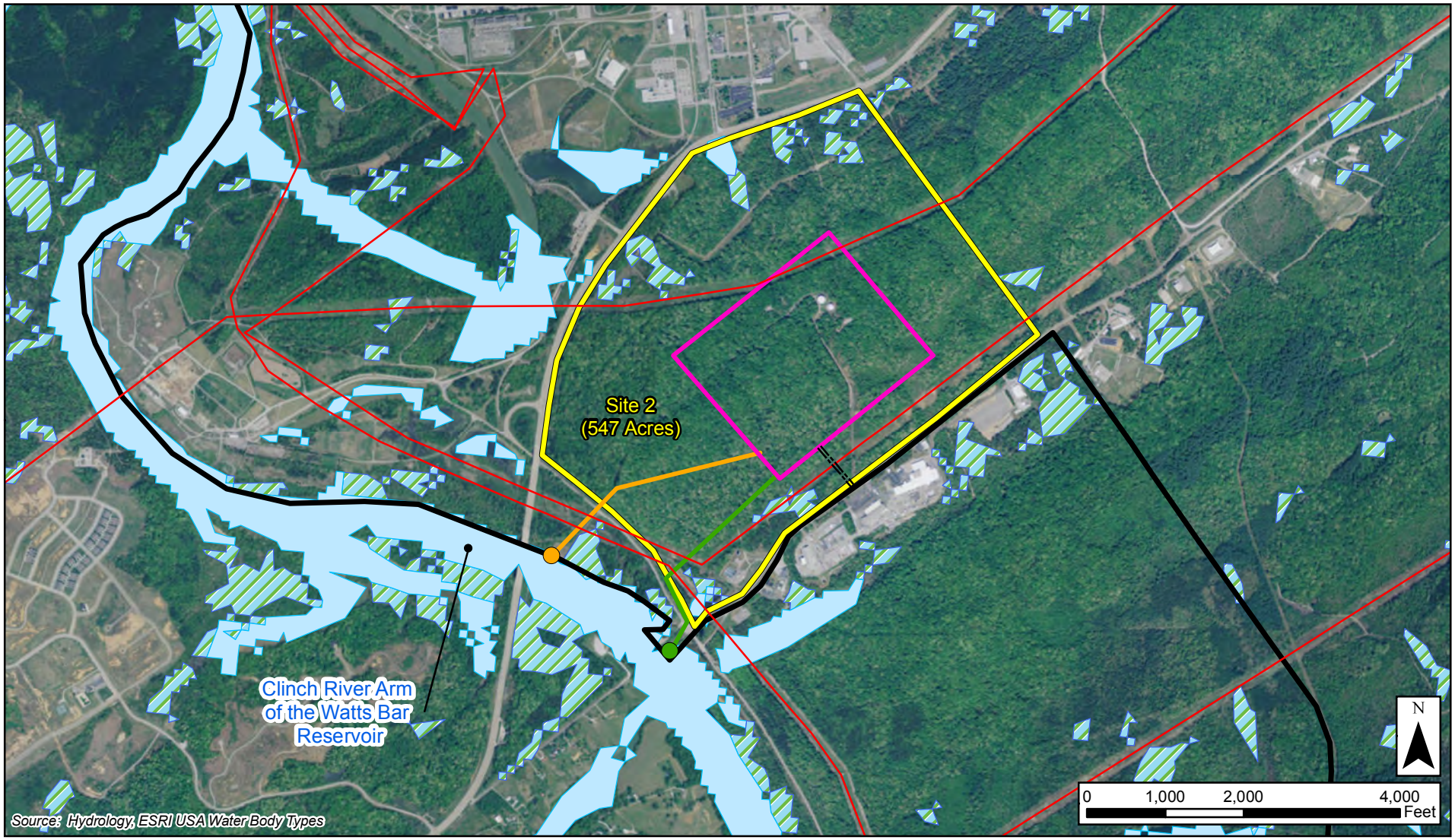


Figure 9.3-6. ORR Site 2 - Potential Layout

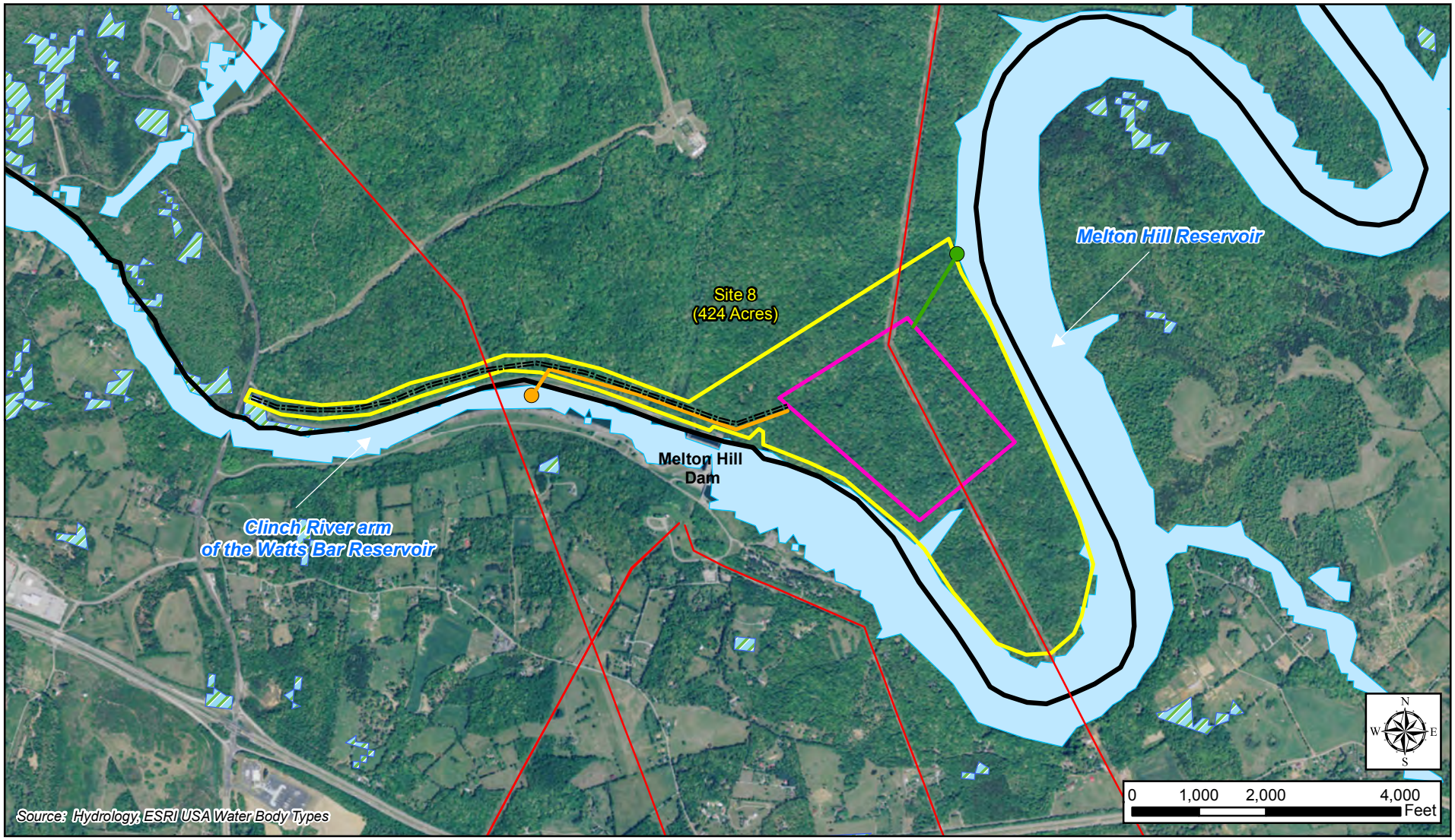


Figure 9.3-7. ORR Site 8 - Potential Layout

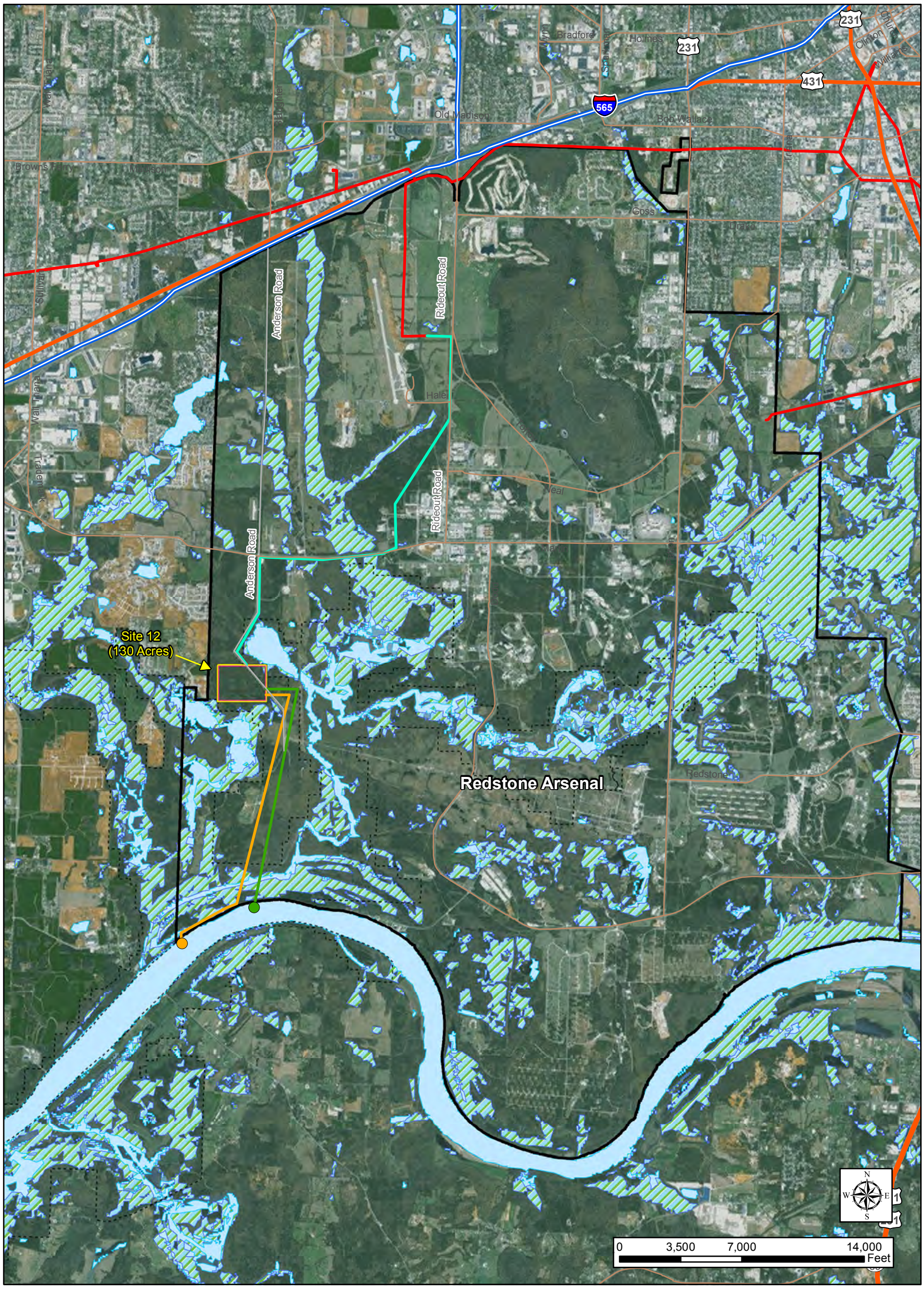
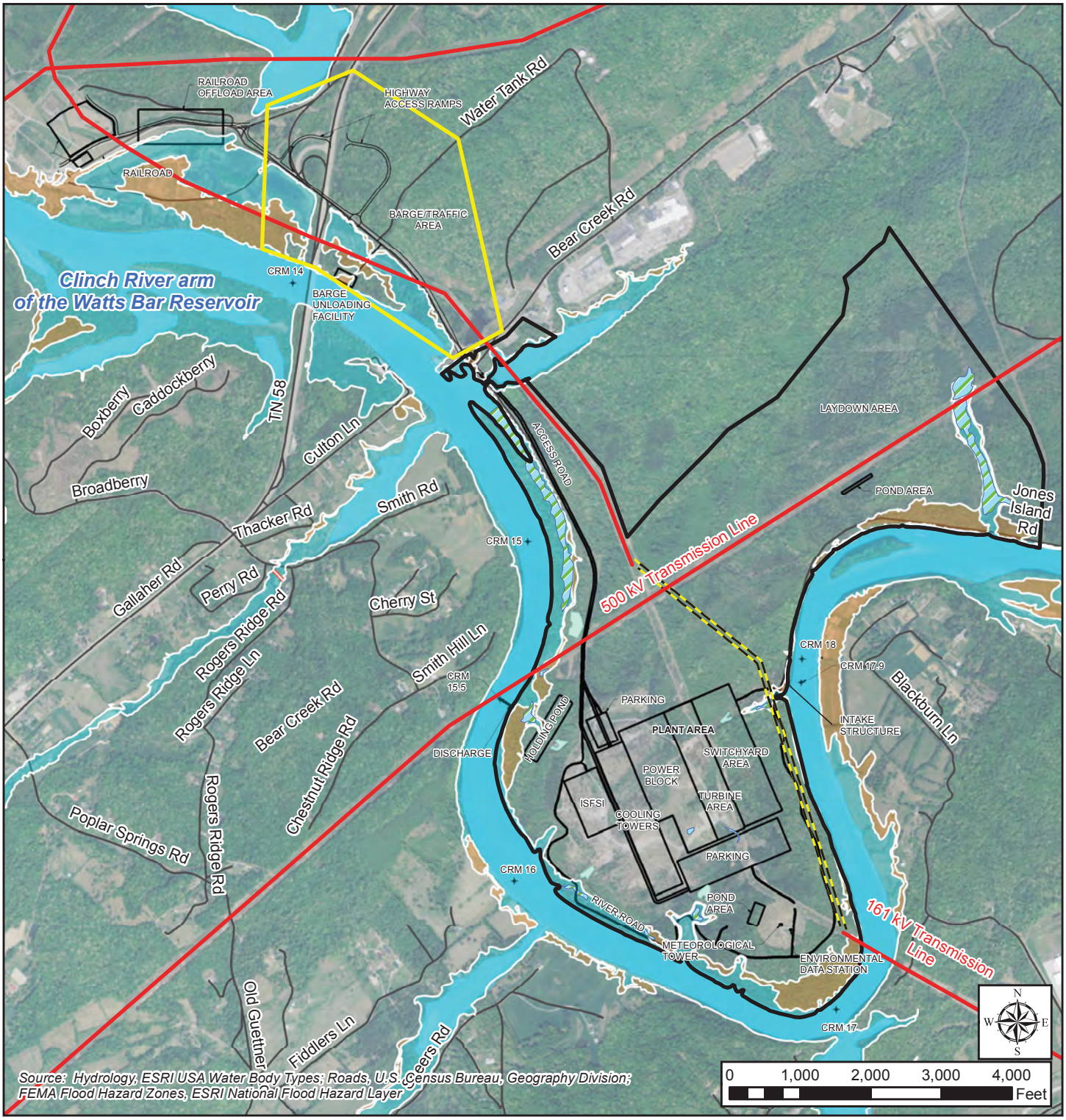


Figure 9.3-8. Redstone Arsenal Site 12 - Potential Layout



Legend

- CRN Site
- Ponds
- Wetland
- Rivers and Lakes
- Barge/Traffic Area
- Local Roads
- Transmission Line
- Approximate Proposed 161 kV Transmission Line Relocation
- 1% Annual Chance Flood Hazard
- 0.2% Annual Chance Flood Hazard

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

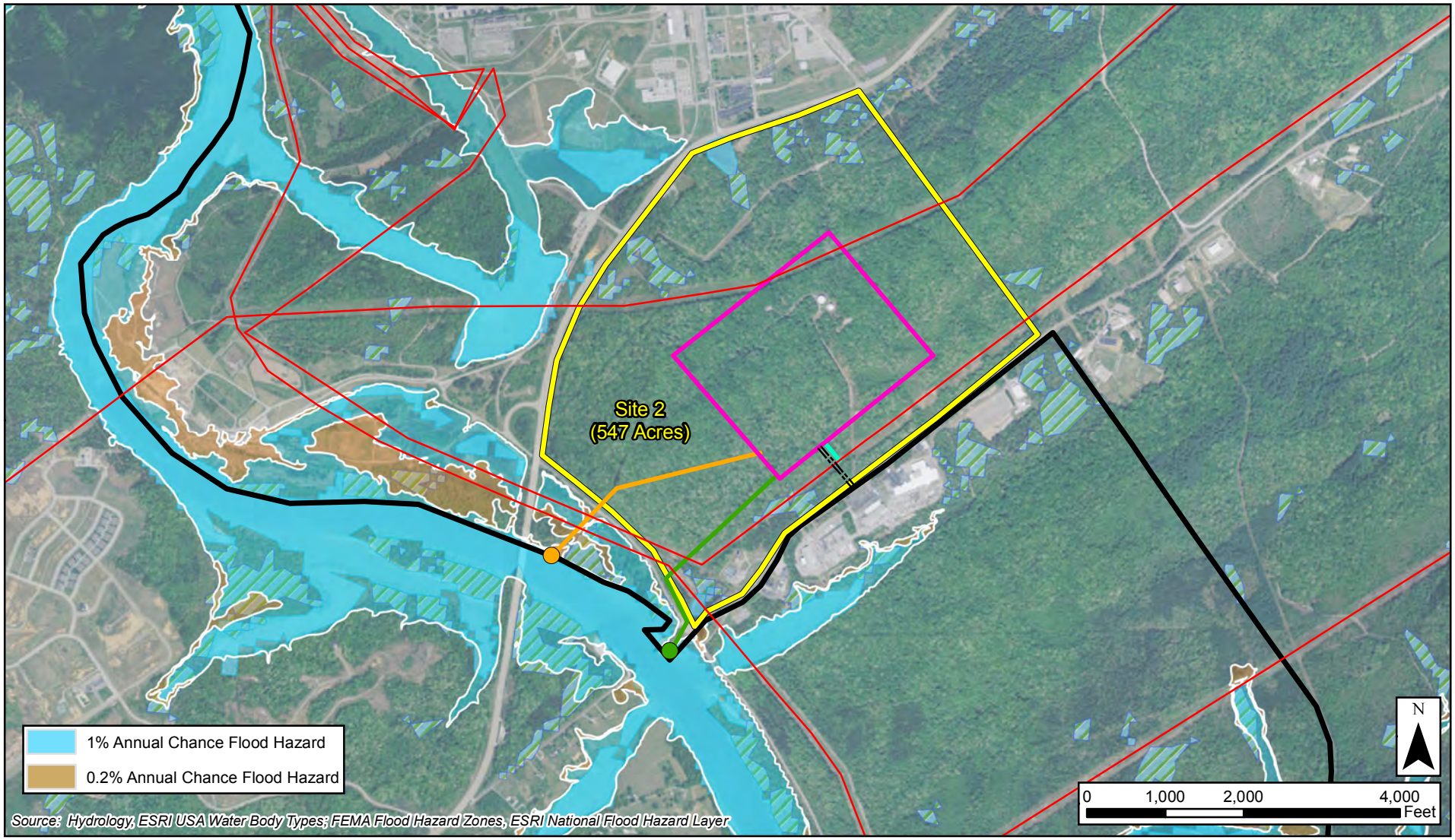


Figure 9.3-10. ORR Site 2 Flood Hazard Map

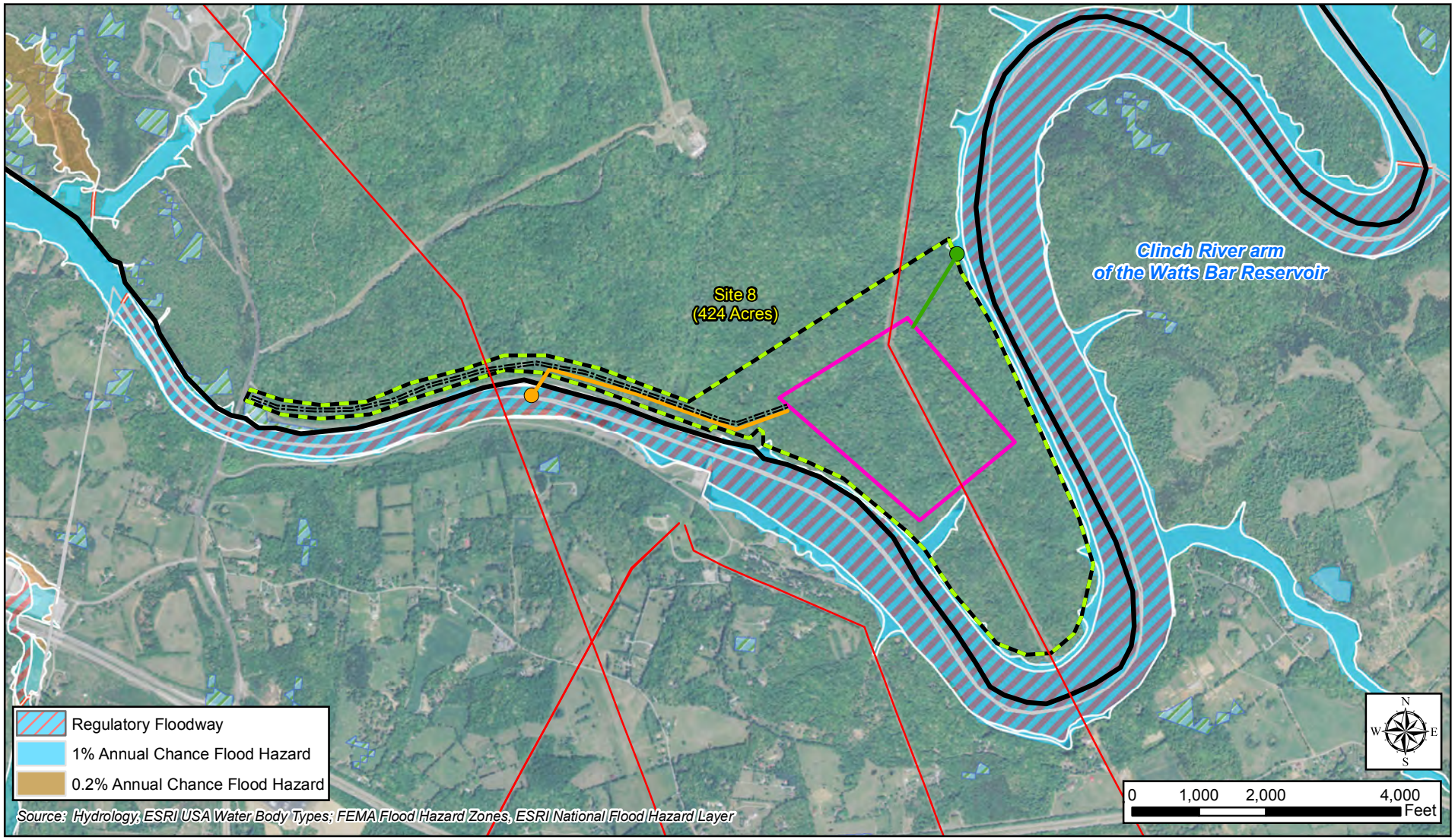
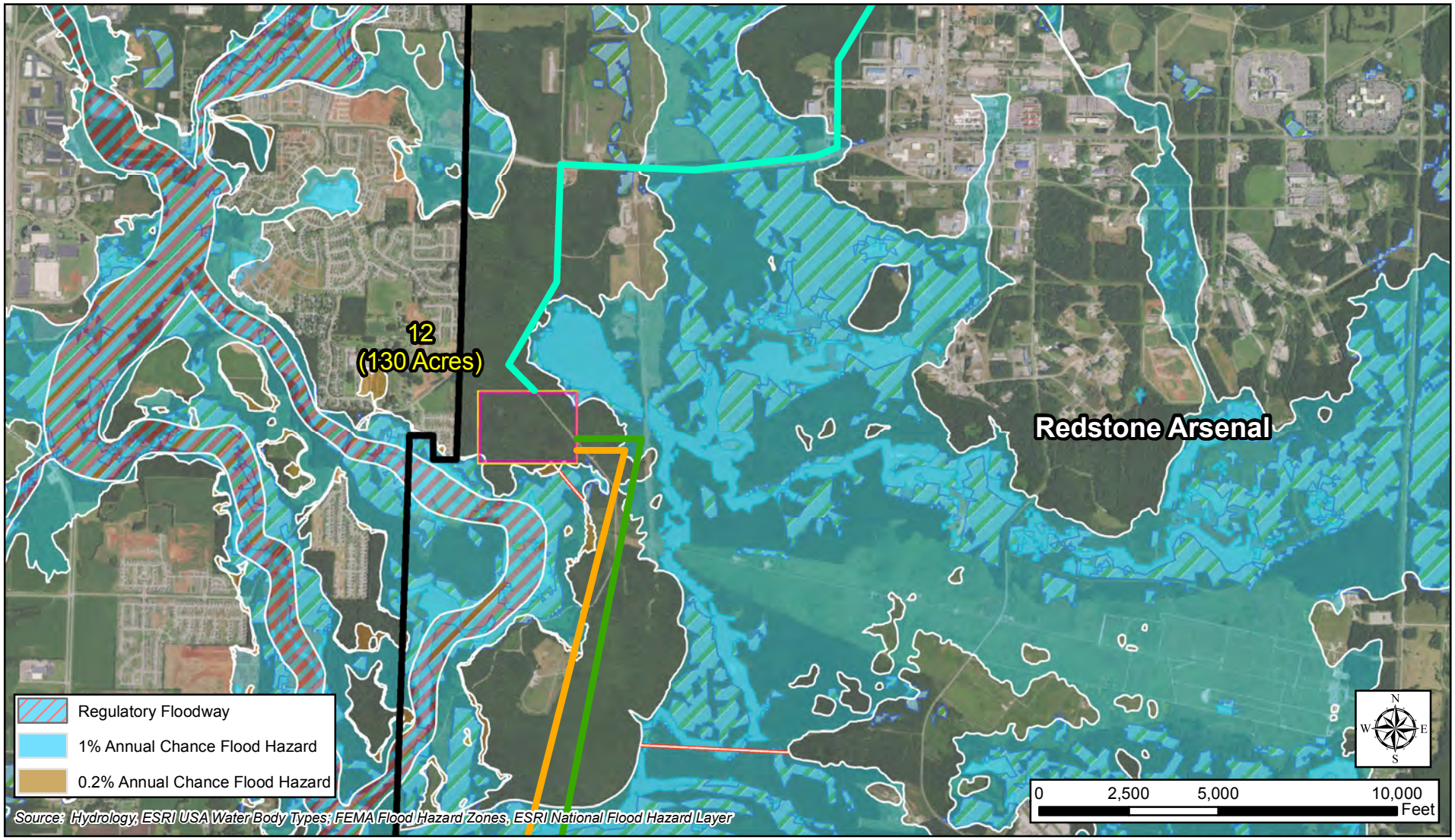


Figure 9.3-11. ORR Site 8 Flood Hazard Map

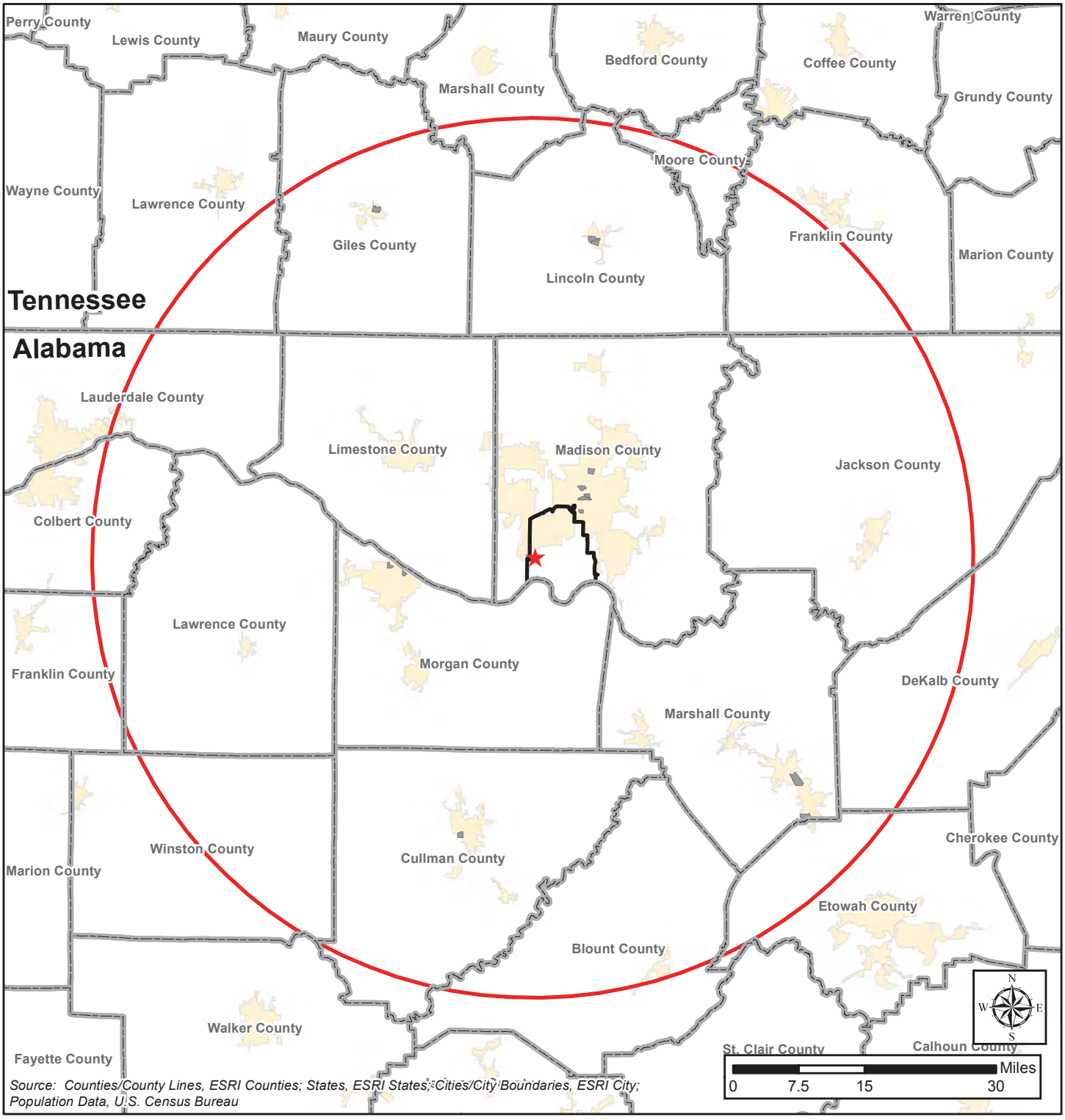


Legend

- Potential Candidate Site 12
- Redstone Arsenal Installation Boundary
- SMR Project Facilities
- Rivers and Lakes
- Woody Wetlands
- Potential Discharge
- Potential Intake
- Potential Transmission Line Connector
- Transmission Lines
- Potential Pipeline To Discharge
- Potential Pipeline To Intake

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

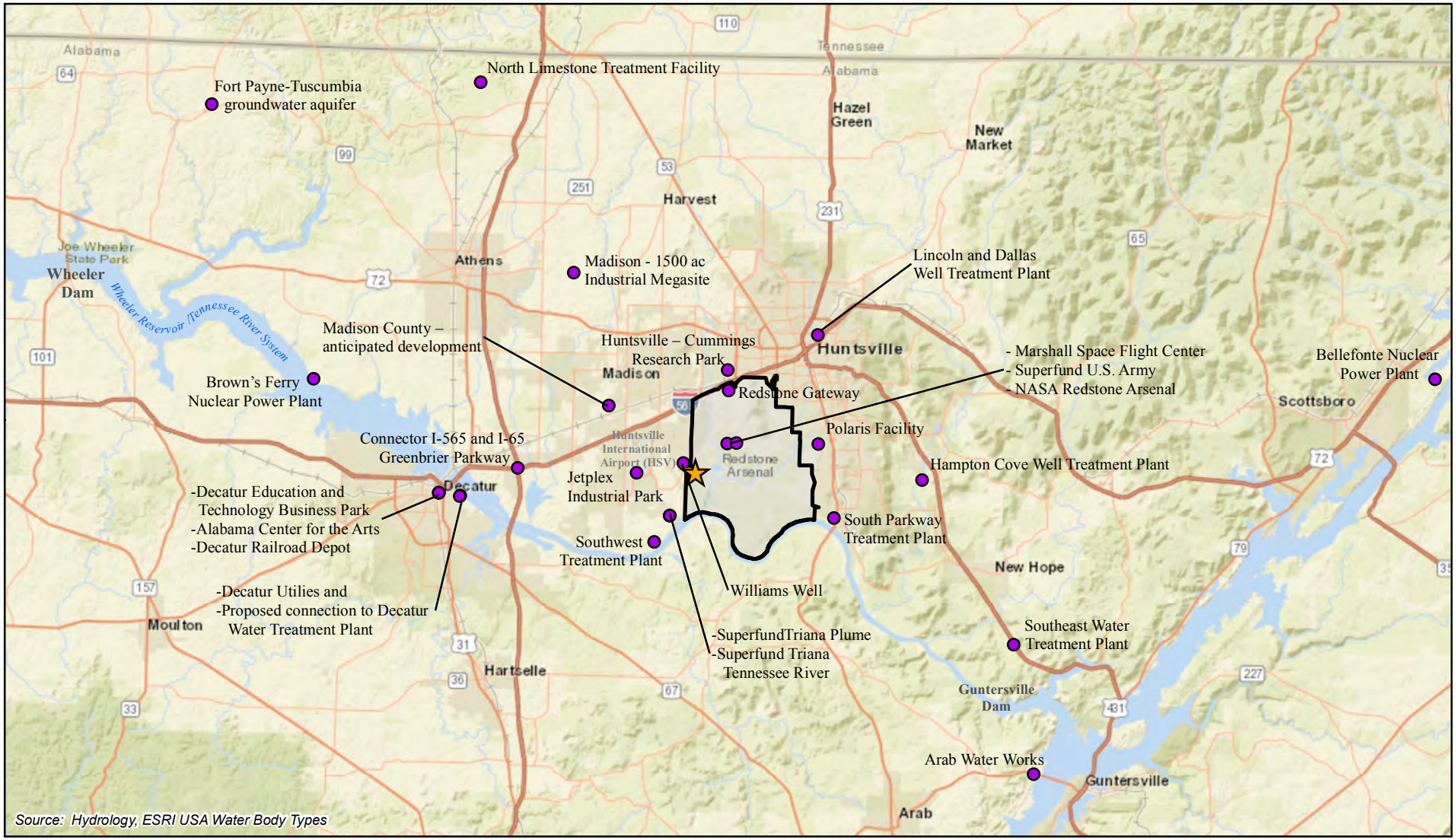
Figure 9.3-13. Minority Population Block Groups within 50 Miles of the Redstone Arsenal Candidate Site



Legend

- Potential Candidate Site Center Point
- Redstone Site 12 50-Mile Radius
- Customer Property Boundary
- City/Town Boundaries
- Counties
- State Line
- Low-Income Household Block Groups

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



Legend

- Foreseeable Project Locations
- Redstone Arsenal Installation Boundary
- Potential Candidate Site 12

Nuclear Plants included in the cumulative analysis, but not shown due to scale:

- Sequoyah Nuclear Power Plant 100.0 mi NE
- Watts Bar Nuclear Reactor 131.0 mi NE
- Joseph M. Farley Nuclear Power Plant 251.0 mi SE

0 5 10 20 Miles

N W E S

Figure 9.3-15. Redstone Arsenal Past, Present and Reasonably Foreseeable Projects Considered in the Cumulative Analysis

ENCLOSURE 2

Supplemental Information Supporting the Tennessee Valley Authority

Site Selection Report, Revision 2

ENCLOSURE 2

By the letter dated May 12, 2016 (Reference 1), Tennessee Valley Authority (TVA) submitted an application for an early site permit for the Clinch River Nuclear (CRN) Site in Oak Ridge, TN. By the letter dated July 6, 2016 (Reference 2), TVA submitted the "Small Modular Reactor Final Siting Study, Revision 1." Subsequent to the submittal of the application, and consistent with interactions with Nuclear Regulatory Commission (NRC) staff, TVA identified certain aspects of the application that it intends to supplement. By letter dated August 11, 2016 (Reference 3), TVA provided a plan for submitting the identified supplemental information.

This enclosure provides supplemental information to clarify the potential candidate sites outside of the candidate area boundaries, elimination of atmospheric dispersion, emergency planning and security plans as screening criteria for candidate areas, and provides additional information on the basis of the conclusion regarding impacts to aquatic species.

Supplemental Information 1

The TVA "Small Modular Reactor Final Siting Study," Section 4.0, "Identification of Preliminary Potential Sites," discussed the identification of 24 preliminary potential sites. The preliminary sites were evaluated to eliminate sites that were obviously less preferable for siting two or more SMRs. Table 4.0-1, "Preliminary Potential Site Screening and Elimination Justification," provided the rational used to justify the elimination of 11 of the preliminary potential sites.

The TVA Small Modular Reactor Final Siting Study has been revised and renamed, "TVA Site Selection Report." The TVA Site Selection Report, Subsection 4.1.1, "Customer-Identified Sites of Interest," establishes the criteria for the site selection evaluations. TVA identified sites that (1) have a contiguous area of 120 acres; (2) sites that are consistent with TVA's objectives for the project; and (3) sites that are consistent with TVA's land use plan and other existing missions and objectives. Identified Sites included in the Subsection 4.1.1 site evaluation discussion are TVA-owned properties that are adjacent to the candidate areas.

The revised TVA Site Selection Report, Sections 4.1.1 and associated conforming changes are contained in Enclosure 1, Attachment 1.

Supplemental Information 2

The TVA Small Modular Reactor Final Siting Study, Section 3.2, "Comparison of Safety Criteria for Candidate Areas," included Atmospheric Dispersion, Emergency Planning, and Security Plans as screening criteria. Section 3.2 has been replaced in the TVA Site Selection Report with Section 3.1, "Regional Screening Process."

The revised TVA Site Selection Report, Section 3.1, "Regional Screening Process," defines the screening process, including the application of the screening criteria. Exclusionary criterion have been defined and applied to eliminate those areas that are either unsuitable or are significantly less suitable than other potential siting areas. The regional screening process considers safety and security considerations, including proximity to federal direct-served customers, distance to viable water sources, and other related physical features that provide insights into site suitability on an areal basis within the Region of Interest (ROI). The exclusionary criteria applied to the regional screening of the ROI are listed in Table 3.1, "Regional Screening Criteria," of the revised Site Selection Report. These screening criteria

are consistent with the exclusionary criteria identified in Chapter 3.0 of the Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Power Generation Facilities (Siting Guide), June 2015 (Reference 4).

The revised TVA Site Selection Report, Section 3.1, Table 3.1 and associated conforming changes are contained in Enclosure 1, Attachment 1.

Supplemental Information 3

The TVA Small Modular Reactor Final Siting Study, Section 5.0, "Candidate Area Evaluations," has been replaced with the TVA Site Selection Report, Appendix C, "Technical Basis for General Site Criteria Evaluations." TVA Site Selection Report, Appendix C is consistent with the criteria identified in the Siting Guide. The information provided for each criterion evaluation in Appendix C includes a discussion of the Objective, Evaluation Approach, Data Discussion and Results.

Appendix C, Subsection C.2.1, "Construction Related Effects on Aquatic Ecology," and Subsection C.2.3, "Operational-Related related Effects on Aquatic Ecology," provide an evaluation of the potential impacts to aquatic species. Subsection C.2.1.1, "Disruption of Important Species/Habitats," and Subsection C.2.1.2, "Bottom Sediment Disruption Effects," each discuss the construction related impacts to aquatic/marine life and their habitats at each of the potential sites. Subsection C.2.3.1,"Thermal Discharge Effects," Subsection C.2.3.2, "Entrainment/Impingement Effects," and Subsection C.2.3.3, "Dredging Discharge Effects," each discusses the operational/maintenance related impacts to aquatic/marine life and their habitats at each of the potential sites.

The revised TVA Site Selection Report, Appendix C, Sections C.2.1.1, C.2.1.2, C.2.3.1, C.2.3.3 and associated conforming changes are contained in Enclosure 1, Attachment 1.

References:

1. Letter from TVA to NRC, CNL-16-081, "Application for Early Site Permit for Clinch River Nuclear Site," dated May 12, 2016

2. Letter from TVA to NRC, CNL-16-112, "Submittal of Siting Study in Support of Early Site Permit Application for Clinch River Site," dated July 6, 2016

3. Letter from TVA to NRC, CNL-16-134, "Schedule for Submittal of Supplemental Information in Support of Early Site Permit Application for Clinch River Nuclear Site," dated August 11, 2016

4. Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Power Generation Facilities (Siting Guide). Electric Power Research Institute, Palo Alto, Ca. June 2015

ENCLOSURE 3

Supplemental Information Supporting CRN Early Site Permit Application, Part 3,
Environmental Report Section 9.3, "Alternative Sites"

ENCLOSURE 3

By the letter dated May 12, 2016 (Reference 1), Tennessee Valley Authority (TVA) submitted an application for an early site permit for the Clinch River Nuclear (CRN) Site in Oak Ridge, TN. By letter dated June 23, 2016 (Reference 2), TVA provided RADTRAN input and output data used to estimate the radiological doses and dose risks to populations and transportation workers resulting from incident-free transportation and to the general population from accident scenarios. By the letter dated July 6, 2016 (Reference 3), TVA submitted the "Small Modular Reactor Final Siting Study, Revision 1." Subsequent to the submittal of the application, and consistent with interactions with Nuclear Regulatory Commission (NRC) staff, TVA identified certain aspects of the application that it intends to supplement. By letter dated August 11, 2016 (Reference 4), TVA provided a plan for submitting the identified supplemental information.

This enclosure provides supplemental information supporting CRN Early Site Permit Application (ESPA), Part 3, Environmental Report (ER) Section 9.3, "Alternative Sites," associated with the following topics:

1. Methodology used to determine the population density for the 20-mi radius around each Candidate Area and Potential Site;
2. Land use impacts associated with linear facilities (roads, rail lines, pipelines, transmission lines) that will be necessary to build and operate the project at each site;
3. Surface water use, quality impacts, groundwater use, proximity to other water users, use of intake and discharge areas for recreation or navigation, differences in hydrogeology, and differences in effects of discharge on receiving water body;
4. Economy and tax revenue impacts and demographics for each of the project sites;
5. TVA in-lieu tax payments and the expected magnitude of both the direct and the cumulative impacts for each site;
6. Transportation around each the alternative sites including a discussion of road level of service, the impact associated with addition of the workforce and mitigation plans, and incremental impact associated with construction and operation;
7. Traffic analysis using the Alabama Department of Transportation daily traffic volumes in comparison to the addition of the construction workforce traffic and the potential mitigation that would be required;
8. Environmental Justice discussion on the pathways most likely to affect minority and low-income populations and the criteria used to determine impact levels for each of the resources;
9. Cumulative impacts analysis for the transportation of unirradiated fuel, irradiated fuel, and radioactive waste to and from the proposed alternative sites; and,
10. Conforming changes to ER Subsection 4.4.2.1, "Population and Housing," and Subsection 5.8.2, "Social and Economic Impacts of Station Operation."

These proposed changes to the ER will be incorporated in a future revision of the ESPA.

Supplemental Information 1

The total population and persons per square mile were obtained from the Census Bureau's U.S. Population by Zip Code, 2010 Census database through ESRI, using Arc Map 10 geographic information system (GIS) software to identify the zip codes within 20-miles (mi) of Oak Ridge Reservation (ORR) and Redstone Arsenal. The geographical area of the 20-mi radius is not a uniform circle of population density, but includes the entire area (and population) of those zip codes that are located within or are intersected by the boundary of the 20-mi radius. (A similar approach was used for the Environmental Justice analysis in ER

Subsection 2.5.4, which identifies minority and low-income populations based on "all census block groups that are located within or are intersected by the boundary of the Clinch River Nuclear (CRN) Site region" (a 50-mi radius.) ER Subsection 9.3.5.2.5 (renumbered as ER Subsection 9.3.4.1.5) was revised by replacing the area in square miles with the phrase "(representing population by zip code as determined by the U.S. Census Bureau)" for ORR and for Redstone Arsenal.

During the November 17, 2016 follow-up audit concerning ER Section 9.3, the NRC staff requested that the ER be clarified to identify the variables used (population and acreage of the entire zip code areas) to calculate population density, including those portions of the zip code areas that extend outside of the 20-mi radius.

To address the NRC follow-up audit comments, ER Subsection 9.3.4.1.5 is being revised to include total acreage of the zip codes used to represent the 20-mi radius and a discussion of the entire zip code acreage and population for zip codes that are only partially within the 20-mi radius.

The revised ER Subsection 9.3.4.1.5 and associated conforming changes are contained in Enclosure 1, Attachment 2.

Supplemental Information 2

The text of ER Subsection 9.3.5.2, "Environmental Criteria," and Subsection 9.3.5.2.1, "Land Use," are being revised and renumbered to 9.3.4.1 and 9.3.4.1.1, respectively.

The CRN Site land use/land cover, as discussed in ER Subsection 9.3.4.1.1, is being revised to include a reference back to the land use/land cover discussion in ER Subsection 2.2.1.1, "The Site." Additionally, three new tables are being added, ER Tables 9.3-2 through 9.3-4, showing the land use/land cover classifications on ORR Site 2, ORR Site 8, and Redstone Arsenal Site 12. The new tables show the total land use/land cover on each of these sites and the land use/land cover that would be affected by the site features, including roads (where new roads are required), pipelines, and transmission lines. No new rail lines were considered at this time. Estimates of land use acreages in these affected areas are included in the new tables.

The revised ER Subsections 9.3.4.1, 9.3.4.1.1, and associated conforming changes are contained in Enclosure 1, Attachment 2.

Supplemental Information 3

The text of ER Subsection 9.3.5.2.2 is being revised and renumbered to 9.3.4.1.2. ER Subsection 9.3.4.1.2, "Water Use and Quality," is being revised as follows:

1. Subsection 9.3.4.1.2 was sub-divided into specific, focused subsections for discussion of Surface Water Use, Surface Water Hydrology, Onsite Surface Water and Wetlands, Surface Water Quality, and Groundwater.

2. Resource data specific to the four candidate sites, including quantitative data, was obtained from the revised Site Selection Report (Enclosure 1, Attachment 1), Sections 2.3 and 3.3, and other sources, and incorporated into ER Subsection 9.3.4.1.2. The additional quantitative data incorporated includes the total surface water withdrawal

rate, the consumptive water use rate, blowdown discharge rate, average reservoir flow rate, 7Q10 (lowest 7 day average flow rate that occurs on average once every 10 years) flow rate, and the wetland and open water acreages for each site. Other non-quantitative data incorporated includes location and type of existing water quality impacts and location and type of potentially affected water users.

3. Quantitative impact calculations and conclusions for the CRN Site were obtained from ER Section 5.2, "Water-Related Impacts," to support the watershed-wide analysis of the impact of consumptive water use on the water balance in the Tennessee River watershed. A discussion of the applicability of the calculation to ORR Sites 2 and 8, and Redstone Arsenal Site 12 is being added.

4. Additional quantitative calculations and conclusions for the CRN Site, ORR Sites 2 and 8, and Redstone Arsenal Site 12 are being added to ER Subsection 9.3.4.1.2. This information discusses the impact of consumptive water use on 7Q10 flow in each of the reservoirs, a comparison of the consumptive water use to withdrawals of other water users in the applicable study areas, the impact of discharge on the 7Q10 flow in each reservoir, the impact on onsite water bodies and wetlands, and the impact of consumptive water use on flow rates and pool levels. For each site, the impact of consumptive water use on flow rates and pool levels was used to reach a conclusion regarding impacts to recreation and navigation.

5. The discussion that impacts at Site ORR 8 are the same as those of the CRN Site and ORR Site 2 is being removed. ER Subsection 9.3.4.1.2 is being revised to add a separate discussion, and associated conclusions for each specific impact, is presented for ORR Site 8. Some of the discussions and conclusions for ORR Site 8 appear similar to those of the CRN Site and ORR Site 2, because there are similarities between the sites and their impacts. Melton Hill Reservoir, the main source of flow within the Clinch River arm of the Watts Bar Reservoir, is a run-of-river system and generally releases the same amount of water that flows into it. As a result of these releases, the average and 7Q10 flow rate within the Clinch River arm of the Watts Bar Reservoir is the same as in the Melton Hill Reservoir. Therefore, the quantification of impacts based on the 7Q10 and average flow rates is the same for ORR Site 8, the CRN Site, and ORR Site 2, although the potential impacted surface water users are different.

6. A discussion of the hydrogeological setting and potential groundwater use and quality impacts are being added to ER Subsection 9.3.4.1.2. As discussed in the new text, the SMRs at each location would not involve groundwater withdrawal that would affect, or be adversely affected by, local groundwater users. The CRN Site and ORR Site 8 are located directly on a reservoir with groundwater discharges to the reservoir. ORR Site 2 is situated such that the down gradient groundwater flow pathway between the site and the reservoir is on ORR property. As a result of the proposed plant location, there would be no groundwater users situated between the plant and the groundwater discharge location. Therefore, there would be no potential impact to offsite groundwater users. Although Redstone Arsenal Site 12 is not situated directly on a reservoir, the entire down gradient groundwater flow pathway between the site and the groundwater discharge location on Wheeler Reservoir to the south is located on Redstone Arsenal property. Therefore, the proposed SMRs at Redstone Arsenal Site 12 would not impact any groundwater users off of the property. The SMR construction at each site would be performed in accordance with the Construction Storm Water Pollution Prevention Plan

and the TVA Best Management Practice procedures, ensuring constant maintenance of groundwater quality and elimination of the impact to offsite groundwater users.

The revised ER Subsection 9.3.4.1.2 and associated conforming changes are contained in Enclosure 1, Attachment 2.

Supplemental Information 4

The text of ER Subsection 9.3.5.2.5 is being revised and renumbered as 9.3.4.1.5. ER Subsection 9.3.4.1.5, "Socioeconomics," is being revised to provide a discussion of economy and tax revenue impacts for the CRN Site, ORR Site 2, ORR Site 8 and for Redstone Arsenal Site12. This subsection also provides a discussion of the demographics around Redstone Arsenal Site 12.

ER Subsection 9.3.4.1.5 is being revised to discuss employment by industry, unemployment, present construction, operations, and construction/operation overlap workforce as a percentage of the total workforce. Included in this discussion is information related to the estimated total workforce that would be onsite during the overlap between construction and operation, including number of workers and percent of area employment those workers represent. This subsection also addresses tax revenues for local governments and TVA's tax equivalent payments to those governments, including TVA payments as a percentage of total taxes collected. In addition, this subsection now defines the geographic area of interest for economy and tax revenues.

ER Subsection 9.3.4.1.5 is also being revised to include demographic information for the Redstone Arsenal area, as well as for the ORR area. As part of this revision, the "Population and Housing" subsection is being divided into two separate subsections.

The changes to the "Population" subsection of ER 9.3.4.1.5 include defining the geographic area of interest for population evaluations, a discussion of population increase due to in-migration of construction and operation workers and their families, a clarification of how many construction workers would be from within a 50-mile radius and how many workers would relocate from outside the 50-mile radius (in-migrate), a discussion of the estimated total workforce that would be onsite during the overlap between construction and operation, and the total population increase represented by the in-migrating workers and their families.

The revised ER Subsection 9.3.4.1.5, and associated conforming changes are contained in Enclosure 1, Attachment 2.

Supplemental Information 5

The text of ER Subsection 9.3.5.2.5 and 9.3.5.3.4 are being revised and renumbered to 9.3.4.1.5 and 9.3.4.2.4, respectively. ER Subsections 9.3 4.1.5 and 9.3.4.2.4 are being revised to provide a quantitative discussion of the magnitude of TVA's tax equivalent payments to counties in relation to total county revenues. The basis for calculating percent of county revenues, represented by TVA in-lieu tax payments (TVA payments to each county divided by the total tax revenues in that county), is provided for the ORR sites and for the Redstone site.

In ER Subsection 9.3.4.1.5, "Socioeconomics," total annual tax revenues collected in FY 2013-2014 and Tennessee's allocation of TVA in-lieu tax payments for the same time period are being provided for the counties in the geographic area of interest, including Anderson, Knox, Loudon, and Roane Counties, Tennessee. The percentage of total county revenues represented by the TVA tax equivalent payment (i.e., TVA payment divided by total county revenues) ranged from 0.4 percent for Knox County to 1.8 percent for Roane County.

In ER Subsection 9.3.4.1.5, the total annual tax revenues collected and the TVA tax equivalent payments distributed during FY 2013-2014 are being provided for Madison and Morgan Counties, Alabama. The TVA tax equivalent payments in the Redstone Arsenal Site 12 geographic area of interest represent 8.4 percent of total county revenues for Madison County and 28.4 percent of total county revenues for Morgan County.

ER Subsection 9.3.4.2.4, "Cumulative Socioeconomic Impacts," is being revised to add a quantitative discussion of TVA's FY 2013-2014 tax equivalent payments to the counties within the Redstone Arsenal cumulative geographic area of interest (Madison, Morgan, and Limestone Counties) as a percentage of total taxes collected in each county. The TVA tax equivalent payments represent 8.4 percent of total county revenues for Madison County, 28.4 percent for Morgan County, and 19.6 percent for Limestone County. For the three counties combined, the TVA tax equivalent payments represent 13 percent of total revenues.

During the NRC November 17, 2016 follow-up audit on ER Section 9.3, the NRC staff requested clarification of the basis numbers (equivalency payments and county revenues) that the ER used for ORR sites and Redstone Arsenal Site 12 to derive percentages of taxes that the SMR project would pay through in-lieu payments.

Quantitative estimates of the impact payments associated with the SMR Project 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 payments for the associated counties. Given the structure by which TVA makes tax equivalent payments, the general distribution structure of funding by the state, as well as the increase in sales and property taxes, the potential impact of taxes for the SMR project, at either the ORR sites Redstone Arsenal Site 12, would be considered beneficial.

Therefore, based on comments received during the audit, the text of ER Subsections 9.3.4.1.5 and 9.3.4.2.4 are being revised to present the basis for the in-lieu tax payments analysis for ORR sites and Redstone Arsenal Site 12.

The revised ER Subsections 9.3.4.1.5, and 9.3.4.2.4, and associated conforming changes are contained in Enclosure 1, Attachment 2.

Supplemental Information 6

The CRN Site road related information is applicable to ORR Sites 2 and 8. The road level of service, the effect of an addition to the workforce on the roads, and the required mitigation are discussed for the CRN Site in ER Subsection 2.5.2.2.3, "Traffic Conditions." A summary of the CRN Site information and a discussion of the mitigation that would be required at ORR Site 8 are being added to ER Subsection 9.3.4.1.5, "Socioeconomics, subheading, *Transportation*."

For Redstone Arsenal Site 12, the Alabama Department of Transportation daily traffic volumes were obtained and reviewed against the anticipated construction workforce traffic associated with the SMR project to determine the effect on the roads and any potential mitigation plans that might be required. ER Subsection 9.3.4.1.5 is being revised to reflect the results of this analysis.

Information on workforce access to the CRN Site is in ER Subsection 2.5.2.2.1, "Roads." Information on workforce access to ORR Sites 2 and 8 and Redstone Arsenal Site 12 is being added to ER Subsection 9.3.4.1.5. Figures 9.3-5, 6, 7, and 8 are being updated to show the proposed access roads and road names.

The revised ER Subsection 9.3.4.1.5 and associated conforming changes are contained in Enclosure 1, Attachment 2.

Supplemental Information 7

The conclusion in ER Subsection 9.3.4.1.5, "Socioeconomics," that impacts to traffic during construction at Redstone Arsenal Site 12 would be SMALL to MODERATE is changed to MODERATE. This change is based on a more in-depth analysis using the Alabama Department of Transportation daily traffic volumes in comparison to the addition of the construction workforce traffic and the potential mitigation that would be required. ER Table 9.3-6 is being renumbered to ER Table 9.3-7. ER Table 9.3-7, "Summary of Potential Cumulative Impacts of Construction and Operation to Environmental and Socioeconomic Criteria by Site," is being revised to reflect the MODERATE impact to transportation.

The conclusions in ER Subsection 9.3.4.2.4, "Cumulative Socioeconomic Impacts," and Table 9.3-7 that construction would cause MODERATE cumulative transportation impacts for all of the sites, and that incremental contributions to cumulative impacts would be SMALL for all of the sites is unchanged.

The revised ER Subsections 9.3.4.1.5, and 9.3.4.1.2, Table 9.3-7 and associated conforming changes are contained in Enclosure 1, Attachment 2.

Supplemental Information 8

The text of ER Subsection 9.3.5.2.6 is being revised and renumbered to 9.3.4.1.6. The concluding statement in ER Subsection 9.3.4.1.6 is being replaced with two new subsections, titled "Potential Physical Impacts" and "Potential Socioeconomic Impacts." ORR (Alternative Sites 2, 3, and 8) and Redstone Arsenal (Alternative Site 12) are addressed separately. The new subsections discuss the pathways most likely to affect minority and low-income populations and identify the criteria used to determine impact levels for each of the resources. The revised discussion provides the basis for the conclusions reached in ER Subsection 9.3.4.1.6, i.e., whether there is the potential for physical and socioeconomic impacts that could disproportionately affect minority and low-income populations.

The revised ER Chapter 9.3, Subsection 9.3.4.1.6 and associated conforming changes are contained in Enclosure 1, Attachment 2.

Supplemental Information 9

ER Subsection 9.3.4.2.8 is being revised to address the cumulative impacts analysis from the transportation of unirradiated fuel, irradiated fuel, and radioactive waste to and from the proposed alternative sites (ORR Sites 2 and 8 and Redstone Arsenal Site 12). The revised text references the incident-free transportation analysis provided in ER Subsection 5.7.2.2 and transportation accident analysis in ER Section 7.4.

In addition, ER Subsection 9.3.4.2.8 is being revised to address the analysis of transportation of fuel and waste from the three alternative sites. The evaluations of incident free and transportation accident impacts for the CRN Site are representative of the impacts at the alternative sites due to the very similar transportation routes, distances, and means of transportation. Therefore, no additional detailed analyses per 10 CFR 51.52(b) and no comparisons to the Table S-4 values are necessary for the alternative sites.

The revised ER Subsection 9.3.4.2.8 and associated conforming changes are contained in Enclosure 1, Attachment 2.

Supplemental Information 10

ER Chapter 4, "Environmental Impacts of Construction," Subsection 4.4.2.1, "Population and Housing," is being revised to conform with the 2040 projected population estimates provided by the State of Tennessee, as described in ER Subsection 9.3.4.1.5, "Socioeconomics."

ER Chapter 5.0, "Environmental Impacts of Station Operation," Subsection 5.8.2, "Social and Economic Impacts of Station Operation," is being revised as follows:

1. ER Subsection 5.8.2.1.1, "Population," is being revised to conform to the 2040 projected population estimates provided by the State of Tennessee, as described in ER Subsection 9.3.4.1.5, "Socioeconomics." An additional discussion provides population increases during preconstruction, construction, operation and the overlap between those phases of the SMR Project.

2. ER Subsection 5.8.2.1.2, "Housing," is being revised to conform with the ER Subsection 9.3.4.1.5 discussion about population increases during preconstruction, construction, operation and the overlap between these phases of the SMR Project. Additionally, ER Subsection 5.8.2.1.2 is being revised to add the NUREG-1437, Revision 1 criteria for the assessment of housing impacts.

3. ER Subsection 5.8.2.2, "Employment and Income," is being revised to conform to ER Subsection 9.3.4.1.5. An additional employment population discussion is provided (as a percentage of the total employment workforce for the relevant study area), that describes population increases during preconstruction, construction, operation and the overlap between those phases of the SMR Project. Additionally, ER Subsection 5.8.2.2 is being revised to add the NUREG-1437, Revision 1 criteria for the assessment of economic impacts based on the operations-related employment of the population increase associated with the SMR Project.

4. ER Subsection 5.8.2.3, "Transportation," is being revised to conform to ER Subsection 9.3.4.1.5. ER Subsection 5.8.2.3 is being revised to add the NUREG-1437, Revision 1,

criteria for the assessment of transportation impacts based on the operations traffic on the level of service roadways for the relevant study area.

5. ER Subsection 5.8.2.4, "Tax Revenues to Local Jurisdictions," is being revised to conform to ER Subsection 9.3.4.1.5. ER Subsection 5.8.2.4 is being revised to add the NUREG-1437, Revision 1 criteria for the assessment of local tax receipts based on the magnitude of potential new tax payments or payments in lieu of taxes in relation to the host community.

6. ER Subsection 5.8.2.5, "Land Use," is being revised to conform to ER Subsection 9.3.4.1.5. ER Subsection 5.8.2.5 is being revised to add the NUREG-1437, Revision 1, criteria that provides the levels of significance for identifying impacts to offsite land use related to refurbishment of an existing nuclear facility. The analysis is based on population changes caused by refurbishment activities. The significance levels are applicable to the analysis of the impacts associated with operating a new nuclear power plant. This subsection also discusses the NRC-identified key predictors of population-induced land use changes.

7. ER Subsection 5.8.2.6, "Recreation," is being revised to conform to ER Subsection 9.3.4.1.5. ER Subsection 5.8.2.6 is being revised to add the NUREG-1427, Revision 1, criteria for assessing the impacts of nuclear power plants on recreation and tourism based on level of demand for recreational facilities.

8. ER Subsection 5.8.2.7, "Community Infrastructure and Services," is being revised to conform to ER Subsection 9.3.4.1.5. ER Subsection 5.8.2.7 is being revised to add the NUREG-1427, Revision 1, criteria for the evaluation of public utilities and public safety within the community services and education issue area.

9. ER Subsection 5.8.2.8, "Education," is being revised to conform to ER Subsection 9.3.4.1.5. ER Subsection 5.8.2.8 is being revised to add the NUREG-1427, Revision 1, criteria for the assessment of education impacts based on the baseline conditions of the potentially affected school system.

   Attachment 1 of this enclosure contains the markups of the changes to ER Subsection 4.4.2.1, "Population and Housing."

   Attachment 2 of this enclosure contains the markups of the changes to ER Subsection 5.8.2, "Social and Economic Impacts of Station Operation."

References:

1. Letter from TVA to NRC, CNL-16-081, "Application for Early Site Permit for Clinch River Nuclear Site," dated May 12, 2016

2. Letter from TVA to NRC, CNL-16-103, "Submittal of Calculation Input and Output Files in Support of Early Site Permit Application for Clinch River Nuclear Site," dated June 23, 2016

3. Letter from TVA to NRC, CNL-16-112, "Submittal of Siting Study in Support of Early Site Permit Application for Clinch River Site," dated July 6, 2016

4. Letter from TVA to NRC, CNL-16-134, "Schedule for Submittal of Supplemental Information in Support of Early Site Permit Application for Clinch River Nuclear Site," dated August 11, 2016

Attachments:

1. ER Subsection 4.4.2.1, "Population and Housing," markups.
2. ER Subsection 5.8.2, "Social and Economic Impacts of Station Operation," markups.

ATTACHMENT 1

ER Subsection 4.4.2.1 "Population and Housing," markups

ER Subsection 4.4.2.1 is being revised as indicated. Underlines indicate text to be added.

4.4 SOCIOECONOMIC IMPACTS

4.4.2.1 Population and Housing

This analysis of population and housing is based on the estimated peak construction workforce. The estimated construction workforce by month is presented in Table 3.10-2. As shown in Table 3.9-1, the overall schedule duration from preconstruction and site preparation activities until fuel load of the last unit is projected to be six years. Based on this schedule and an assumed 40-hr work week, the onsite peak construction workforce is estimated to be 3300 (Subsection 3.10.1.2 and Table 3.10-2). Figure 3.10-1 illustrates the distribution of the construction workforce over the construction period.

Based on the information presented in Section 3.10, it is anticipated that approximately 2185 construction workers already reside within the 50-mi region. The remaining 1115 workers would migrate into the region. It is conservatively assumed that 100 percent of this in-migrating workforce would relocate within the geographic area of interest.

Population

In 2010, the permanent population within the 50-mi radius of the CRN Site was 1,158,026 and is projected to grow to 1,305,189 by 2021 (Tables 2.5.1-2 and 2.5.1-5). The four-county geographic area of interest, including Anderson, Knox, Loudon, and Roane counties, had a population of 610,092 in 2010 and a projected population of 682,278 in 2020 and 807,594 in 2040 (Table 2.5.1-6).

ATTACHMENT 2

ER Subsection 5.8.2, "Social and Economic Impacts of Station Operation," markups

ER Subsection 5.8.2 is being revised as indicated. Strikethroughs indicate text to be deleted. Underlines indicate text to be added.

5.8.2 Social and Economic Impacts of Station Operation

This subsection evaluates the potential demographic, economic, infrastructure, and community impacts associated with operation of two or more SMRs at the CRN Site. The evaluation assesses potential impacts associated with operation of the CR SMR Project, including routine capital expenditures needed to support operations and the size of the operations workforce. The analysis is based on the PPE, which is discussed in Section 3.1 and provided in Tables 3.1-1 and 3.1-2.

5.8.2.1 Population and Housing

This analysis of population and housing is based on an operations workforce of 500 workers, which represents the total number of operational employees for operation of the CR SMR Project at full power, as presented in Table 3.1-2, Item 16.3.1. An additional 1000 workers would temporarily work at the CRN Site during periodic refueling and major maintenance activities, as presented in Table 3.1-2, Item 16.3.2.

As discussed in Subsection 3.10.3, it is anticipated that approximately 250 operations workers would already reside within the 50-mi region of the CRN Site. The remaining 250 workers would relocate into the region. It is conservatively assumed that 100 percent of this in-migrating workforce would relocate within the geographic area of interest. All of the 1000 temporary workers required for the scheduled refueling outages are assumed to be from outside the region. It is assumed they would temporarily reside in the geographic area of interest.

5.8.2.1.1 Population

In 2010, the population within the 50-mi radius of the CRN Site was 1,158,026 and is projected to grow to 1,305,189 by 2021 (Tables 2.5.1-2 and 2.5.1-5). The four-county geographic area of interest, including Anderson, Knox, Loudon, and Roane counties, had a population of 610,092 in 2010 and a projected population of 682,278 in 2020 and 807,594 in 2040 (Table 2.5.1-6).

It is assumed that each operations worker that relocates into the geographic area of interest would bring a family. The average household size in Tennessee is 2.48 (Reference 5.8-8). Therefore, an in-migrating workforce of 250 would increase the population of the geographic area of interest by 620 people, or 0.1 percent of the geographic area of interest population in 2010. It is assumed that the residential distribution of the in-migrating operations workforce would resemble the residential distribution of the DOE Oak Ridge workforce. Of the 11,433 employees at the DOE Oak Ridge facilities that reside within the geographic area of interest, 27 percent reside in Anderson County, 50 percent in Knox County, 6 percent in Loudon County, and 17 percent in Roane County. Therefore, of the total population increase due to the operations workforce, it is assumed that 166 people (27 percent of 620) would settle in Anderson County, 310 people in Knox County, 37 people in Loudon County, and 107 people in Roane County. These numbers constitute 0.2 percent, 0.1 percent, 0.1 percent, and 0.2 percent of the 2010 populations of Anderson, Knox, Loudon, and Roane counties, respectively.

Scheduled refueling is performed every 2 years for each SMR unit, as presented in Table 3.1-2, Item 18.0.4. It is conservatively assumed that the 1000 temporary workers required for each periodic refueling ~~event~~ outage work at the CRN Site for 30 to 60 days. This is based on the mean duration of refueling ~~event~~ outages for pressurized water reactors of 37 days and the maximum of 54 days (Reference 5.8-9). Based on the infrequent nature and limited length of time for refueling ~~event~~ outages, it is assumed that the temporary refueling workers would not permanently relocate to the geographic area of interest and would not bring families.

The CR 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 SMRs is operating while other SMR(s) are being constructed. The duration of this overlap between preconstruction/construction and operation would be expected to take between three and five years. During that overlap period, the combined project workforce would include the construction workforce (3300 workers) plus the operation workforce (conservatively assumed to be the 500 workers for full plant operation) for an estimated total onsite workforce of 3800 workers. 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. During the overlap period between preconstruction/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.

The operations workers and their families would represent a small increase to the population~~s~~ of the four counties within the geographic area of interest (0.1 percent) and the combined population increase associated with in-migrating workers during the overlap period between preconstruction/construction and operation would also represent a small increase (0.6 percent) ~~and an even smaller increase to the total population in the geographic area of interest.~~ The temporary refueling workers would not be associated with a permanent increase in the geographic area of interest population. Therefore, based on a population increase of less than 1 percent in the geographic area of interest, the potential impacts on population for the CR SMR Project would be SMALL.

5.8.2.1.2 Housing

Subsection 2.5.2.6 and Table 2.5.2-10 summarize availability of housing in the year 2010 in the geographic area of interest. This information was used as a basis for estimating the number of housing units that may be available for CR SMR Project operations workers. Generally, the counties with larger populations (in particular Knox County) have more available vacant housing.

NUREG-1437, Revision 1 presents criteria for the assessment of housing impacts based on the discernible changes in housing availability, prices, and changes in housing construction or conversions. These criteria are:

- SMALL: small and not easily discernible change in housing availability; increases in rental rates or housing values equal to or slightly exceeding the statewide inflation rate; and no extraordinary construction or conversion of housing
- MODERATE: discernible but short-lived reduction in housing availability; rental rates or housing values rise slightly faster than statewide inflation rate with prices realigning as

new housing added or project-related demand diminished; and minor or temporary conversions of non-living space to living space

- LARGE: very limited housing availability; rental rates and housing values increase well above normal inflation rate for state; and substantial conversions of housing units as well as overbuilding of new housing units.

There is currently enough housing to accommodate all the expected in-migrating families in Knox County alone. Knox County, with the greatest number of housing units in the geographic area of interest, had 17,700 vacant units in 2010, with 6777 for rent and 3747 for sale. In the geographic area of interest as a whole, there were a total of 26,403 vacant housing units, with 8984 for rent and 5120 for sale in 2010. It is likely adequate housing would be available within the geographic area of interest at the time the in-migrating operations workforce would move into the area. If all of the new in-migrating workers move to the geographic area of interest, 620 operations workers and family members would seek permanent housing in the four counties. It is also probable that workers on short-term assignments, such as refueling operations, would utilize temporary housing in the form of hotels, seasonal homes, and recreational vehicle parks and campgrounds. As described in Subsection 2.5.2.6, there are over 8100 hotel rooms in the Knoxville area and another 1185 rooms in Anderson, Loudon, and Roane counties. According to the 2010 Census, the geographic area of interest has 2329 seasonal housing units. Also, there are approximately 1302 temporary housing sites at recreational facilities in the geographic area of interest (Table 2.5.2-12). Also, refueling ~~event~~ outage workers could utilize temporary housing in the surrounding region, beyond the four counties in the geographic area of interest. During the overlap between preconstruction/construction and operation, 3385 people would potentially seek permanent and temporary housing within the geographic area of interest.

The in-migrating operations workforce of 250 workers and overlap period workforce of 1365 (1115 construction + 250 operations) are ~~is~~ small compared to the 26,403 vacant housing units within the geographic area of interest. Also the 1000 temporary workers required for the scheduled refueling outages, assumed to be from outside the region, could be accommodated in approximately 3600 seasonal and temporary housing units and 9200 hotel rooms within the geographic area of interest. Based on the large number of available vacant housing units in the geographic area of interest and the relatively small requirements for the in-migrating operations and overlap period workforces and the temporary refueling outage ~~event~~ workforce, the potential impacts on housing would be SMALL.

5.8.2.2 Employment and Income

Subsection 2.5.2.1 and Tables 2.5.2-1 through 2.5.2-8 summarize current employment characteristics and income levels in the geographic area of interest. Employment of the operations workforce and routine capital expenditures needed to support CR SMR Project operations over the period of operation would have economic impacts on the surrounding region.

NUREG-1437, Revision 1 presents criteria for the assessment of economic impacts based on operation-related employment as a percentage of total employment for the relevant study area. These criteria are:

- SMALL: if operations employment accounts for less than 5 percent of total study area employment

- MODERATE: if operations employment accounts for 5 to 10 percent of total study area employment
- LARGE: if operations employment accounts for more than 10 percent of total study area employment.

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 3800 represents 1 percent of the total workforce.

The U.S. Department of Commerce Bureau of Economic Analysis, Economics and Statistics Division, calculates multipliers for industry jobs and earnings within a specific region. The economic model they use is called the Regional Input-Output Modeling System (RIMS II).

RIMS II multipliers were obtained for the geographic area of interest consisting of Anderson, Knox, Loudon, and Roane counties. The RIMS II direct effect employment multiplier for jobs in the utilities industry is 2.2149. Thus, for every newly created operations job at the CR SMR Project, an estimated additional 1.2149 jobs would be created in the region. (Reference 5.8-10) Based on the Bureau of Economic Analysis multiplier and an operations workforce of 500, the CR SMR Project would create approximately 607 indirect jobs within the geographic area of interest during the period of operation. The combined total of 1107 direct operations jobs plus indirect jobs represents approximately 0.3 percent of the geographic area of interest workforce.

It is assumed that most indirect jobs would be service related and it is expected that those jobs would be filled by the existing workforce within the geographic area of interest. As of 2011, there were approximately 24,000 unemployed persons in the geographic area of interest (Table 2.5.2-2). The 607 indirect jobs created by the CR SMR Project during the operations phase represent approximately 2.5 percent of the existing unemployed workforce.

For every dollar earned by an operations worker, an additional 0.5423 dollars is added to the regional economy based on the Bureau of Economic Analysis Utilities industry direct-effect earnings multiplier for the geographic area of interest (Reference 5.8-10).

It is assumed that the additional 1000 temporary workers required for each periodic refueling outage ~~event~~ reside temporarily in the geographic area of interest during the 30- to 60-day outage period. Therefore, they would affect the local economy to a lesser extent than the permanent operations workforce.

As described in Subsection 4.4.2.2, the combined total of 3300 direct construction jobs plus 2450 indirect jobs would result in an increase of 5750 jobs, representing approximately 1.5 percent of the geographic area of interest workforce. During the overlap period between preconstruction/construction and operation, the combined direct plus indirect total of 6857 jobs (5750 construction-related + 1107 operation-related) represents approximately 1.7 percent of the geographic area of interest workforce

The employment of the operations workforce and temporary refueling ~~event~~ outage workers over the CR SMR Project period of operation, as well as employment during the overlap period between preconstruction/construction and operations, would have positive economic effects on the geographic area of interest and surrounding region. The CR SMR Project would introduce millions of dollars into the regional economy, creating indirect jobs that can help reduce unemployment and add business opportunities for housing and service-related industries. Operational activities at the facility would result in additional positive economic effects in the region related to expenditures for goods and services. Considering that operations-related employment (direct operations jobs plus indirect jobs) and overlap period-related employment each represents less than 5 percent of the workforce in the geographic area of interest ~~Therefore~~, there would be a SMALL beneficial impact of CR SMR Project operations on the economy ~~of the geographic area of interest~~.

5.8.2.3 Transportation

Figure 2.5.2-1 identifies federal highways and state roads that provide access to the geographic area of interest. Operations workers would typically access the CRN Site via Tennessee State Highway (TN) 58 and Bear Creek Road. As shown in Figure 3.1-2, driveway access to and from the CRN Site is from Bear Creek Road.

As discussed in Subsection 2.5.2.2.3, capacity analyses of the four intersections most likely to be affected by the construction and operation of the CR SMR Project were performed in 2013 as part of the traffic assessment for the CRN Site (Reference 5.8-11). The intersections analyzed are TN 58 at Bear Creek Road ramp, TN 58 at TN 327, TN 95 at Bear Creek Road, and Bear Creek Road at Bear Creek Road ramp.

NUREG-1437, Revision 1 presents criteria for the assessment of transportation impacts based on the effect of operations traffic on the level of service (LOS) for roadways within the relevant study area. These criteria are:

- SMALL: 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
- MODERATE: 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
- LARGE: 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.

Traffic generation estimates were determined for several scenarios, including for the peak year 2024 during the overlap period between preconstruction/construction and operation, which was assumed to have a construction workforce of 3300 (maximum number onsite during a 24-hr period) and an operations workforce of 366. Capacity analyses were performed for the AM and PM peak hours for all the study intersections. Under existing roadway conditions, Bear Creek Road as a two-lane section (between Bear Creek Road ramp and Proposed Site Entrance) was projected to operate at level of service (LOS) F (i.e., low variable speeds, heavily congested) in AM peak and the PM peak hours. Based on this traffic analysis, roadway improvements were recommended to mitigate adverse impacts to LOS as a result of increased traffic volume; these recommended improvements are

summarized in Subsection 4.4.2.3. It is assumed that those improvements would provide an acceptable operation for the peak year 2024, which would have the largest combination of construction and operations traffic volumes.

It is assumed that approximately 75 percent of the operations workers work the 1st shift (7:00 AM to 3:00 PM), 5 percent the 2nd shift (3:00 PM to 11:00 PM), and 5 percent the 3rd shift (11:00 PM to 7:00 AM). The remaining 15 percent, including 5 percent in training and 10 percent on annual sick leave, were not included in the daily traffic generation estimates. Based on this breakdown of shift workers, during the long-term operations phase approximately 375 employees arrive at the CRN Site around 7:00 AM. Assuming one person per vehicle, this represents 375 vehicles. If the local roadways were in their current configuration, this influx of traffic could create an adverse impact to transportation in the immediate CR SMR Project area. (Reference 5.8-11) However, the peak operations workforce at the completion of the CR SMR Project would be well below the peak of construction personnel plus operations personnel evaluated in the traffic assessment for the CRN Site. Therefore, although operations traffic could slightly increase the commute time along Bear Creek Road for persons working at the Clinch River Industrial Park, the roadway improvements recommended to accommodate the peak year/overlap period would also accommodate the operations staff traffic once the CR SMR Project is complete.

During refueling operations, an increased number of vehicles would be travelling on the local roads. Using the same shift breakdown as described for the operations workers, an estimated 750 additional outage workers arrive at the CRN Site around 7:00 AM. The total of operations and outage workers (1125) is less than the year 2024 total of construction and operations workers used in the traffic analysis (3666). Therefore, it is anticipated that the LOS at each of the intersections studied in the traffic assessment would be adequate, because the intersections would have been upgraded to handle the higher construction traffic volumes.

The mitigation measures used to offset the construction impacts on local roads, as described in Subsection 4.4.2.3, are sufficient to offset operational impacts to LOS for these roads. Considering that the road improvements are designed to accommodate the much larger construction workforce, the improved LOS resulting from the mitigation measures would have a beneficial impact on operations of those intersections and roads. Therefore, impacts to local roads would be beneficial and SMALL.

The volume of equipment delivered by rail and barge during operation of the CR SMR Project and during the overlap period is expected be similar to ~~less than~~ the volume of large components transported during construction. Therefore, the impact on local railroads and on barge traffic on the Clinch River arm of the Watts Bar Reservoir would be SMALL.

The estimated geographic area of interest population increase associated with operation of two or more SMRs at the CRN Site is approximately 620 workers and family, and 3385 people (2765 associated with construction and 620 associated with operation) for the overlap period between construction/preconstruction and operation. This could slightly increase public transportation usage, which would have a SMALL impact on public transportation facilities in the geographic area of interest.

5.8.2.4 Tax Revenues to Local Jurisdictions

NUREG-1437, Revision 1 presents criteria for the assessment of impacts on local tax receipts based on the magnitude of potential new tax payments, or payments in lieu of taxes, in relation to total revenues in the host community. These criteria are:

- SMALL: if the new tax payments constitute less than 10 percent of total revenues for local taxing jurisdictions
- MODERATE: if the new tax payments constitute 10 to 20 percent of total revenues for local taxing jurisdictions
- LARGE: if the new tax payments constitute more than 20 percent of total revenues for local taxing jurisdictions.

Several types of taxes are generated by operational activities and by workforce expenditures. These include sales and use taxes on employee purchases and personal property tax associated with employees. In addition, TVA makes tax equivalent payments. As described in Subsection 4.4.2.4, Anderson, Knox, Loudon, and Roane counties are the tax districts that are assumed to be most directly affected by the CR SMR Project.

Sales and use taxes would be generated in the geographic area of interest and region through retail expenditures of the operations and refueling outage workforce and the preconstruction/construction and operations overlap period workforce. Property tax revenues would be generated by the increased economic activity involving the operations and overlap period workforce. Revenues such as residential property taxes, real estate transfer fees, and motor vehicle taxes are collected by or on behalf of the state government. These funds are then distributed to the jurisdictions, including schools and public services.

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 and counties where its power operations are carried out (the State of Tennessee and Roane County for the CR SMR Project). 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. TVA’s tax equivalent payments to the four counties in the geographic area of interest are presented in Table 2.5.2-11 and total revenues in those counties are provided in Table 2.5.2-7. Fiscal Year (FY) 2013-2014 is the most recent year for which data on TVA tax equivalent payments and total county revenues are both available. 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 are:

Anderson County, 1.0 percent ($1.1 million/$109.6 million)
Knox County, 0.4 percent ($3.4 million/$846.9 million)
Loudon County, 1.6 percent ($1.1 million/$67.3 million)
Roane County, 1.8 percent ($1.6 million/$91.3 million)

Although the amount of sales and property taxes as well as TVA tax equivalent payments would be large in absolute terms, they would be small when compared to the total amount of taxes collected within the geographic area of interest.

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 new tax payments are expected to represent less than 10 percent of total revenues and potential impact of taxes within the geographic area of interest and region would be SMALL and beneficial.

5.8.2.5 Land Use

NUREG-1437, Revision 1, the NRC defines levels of significance for identifying impacts to offsite land use related to refurbishment of an existing nuclear facility. The analysis is based on population changes caused by refurbishment activities. These significance levels are applicable to the analysis of the impacts associated with operating a new nuclear power plant. NUREG 1437 concludes that the impacts to off-site land use during refurbishment at nuclear plants are considered:

- SMALL: if population growth results in very little new residential or commercial development compared with existing conditions and if the limited development results only in minimal changes in an area's basic land use pattern
- MODERATE: if plant-related population growth results in considerable new residential or commercial development and the development results in some changes to an area's basic land-use pattern
- LARGE: if population growth results in large-scale new residential or commercial development and the development results in major changes in an area's basic land-use pattern

Key predictors of population-induced land use changes are identified as:

- SMALL: if plant-related population growth is less than 5 percent of the study area's total population, especially if the study area has established patterns of residential and commercial development, a population density of at least 60 persons per square mile, and at least one urban area with a population of 100,000 or more within 50 mi
- MODERATE: if plant-related growth is between 5 and 20 percent of the study area's total population, especially if the study area has established patterns of residential and commercial development, a population density of 30 to 60 persons per square mile, and one urban area within 50 mi
- LARGE: if plant-related population growth is greater than 20 percent of the study area's total population and population density is less than 30 persons per square mile

Subsection 4.4.2.5 describes impacts to offsite land use due to the influx of 2765 construction workers and family members. As stated in Subsection 4.4.2.5, according to U.S. Nuclear Regulatory Commission (NRC) guidelines, population-induced land use changes would be SMALL because the construction-related population increase would be 0.5 percent of the geographic area of interest population, the area has an established pattern of residential and commercial development, a population density of greater than 60 people per square mile, and at least one urban area with a population of 100,000 or more within 50 mi (178,874 in Knoxville, Tennessee). As discussed in Subsection 5.8.2.1, an in-migrating operations workforce of 250 workers and their family members would increase the population of the geographic area of interest by 620 people, or 0.1 percent of the geographic area of interest population in 2010. Population increases during the overlap period between preconstruction/construction and operations would represent an increase of 0.6 percent of

the geographic area of interest population. Accordingly, the population-induced land use changes associated with the smaller operations-related population and the population during the overlap period would be minor ~~less than the construction-related changes~~, and the impacts ~~of operations~~ on land use would be SMALL.

As discussed in Subsection 5.8.2.1, population increases due to the operations workforce constitute 0.2 percent, 0.07 percent, 0.08 percent, and 0.2 percent of the 2010 populations of Anderson, Knox, Loudon, and Roane counties, respectively. The population density is greater than 60 people per square mile in each county: 222.8 in Anderson County, 850.5 in Knox County, 211.8 in Loudon County, and 150.2 in Roane County. Accordingly, population-induced land use changes would also be SMALL if the counties within the geographic area of interest are considered individually.

A temporary influx of approximately 1000 workers during refueling operations are not expected to cause impacts to offsite land use because these temporary employees are assumed to utilize temporary housing in the form of hotels, seasonal homes, and recreational vehicle parks and campgrounds.

Overall, because CR SMR Project-related population growth would be less than 5 percent, according to NRC guidelines the population-induced impacts to offsite land use patterns would be SMALL.

5.8.2.6 Recreation

NUREG-1427, Revision 1 presents criteria for assessing the impacts of nuclear power plants on recreation and tourism based on level of demand for recreational facilities. The criteria are:

- SMALL: if current facilities are adequate to handle local levels of demand
- MODERATE: if facilities are overcrowded during peak demand times
- LARGE: if additional recreation areas are needed to meet ongoing demands.

The existing visual resources and recreational opportunities near the CRN Site are described in Subsection 2.5.2.5.1. A number of public and private recreational facilities and a range of outdoor activities are located in the vicinity of the CRN Site, as described in Subsection 2.5.2.5.2, and in the region, as discussed in Subsection 2.5.1.3. Recreational opportunities in the immediate vicinity of the CRN Site include outdoor activities such as fishing and boating (including on the Clinch River arm of the Watts Bar Reservoir), hunting, hiking, and camping. Recreational areas within the CRN Site vicinity and region could potentially be impacted by the increased population of operations workers and their families and the increased competition for transient housing during refueling ~~event~~ outages. Workers who relocate to the geographic area of interest are expected to utilize recreational areas and facilities to a similar degree as the permanent population of the geographic area of interest. Because many of the recreational opportunities of the region are outdoor activities without associated maximum capacities, it is difficult to accurately estimate utilization by the permanent population. As discussed on Subsection 5.8.2.1, an in-migrating workforce of 250 would increase the population in the geographic area of interest by 620 people, or 0.1 percent based on the 2010 population of 610,092 and an in-migrating workforce of 1365 would increase the population by 3385 people or 0.6 percent. Sufficient recreational facilities are available to accommodate the associated increase in usage. Therefore, impacts to

recreation resources during CR SMR Project operation would be SMALL. Based on the regional supply of transient housing, including 2329 seasonal units and 1302 temporary housing sites at recreational facilities in the geographic area of interest, the impact on recreational facilities due to increased competition for transient housing during refueling ~~event~~ outages also would be SMALL.

5.8.2.7 Community Infrastructure and Services

NUREG-1437, Revision 1 has consolidated the evaluation of public utilities, public safety, and education within the community services and education issue area. (Education is addressed in Subsection 5.8.2.8.) The criteria identified for community services are:

- SMALL: if little or no change occurs in the community's ability to respond to the level of demand and there is no need to add capital facilities or additional personnel
- MODERATE: if overtaxing of facilities during peak demand periods occurs or some permanent additions to public safety forces or new capital equipment purchases are needed
- LARGE: if existing service levels are substantially degraded and additional capacity, personnel, or equipment is needed.

Demands from operational activities as well as from associated population increases were considered when evaluating the effects of operation of the CR SMR Project on infrastructure and services. During the period of operation, an estimated 250 workers would migrate into the geographic area of interest accompanied by 370 family members, for a population increase of 620, and the total permanent onsite operations workforce would be an estimated 500 workers. An additional 1000 temporary workers would be on site during the periodic refueling operations. During the overlap period, an estimated 1365 workers would in-migrate accompanied by 2020 family members, for a total population increase of 3385.

Water Supply Facilities

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 source of water for the potable and sanitary water systems at the CR SMR Project is municipal water from the City of Oak Ridge Public Works Department, which obtains its raw water from the surface water in the Watts Bar Reservoir. As discussed in Subsection 4.4.2.7, the U.S. Geological Survey (USGS) estimates that the average person uses 80 to 100 gallons per day (gpd) of water at home, including bathing, laundry, and outdoor watering. Considering that the operations workers are present on site for 8 hr per day, it is assumed that a conservative estimate of 50 gpd of potable water per worker would be required. The peak onsite workforce of 500 operations workers and 1000 outage workers would require a maximum of 75,000 gpd, or 0.08 million gallons per day (mgd), of potable water. During the overlap period, the peak onsite workforce of 3300 construction workers and 500 operations workers would require a maximum of 190,000 gpd, or 0.19 mgd. As shown in Table 2.5.2-15, the utility has a maximum potable water capacity of 9.9 mgd and an average daily consumption of 7.7 mgd, for an excess capacity of 2.2 mgd. The onsite maximum potable water usage of 0.08 mgd represents less than 4 percent of excess capacity and 0.19 mgd represents less than 9 percent of excess capacity. Therefore, ~~so~~ operational impacts to water supply facilities and the temporary overlap period impacts would be SMALL.

The impacts to the water supply systems within the geographic area of interest from the operations-related population increase can be estimated by calculating the amount of potable water that is required by these individuals. Table 2.5.2-15 contains details regarding the more than 20 public water suppliers in the four counties of the geographic area of interest, including their maximum daily capacity and current demand. Most of these water supply systems are operating well below capacity. As stated earlier, the USGS estimates that the average person uses 80 to 100 gpd of water at home. This represents an increased demand of approximately 62,000 gpd (during operations) ~~or~~ and 338,500 gpd (overlap period). Because all of the local utilities are operating below capacity and the in-migrating workforce would be spread out among four counties, an increase of 620 persons (operations) or 3385 persons (overlap period) in the geographic area of interest would not adversely affect the local utilities' capacity to supply potable water to their customers. Therefore, impacts to public water supply systems in the geographic area of interest would be SMALL.

The 1000 refueling ~~event~~ outage workers are conservatively assumed to reside within the geographic area of interest during periodic refueling activities. The associated increase in potable water demand would be temporary and spread over several water supply systems. Most of these water supply systems are operating well below capacity. Therefore, impacts to public water supply systems in the geographic area of interest would be SMALL during refueling activities.

Wastewater Treatment Facilities

Similar to potable water supplies, potential impacts to wastewater treatment facilities would result from onsite operation-related needs and the increase in the local population associated with in-migrating operations workers. Wastewater generated during operation of the CR SMR Project is discharged to the City of Oak Ridge Rarity Ridge sanitary treatment facility. As previously described, the average person in the United States uses 80 to 100 gpd of water at home, including such activities as dishwashing, laundry, and outdoor watering. During operations, 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. During the overlap period, a maximum of 190,000 gpd or 0.19 mgd of wastewater would be produced on site. As shown on Table 2.5.2-16, the City of Oak Ridge Rarity Ridge facility has a maximum treatment capacity of 0.6 mgd and an average daily utilization of 0.1 mgd, for an excess capacity of 0.5 mgd. The onsite wastewater production of 0.08 mgd represents approximately 15 percent of excess capacity and the wastewater production of 0.19 mgd represents approximately 38 percent of excess capacity. Although the temporary demand during the overlap period would be noticeable, it would not overtax existing facilities and there would be no capital purchases required to increase treatment capacity. Accordingly, the operations-related impact to wastewater treatment facilities would be SMALL.
Table 2.5.2-16 lists the wastewater treatment facilities in the geographic area of interest, their maximum daily capacity, and wastewater flows processed daily. The increase to the geographic area of interest population of an estimated 620 operation-related residents and 3385 overlap period-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 four counties. All of the wastewater treatment facilities in the geographic area of interest are operating below capacity, and would be able to absorb the increased demand without adversely affecting the

current customers. Therefore, based on the current excess capacities of the existing wastewater treatment facilities in the geographic area of interest, impacts to wastewater treatment facilities would be SMALL.

The 1000 refueling ~~event~~ outage workers are conservatively assumed to reside within the geographic area of interest during periodic refueling activities. The associated increase in wastewater treatment demand would be temporary and distributed over several water supply systems. Most of these water supply systems are operating well below capacity. Therefore, impacts to public water supply systems in the geographic area of interest would be SMALL during refueling activities.

Police Services

The number of sworn law enforcement officers and the resident-to-officer ratio for the four counties and the larger cities in the geographic area of interest are given in Table 2.5.2-17. The recommended ratio of officers to residents is between 1 and 4 officers to 1000 residents, or a police officer-to-resident ratio between 1:250 and 1:1000 (Reference 5.8-12). Table 2.5.2-17 shows that the cities within the geographic area of interest are within this ratio range and the counties are at or slightly above 1:1000. As previously stated, during the period of operation an estimated 620 workers and family members and during the overlap period an estimated 3385 workers and family members would migrate into the geographic area of interest. It is expected that most of these workers would reside in the larger cities in the area, including Knoxville, Oak Ridge, Clinton, Harriman, Kingston, and Lenoir City, Tennessee. These cities would be able to absorb the additional residents without the necessity of hiring more police officers because their police forces are already larger than the size required to achieve the recommended ratio of officers to residents. Table 5.8-3 shows distribution of the operations workforce among the four counties within the geographic area of interest and the resulting increased total populations by county. These population increases would increase the police-to-resident ratios slightly. The percent increase in ratio attributed to operation would be 0.2 percent in Anderson, Loudon, and Roane counties and no change in Knox County. During the overlap period, an increase in ratio attributed to construction would also occur, including 1.0, 0.4, 0.3, and 0.8 percent in Anderson, Knox, Loudon, and Roane Counties, respectively (as described in Subsection 4.4.2.7). Based on the percentage increase in police-to-resident ratios, the impact of in-migrating operation-related population to police services would be SMALL.

The 1000 refueling ~~event~~ outage workers are conservatively assumed to reside within the geographic area of interest during periodic refueling activities. The associated population increase would be temporary and spread over the geographic area of interest. Therefore, impacts to police services in the geographic area of interest would be SMALL during refueling activities.

Fire Protection Services

The existing levels of fire protection services in the geographic area of interest are close to the national average, as described in Subsection 2.5.2.7.3. Firefighter-to-resident ratios range from 1:205 in Roane County to 1:715 in Knox County. During operations, the City of Oak Ridge Fire Department provides primary fire and emergency medical services to the CRN Site. The first responder is the station located at the East Tennessee Technology Park, approximately 3.2 mi north of the CRN Site. Table 5.8-4 shows distribution of the operations workforce among the four counties within the geographic area of interest and the effect of

the larger populations. These population increases would increase the firefighter-to-resident ratios slightly. The percent increase in ratio attributed to operations would be 0.3 and 0.5 percent in Anderson and Roane counties, respectively, and no change in Knox and Loudon counties. During the overlap period, the additional percent increase in ratio attributed to construction would be 0.3, 0.4, 0.8, and 1.0 percent in Anderson, Knox, Loudon, and Roane Counties, respectively (as described in Subsection 4.4.2.7). Therefore, the potential impacts of the in-migrating residents to fire protection services during operation would be SMALL.

The 1000 refueling outage workers are conservatively assumed to reside within the geographic area of interest during periodic refueling activities. The associated population increase would be temporary and spread over the geographic area of interest. Therefore, impacts to fire protection services in the geographic area of interest would be SMALL during refueling activities.

Medical Services

The available medical services in the geographic area of interest, including health care facilities and nursing homes, are described in Subsection 2.5.2.7.3 and Tables 2.5.2-18 and 2.5.2-19. During operation of the CR SMR Project, onsite medical personnel would be expected to treat minor injuries to workers. More extensive injuries would be treated at one of the medical centers in the vicinity of the CRN Site. The influx of operations workers, ~~and~~ temporary refueling outage ~~event~~ workers, and overlap period construction and operations workers to the geographic area of interest would not disrupt the existing medical services available in the area. An addition of approximately 620 operation-related residents would increase the geographic area of interest population by 0.1 percent and an addition of 3385 overlap period construction and operations workers would increase the population by 0.6 percent, which would not adversely affect existing medical services. Therefore, impacts to medical services would be SMALL.

~~Political and Social Structure~~

~~The political structure of the geographic area of interest is described in Subsection 2.5.2.7.1, including federal, state and local representation systems. Population centers range from large cities (Knoxville, Tennessee) to moderate-size municipalities (Oak Ridge and Farragut, Tennessee) to small unincorporated communities. Although many of the 620 in-migrating operation-related population would likely settle in the larger cities in the geographic area of interest, they are not likely to all relocate to the same population center. The influx of operation workers and families to the geographic area of interest would not cause a change to the local political structure. Temporary workers associated with the refueling activities would be present in the communities only for a short time. Therefore, impacts to the political structure would be SMALL.~~

~~The social relations between members of a community, and the quality and quantity of their interactions, could potentially be affected by operations at the CRN Site. Regardless of the current state of the communities in the geographic area of interest, it is unlikely that an influx of 620 new residents to the area would have a potentially significant effect on the current social structure and community cohesion. Small indirect changes could occur due to potential economic benefits to the geographic area of interest and individuals employed during operations. These changes would most likely be beneficial as they involve a general increase in stability due to the availability of stable incomes and employment. Temporary workers associated with the refueling activities would be present in the communities for a short time. Considering that the number of operation-related in-migrants to the area is~~

~~limited and that benefits to social structure and community cohesion are presumed to be small but beneficial, social impacts to communities in the geographic area of interest would be SMALL.~~

5.8.2.8 Education

NUREG-1437, Revision 1 presents criteria for the assessment of education impacts based on the baseline conditions of the potentially affected school system (e.g., whether it is below, at, or exceeding maximum allowed student/teacher ratio). These criteria are:

- SMALL: project-related enrollment increases of 3 percent or less; no change in the school systems' abilities to provide educational services and no additional teaching staff or classroom space is needed
- MODERATE: project-related enrollment increases of 4 to 8 percent; school system must increase its teaching staff or classroom space
- LARGE: project-related enrollment increases above 8 percent; current institutions not adequate to accommodate the influx of students or project-related demand can be met only if additional resources are acquired.

Schools and student populations are discussed in Subsection 2.5.2.8. In the 2010 US Census Bureau estimates, 17.1 percent of the population of Tennessee was 5 to 17 years old (i.e., school age) and students accounted for 15.1 to 16.3 percent of total county populations in the four-counties within the geographic area of interest. It is assumed that 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.

As described in Subsection 5.8.2.1, it is assumed that 27 percent of the in-migrating operations workforce resides in Anderson County, 50 percent in Knox County, 6 percent in Loudon County, and 17 percent in Roane County. Table 5.8-5 applies the population distribution percentage assumptions to the number of school-aged children in the in-migrating operations workforce population to estimate the number of operations-related school-aged children in each of the four counties. Knox County would experience the largest increase in school-age population of 51 students. This represents less than 0.1 percent of the current public school population of 58,800. Roane County, with an additional 17 students, would experience the largest relative increase at 0.2 percent. Public school teacher-to-student ratios in the geographic area of interest are 1:14 in Anderson County and 1:16 in Knox, Loudon, and Roane counties (Reference 5.8-13). The increase in number of students would not change the teacher-to- student ratios (Table 5.8-5). During the overlap period between construction and operation, the population in the four-county 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. Project-related school enrollment increases would be less than 3 percent and increased revenues from property taxes and sales taxes on purchases as a result of workforce expenditures would help offset the additional education-related costs. Therefore, impacts to education within the geographic area of interest would be SMALL.