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

CNL-16-112

July 6, 2016

10 CFR 2.101
10 CFR 52.15

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

Clinch River Nuclear Site
NRC Project No. 785

Subject: Submittal of Siting Study in Support of Early Site Permit Application for Clinch River Nuclear Site

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

In the referenced letter, Tennessee Valley Authority (TVA) submitted an application for an early site permit for the Clinch River Nuclear (CRN) Site in Oak Ridge, TN. In addition to the contents of the application, TVA is also providing the enclosed Small Modular Reactor Final Siting Study in support of the NRC staff's review of alternatives to the proposed action, pursuant to 10 CFR 51.45(a)(3).

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 6th day of July 2016.

Respectfully,

J. W. Shea
Vice President, Nuclear Licensing

Enclosure

cc: See Page 2

Enclosure:

Small Modular Reactor Final Siting Study, Revision 1

cc (with enclosure):

Project Manager, Division of New Reactor Licensing

cc (without enclosure):

Executive Director of Operations
Regional Administrator, Region II
Deputy Executive Director for Reactor and Preparedness Programs
Director, Office of New Reactor Licensing
Director, Office of New Reactors
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Deputy Assistant Secretary, Nuclear Reactor Technologies, Department of Energy
Light Water Reactor Technologies, Department of Energy
Program Manager, Licensing Technical Support Program, Department of Energy
Project Manager, Licensing Technical Support Program, Department of Energy
Regulatory Specialist, Eastern Regulatory Field Office, Nashville District,
U.S. Army Corp of Engineers

ENCLOSURE

Tennessee Valley Authority Clinch River Nuclear Site

Early Site Permit Application

Small Modular Reactor Final Siting Study

SMALL MODULAR REACTOR

FINAL SITING STUDY

REVISION 1

Prepared For:

Tennessee Valley Authority
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JUNE 2016

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LIST OF ACRONYMS

Acronym	Definition
AFB	Air Force Base
ac	acre
AEDC	Arnold Engineering Development Center
CAA	Clean Air Act
CEQ	Council on Environmental Quality
cfs	cubic feet per second
CO	carbon monoxide
CRM	Clinch River Mile
DG	Draft Guidance
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
EO	Executive Order
EPA	United States Environmental Protection Agency
EPZ	emergency planning zone
ER	Environmental Report
ESPA	Early Site Permit Application
ETTP	East Tennessee Technology Park
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
ft	feet
FY2012	fiscal year 2012
GHG	greenhouse gas
h	hour
I-	Interstate
kW-h	kilowatt hours
LEDPA	Least Environmentally Damaging Practicable Alternative
LPZ	Low Population Zones
mg/kg	milligrams per kilogram
mi	mile
MOU	Memorandum of Understanding
msl	above mean sea level
MW	megawatt
NASA	National Aeronautics and Space Administration
NO_2	Nitrogen Dioxide
NPDES	National Pollution Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NSA	Naval Support Activity
NWR	National Wildlife Refuge
O_3	Ozone
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PDD	Presidential Policy Directive
PGA	peak ground acceleration
$PM_{2.5}$	particulate matter 2.5 micrometers
PM_{10}	particulate matter 10 micrometers

LIST OF ACRONYMS (continued)

Acronym	Definition
ROI	region of interest
SMR	small modular reactor
SO_2	Sulfur Dioxide
TDEC	Tennessee Department of Environment and Conservation
TDOT	Tennessee Department of Transportation
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resource Agency
U.S.	United States
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WMA	Wildlife Management Area
Y-12 Complex	Y-12 National Security Complex

1.0 INTRODUCTION

As authorized by the Tennessee Valley Authority Act, Tennessee Valley Authority (TVA) is committed to maintaining a national leadership role in technological innovation (585 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. 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 (Oct 2009). (66 Tennessee Valley Authority and U.S. Department of Energy 2012; 586 Executive Order: Federal Leadership in Environmental, Energy, and Economic Performance 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* (587 Executive Order 13636 - Improving Critical Infrastructure Cybersecurity 2013; 587 Executive Order 13636 - Improving Critical Infrastructure Cybersecurity 2013). EO 13646 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. EO 13693 specifically addresses the reduction of greenhouse gas emissions and alternative energy sources such as SMRs (1328 The White House Council on Environmental Quality 2015). In response to EOs 13646 and 13693 and PDD-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 of 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 SMRs' installation than for installation of a typical commercial reactor. In the four reactor designs under consideration, the reactor containment vessel is underground and features advanced passive safety systems. Refueling cycles will be longer for SMRs than for TVA's currently operating reactors. Underground facilities will be designed to accommodate a proportionately larger quantity of used fuel than present day 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.

The main objectives of this project are to demonstrate that:

1. SMR technology enhances nuclear safety and security.
2. Multiple units can be deployed incrementally to efficiently meet demand.

3. SMR technology can assist federal facilities with meeting carbon reduction objectives.
4. 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.

In order to successfully demonstrate these objectives, the following elements are critical to site selection:

1. Location within the TVA Service Region.
2. Sufficient acreage available to incrementally construct two or more SMRs.
3. Proximity to a federal installation.
4. Proximity to a water source.
5. Proximity to transmission lines.
6. Proximity to existing transportation infrastructure.

2.0 SUMMARY OF SITING PROCESS

Section 2.0 describes the process utilized in this Siting Study to identify Candidate Sites suitable for siting an SMR facility. This Siting Study generally follows the framework outlined in the Electric Power Research Institute (EPRI) *Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application*. Figure 2.0-1 shows the process.

2.1 Process for Establishing Region of Interest and Identifying Preliminary Candidate Areas

TVA determined the land located within TVA's power service area to be the Region of Interest (ROI) for the SMR project (Figure 2.1-1). 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 (objectives 3 and 4 in Section 1.0). Areas which allow TVA to accomplish the project objectives are those which are in close proximity to TVA's six federal direct-served customers. The six preliminary Candidate Areas are described in Section 3.0.

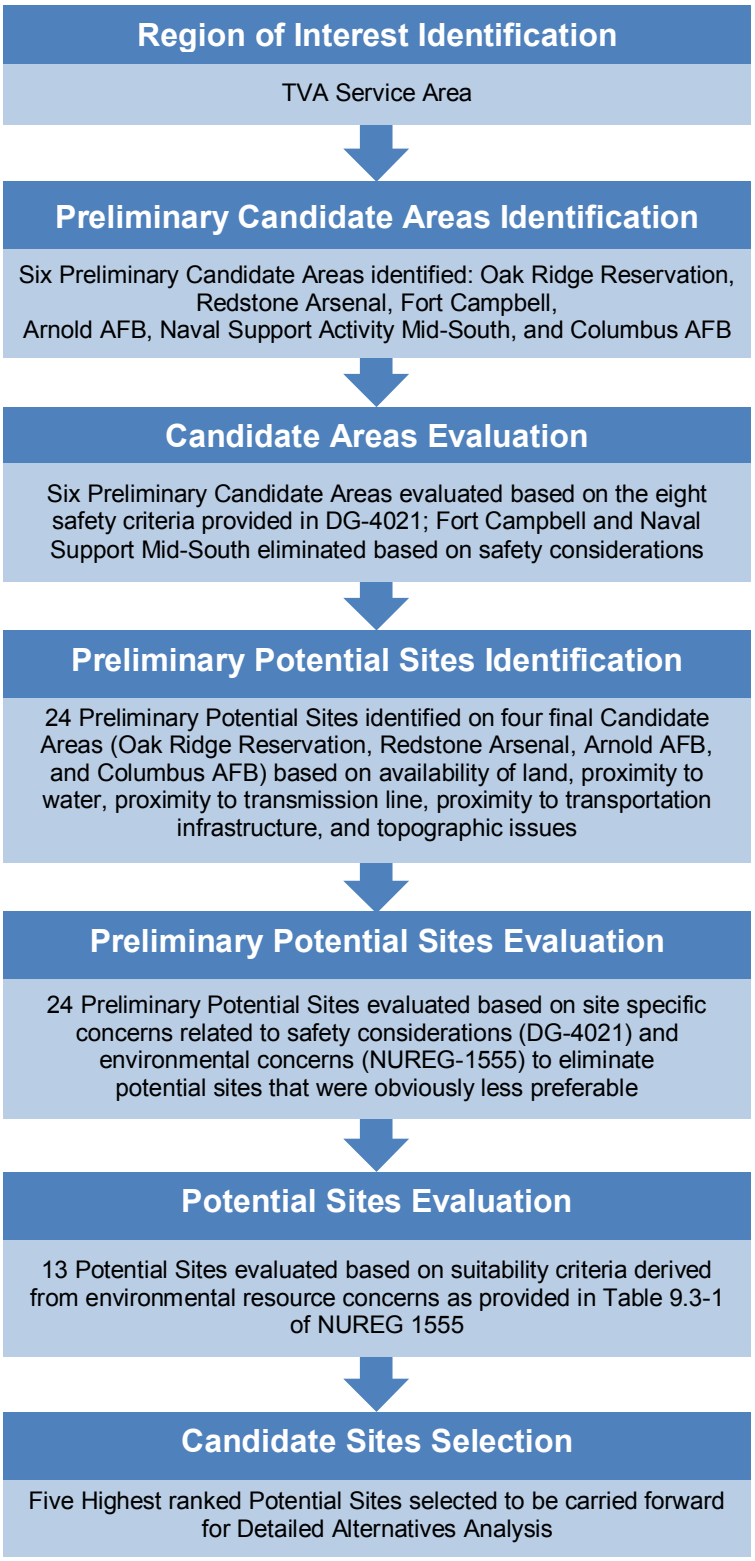
Direct-served customers are those customers that purchase their power directly from TVA and not through a third party power distributor. Table 2.1-1 lists TVA's federal direct-served customers in order of their respective power sales volume for the fiscal year 2014 (FY2014). Additional power generated (not required by the selected direct-served customer) would be incorporated into the regional electrical grid.

Table 2.1-1
Sales Volumes of TVA Federal Direct-Served Customers FY2014

Federal Direct-Served Customer	Sales Volume (kilowatt hours)
Oak Ridge Reservation	805,309,953
Redstone Arsenal	432,047,135
Arnold Air Force Base	334,868,928
Fort Campbell	294,365,870
Naval Support Activity Mid-South	49,568,201
Columbus Air Force Base	30,374,174

(1178 Brellenthin 2015)

Figure 2.0-1
Proposed and Alternative Project Site Screening Methodology



2.2 Candidate Area Evaluation Process

The six preliminary Candidate Areas (Figure 2.1-1) were then evaluated against avoidance criteria based on the following eight safety considerations provided in the U.S. Nuclear Regulatory Commission's (NRC) Draft Regulatory Guidance (DG)-4021, "General Site Suitability Criteria for Nuclear Power Stations."

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

As part of the preliminary Candidate Area evaluations, each area was rated on a scale of one to three, with three designating area-wide suitability for siting with no area-wide concerns regarding the safety considerations and one designating that there are significant issues associated with the safety considerations that will severely limit or potentially eliminate the ability to identify one or more Potential Sites in the Candidate Area. The numerical ratings are further defined in Table 2.2-1.

The results of the preliminary Candidate Area evaluations are presented in Section 3.0. The evaluation of the preliminary Candidate Areas against the avoidance criteria resulted in reducing the six preliminary Candidate Areas to four final Candidate Areas.

Table 2.2-1
Candidate Area Numerical Rating Definitions

Numerical Rating	Definition
3	There are no area-wide concerns regarding the safety considerations.
2	There are some concerns regarding the safety considerations at the Candidate Area that will limit the selection of Potential Sites.
1	There are significant issues associated with the safety considerations that will severely limit or potentially eliminate the ability to identify one or more Potential Sites in the Candidate Area.
0	The Candidate Area contains one or more significant safety considerations that cannot be overcome and the Candidate Area is eliminated from further consideration.

2.3 Process for Identification of Preliminary Potential Sites

After the final Candidate Areas were identified, TVA applied additional exclusionary and avoidance criteria in a two-step process to identify preliminary Potential Sites within those areas. NUREG-1555, "Environmental Standard Review Plan," defines "Potential Sites" as "those

sites within the Candidate Areas that have been identified for preliminary assessment in establishing Candidate Sites."

The first step was to identify preliminary Potential Sites within or adjacent to the final Candidate Areas based on exclusionary criteria such as the 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. To qualify as a Potential Site, a minimum of 120 contiguous acres (ac) is required, preferably in a square configuration. Up to 155 ac of additional laydown areas could be required during construction; however, since laydown areas could be accommodated on any suitable nearby parcel, parking lot, or other area, this component was not considered as a criterion in the development of preliminary Potential Sites. Access to a water source is essential; preference was given to sites immediately adjacent to a primary water source, but a site within 2 miles (mi) of a primary water source was considered. Easy access to transmission lines (on-site or within 2 mi) and availability of existing transportation infrastructure were also considered. This step led to the identification of 24 preliminary Potential Sites within the four Candidate Areas. Identification of the preliminary Potential Sites included discussions with the ORR and Redstone Arsenal personnel to identify the largest available potential sites on their respective installations.

The second step was an evaluation of the 24 preliminary Potential Sites based on site specific concerns related to safety considerations (NRC's DG-4021) and environmental resources (NUREG-1555, Section 9.3, Site Selection Process) to eliminate sites that were obviously less preferable and would be considered less likely to be licensable for nuclear power production. This step led to the elimination of 11 of the preliminary Potential Sites; therefore, 13 Potential Sites were identified for further evaluation.

The results of both preliminary Potential Site evaluation steps are discussed in Section 4.0. That section identifies the 24 preliminary Potential Sites and provides the justification for the elimination of 11 of these sites from further evaluation.

2.4 Process for Evaluation of Potential Sites

The 13 Potential Sites were then analyzed against suitability criteria based on the guidance provided in NUREG-1555, Section 9.3, Site Selection Process. The suitability criteria were derived from the following environmental resource concerns as provided in Table 9.3-1 of NUREG-1555.

- Land use
- Hydrology, water quality, and water availability
- Terrestrial resources (including endangered species)
- Aquatic biological resources (including endangered species)
- Socioeconomics (including aesthetics, demography, and infrastructure)
- Environmental justice
- Historic and cultural resources
- Air quality

- Human health
- Postulated accidents
- Fuel cycle impacts
- Transmission corridors
- Population distribution and density
- Facility costs
- Institutional constraints, as they affect site availability

The evaluation included rating each of the environmental resource concerns using a scale of one to five as defined in Table 2.4-1.

Table 2.4-1
Potential Site Numerical Rating Definitions

Resource Area	Numerical Rating				
	5	**4**	**3**	**2**	**1**
Land use	Potential site meets the following criteria: · Use of the site for energy production is compatible with designated land use. · Sufficient total area available for siting the project (120 contiguous ac and up to 155 ac for additional laydown areas). · Site configuration/ topography are suitable for construction. · No adjacent land use conflicts. No mitigation needed.	Potential site has one of the following concerns · Use of the site for energy production may have compatibility issues with designated land use. · Sufficient total area available for siting the project. Site configuration/ topography moderately suitable for construction. · Small adjacent land use conflicts. Concern could be easily mitigated.	Potential site has one of the following concerns · Use of the site for energy production marginally incompatible with designated land use. · Insufficient total area available for siting the project. Site configuration/ topography moderately suitable for construction. · Moderate adjacent land use conflicts. Concerns could be mitigated with small design changes.	Potential site has one or more of the following concerns: · Use of the site for energy production is incompatible with designated land use. · Insufficient total area for available for siting the project. Site configuration/ topography marginally suitable for construction. · Moderate to large adjacent land use conflicts. Concerns could be mitigated with moderate to large design changes.	Potential site has two or more of the following concerns: · Use of the site for energy production is incompatible with designated land use. · Insufficient total area available for siting the project. · Configuration/ topography not suitable for construction. · Large adjacent land use conflicts. Mitigation of concerns would be impractical or ineffective.

Resource Area	Numerical Rating				
	5	4	3	2	1
Hydrology, water quality, and water availability	Potential site meets the following criteria: · No flooding potential. Entire site is outside of the floodplain. · Access to primary water body less than 1 mi. · Adequate water supply (>1000 cfs) · Water quality suitable for intended use. No mitigation needed.	Potential site meets the following criteria with concerns: · Small potential for minor flooding of ancillary structures or access roadways. No flooding potential for reactor block. · Access to primary water body less than 2 mi. · Adequate water supply (>1000 cfs) · Water quality suitable for intended use. Concerns could be mitigated with small design changes or avoidance.	Potential site has one of the following concerns · Moderate potential for flooding of ancillary structures, access roadways; small potential for flooding of power block. · Access to primary water body greater than 2 mi. · Marginally adequate water supply (<1000 cfs) · Water quality marginally suitable for intended use. Avoidance not an option. Concerns could be mitigated with small design changes.	Potential site has one or more of the following concerns: · Moderate potential for flooding of ancillary structures, access roadways and power block. · Access to primary water body greater than 2 mi. · Marginally adequate water supply (<1000 cfs) · Water quality not suitable for intended use. Avoidance not an option. Concerns could be mitigated with moderate to large design changes	Potential site has one or more of the following concerns: · Large potential for flooding of ancillary structures, access roadways and power block. · Access to primary water body greater than 3 mi. · Marginally adequate water supply (<1000 cfs) · Water quality not suitable for intended use. Avoidance not an option. Concerns could be mitigated with moderate to large design changes

Resource Area	Numerical Rating				
	5	4	3	2	1
Terrestrial resources	· No listed species or suitable habitat on the site or in the vicinity. · No unique or sensitive natural areas or habitats are present. · No mitigation needed.	· Potentially suitable habitat for listed species present on site, but listed species not recorded on or nearby the site and unlikely to be present. · Small areas of unique or sensitive natural areas/habitats are present. · Concerns could be mitigated by avoidance.	· Suitable habitat for listed species present on site, and listed species occur in the vicinity. · Moderate areas of unique or sensitive natural areas/habitats are present but partially avoidable. · Concerns could be mitigated by small design changes, and/or permitting actions.	· Listed species are present on the site but are unlikely to be affected. · Moderate areas of unique or sensitive natural areas/habitats are unavoidable and would be affected. · Concerns could be mitigated as required by applicable regulations, with moderate to large commitment of resources.	· Listed species are present and would be affected. · Large areas of unique or sensitive natural areas/habitats are unavoidable and would be affected. · Mitigation of concerns would be impracticable or ineffective.

Resource Area	Numerical Rating				
	5	4	3	2	1
Aquatic resources	· No listed species or suitable habitat at the site or in the vicinity. · No unique or sensitive natural areas or habitats are present. · No mitigation needed.	· Potentially suitable habitat for listed species present on site, but listed species not recorded on site or in vicinity; unlikely to be present. · Small areas of unique or sensitive natural areas/habitats are present on portions of the potential site not likely to be developed. · Concerns could be mitigated by avoidance.	· Suitable habitat for listed species present at site, and listed species occur in the vicinity. · Unique or sensitive natural areas/habitats are present within the portion of the potential site to be developed; some could be avoided. · Concerns could be mitigated as required by applicable regulations by avoidance, small, design changes, or permitting actions.	· Listed species are present at or adjacent to the potential site but are unlikely to be affected. · Unique or sensitive natural areas/habitats are unavoidable resulting in small to moderate affects. · Concerns could be mitigated as required by applicable regulations, with moderate to large commitment of resources.	· Listed species are present and would be affected. · Unique or sensitive natural areas/habitats are unavoidable resulting in large affects. · Mitigation of concerns would be impracticable or ineffective.

Resource Area	Numerical Rating				
	5	4	3	2	1
Socioeconomics (including demography, infrastructure, and aesthetics)	· Construction workforce represents less than 5 percent of total workforce and less than 20 percent of construction workforce within region of interest (ROI). · Surrounding community services (i.e., utilities, schools, hospitals, police, fire protection, etc.) could easily accommodate increased population · Transportation systems (i.e., roadway, train, and barge) are sufficient to handle increased demands associated with construction · Impacts to aesthetics of the area would be minimal · No mitigation required.	· Construction workforce represents less than 5 percent of total workforce and less than 20 percent of construction workforce within ROI. · One element of community services, transportation, or aesthetics would have small affects. · Concerns are acceptable, but not preferred. Mitigation not required but could be proposed.	· Construction workforce represents more than 5 percent of total workforce or more than 20 percent of construction workforce within ROI. · Two elements of community services, transportation, or aesthetics would have small affects. · Concerns are acceptable, but not preferred. Mitigation efforts would be small.	· Construction workforce represents more than 5 percent of total workforce or more than 20 percent of construction workforce within ROI. · Two elements of community services, transportation systems, or aesthetics would have moderate affects · Concerns not acceptable and mitigation efforts would be moderate.	· Construction workforce represents more than 5 percent of total workforce or more than 20 percent of construction workforce within ROI. · Two or more elements of community services, transportation systems, or aesthetics would have large affects. · Mitigation of concerns would be impracticable or ineffective.
Environmental justice	· Not rated	· Not rated	· Not rated	· Not rated	· Not rated

Resource Area	Numerical Rating				
	5	4	3	2	1
Historic and cultural resources	· No effects on historic and cultural resources. · No mitigation required.	· Potential for small effects on historic or cultural resources. · Concerns could be mitigated through avoidance.	· Small effects on historic or cultural resources. · Concerns could be mitigated with small design changes.	· Moderate effects on historic or cultural resources. · Multiple and/or detailed mitigation measures would be required including assessment of affects and data recover.	· Large effects on historic or cultural resources. · Extensive mitigation would be required including assessment of affects and data recovery. Efforts could be cost prohibitive.
Air quality	· Site is located in an attainment area. · Site is not in close proximity to Class I Areas · No mitigation required.	· Site is located in a non-attainment area · Site is not in close proximity to a Class I Area · Concerns could be mitigated through permitting.	· Site is located in a non-attainment area. · Site is not in close proximity to Class I Areas. · Concerns could be mitigated with small design changes; additional monitoring and emission controls could be required.	· Site is located in a non-attainment area. · Site is in close proximity to a Class I Area. · Multiple and/or detailed mitigation measures would be required including moderate design changes, and addition of monitoring and emission controls.	· Site is located in a non-attainment area · Site is in close proximity to a Class I Area. · Extensive mitigation would be required and may be impractical or ineffective.

Resource Area	Numerical Rating				
	5	4	3	2	1
Human health	· Impacts from plant construction and operation (e.g., occupational injuries and noise, odor, vehicle exhaust, dust exposure) would be very small due to site location and topography. · No mitigation required.	· Impacts from plant construction and operation (e.g., occupational injuries and noise, odor, vehicle exhaust, dust exposure) would be small due to site location and topography. · Concerns could be addressed with small design or operational changes, compliance with applicable regulations and use of BMPs.	· Impacts from plant construction and operation (e.g., occupational injuries and noise, odor, vehicle exhaust, dust exposure) would be moderate due to site location and topography. · Concerns could be addressed with moderate design or operational changes, compliance with applicable regulations and use of BMPs.	· Impacts from plant construction and operation (e.g., occupational injuries and noise, odor, vehicle exhaust, dust exposure) would be moderate due to site location and topography. · Most concerns could be addressed with moderate to large design or operational changes, compliance with applicable regulations and use of BMPs.	· Impacts from plant construction and operation (e.g., occupational injuries and noise, odor, vehicle exhaust, dust exposure) would be large due to site location and topography. · Extensive design or operational changes would be required to comply with applicable regulations. Efforts could be cost prohibitive.

Resource Area	Numerical Rating				
	5	4	3	2	1
Postulated accidents	· The site has no extreme climatological history that would indicate the potential for a larger impact following a postulated accident. · The site meets the three criteria specified in Section 3.5.1.6 of NUREG-0800 associated with proximity to airports. · 1-3% g peak horizontal acceleration rate. (See Fig. 3.2-1).	· The site could have limited extreme climatological history that would indicate the potential for a larger impact following a postulated accident. · The site does not meet the three criteria specified in Section 3.5.1.6 of NUREG-0800 associated with proximity to airports. · Less than 4-5% g peak horizontal acceleration rate. (See Fig. 3.2-1).	· The site could have some extreme climatological history that would indicate the potential for a larger impact following a postulated accident. · The site does not meet the three criteria specified in Section 3.5.1.6 of NUREG-0800 associated with proximity to airports · Less than 6-7% g peak horizontal acceleration rate. (See Fig. 3.2-1).	· The site has some extreme climatological history that would indicate the potential for a larger impact following a postulated accident. · The site does not meet the three criteria specified in Section 3.5.1.6 of NUREG-0800 associated with proximity to airports · Less than 8-9% g peak horizontal acceleration rate. (See Fig. 3.2-1).	· The site has a significant history of extreme climatological events that would indicate the potential for a larger impact following a postulated accident. · The site does not meet the three criteria specified in Section 3.5.1.6 of NUREG-0800 associated with proximity to airports · Greater than 9% g peak horizontal acceleration rate. (See Fig. 3.2-1).
Fuel cycle impacts	· Potential site has easy access to the interstate highway system for truck transport of unirradiated and irradiated fuel. · Transportation routes are much shorter than other site alternatives.	· Potential site has easy access to the interstate highway system for truck transport of unirradiated and irradiated fuel. · Transportation route distances are similar to other site alternatives.	· Potential site has moderate access to the interstate highway system for truck transport of unirradiated and irradiated fuel. · Transportation route distances are similar to other site alternatives.	· Potential site has moderate to difficult access to the interstate highway system for truck transport of unirradiated and irradiated fuel. · Transportation route distances are moderately longer than for other potential site alternatives.	· Potential site has difficult access to the interstate highway system for truck transport of unirradiated and irradiated fuel. · Transportation routes are much longer than other site alternatives.

Resource Area	Numerical Rating				
	5	4	3	2	1
Transmission corridors	· Access to transmission lines within the site boundary.	· Access to transmission lines within 5 mi of the site.	· Access to transmission lines within 5-10 mi of the site.	· Access to transmission lines within 10 - 20 mi of the site.	· Access to transmission lines greater than 20 mi from the site.
Population distribution and density	· No city with 150,000 or more persons within a 20-mi radius. · Mean density of 250 or fewer people per square mi within a 20-mi radius.	· No city with 200,000 or more persons within a 20-mi radius. · Mean density of 300 or fewer people per square mi within a 20-mi radius.	· No city with 200,000 or more persons within a 20-mi radius. · Mean density of 350 or fewer people per square mi within a 20-mi radius.	· One or more cities with 200,000 or more persons within a 20-mi radius. · Mean density of 400 or fewer people per square mi within a 20-mi radius.	· One or more cities with 200,000 or more persons within a 20-mi radius. · Mean density of greater than 500 people per square mi within a 20-mi radius.
Facility costs	· Potential Site has substantial existing infrastructure (e.g., roads, barge landing, water, sewer). · Amount of grading required for site use would be small. Topography is suitable for reactor block excavation. · Property and site access owned/managed by applicant. No additional cost.	· Potential Site has some existing infrastructure (e.g., roads, barge landing, water, sewer). · Amount of grading required for site use would be small. Topography moderately suitable for reactor block excavation. · Property would require transfer from another federal agency resulting in small additional cost.	· Potential Site has some existing infrastructure (e.g., roads, barge landing, water, sewer) or easy offsite access to utilities. · Amount of grading required for site use would be moderate. Topography moderately suitable for reactor block excavation. · Property and/or site access would require transfer from another federal agency and resulting in moderate additional cost.	· Potential site has limited existing infrastructure (only one type) and difficult access to offsite utilities. · Amount of grading required for site use would be moderate. Topography moderately unsuitable for reactor block excavation. · Property and/or site access would require transfer from another federal agency and/or private owner resulting in moderate additional cost.	· Potential site has no existing infrastructure and difficult access to offsite utilities. · Amount of grading required for site use would be large. Topography unsuitable for reactor block excavation. · Property and site access would require transfer from another federal agency and/or private owner resulting in large additional cost.

Resource Area	Numerical Rating				
	5	4	3	2	1
Institutional constraints, as they affect site availability	· SMR project is fully compatible with the proposed federal installation's mission. · SMR project is fully compatible with the proposed federal installations long-term plan.	· SMR project is substantially compatible with the proposed federal installation's mission. Some reviews and approvals could be required. · SMR project is substantially compatible with the proposed federal installation's long-term plan. Small revisions could be required.	· SMR project is incompatible with the portions of the proposed federal installation's mission. Reviews, approvals, and moderate realignment would be required. · SMR project is incompatible with portions of the proposed federal installation's long-term plan. Moderate revisions would be required.	· SMR project is incompatible with the portions of the proposed federal installation's mission. Reviews, approvals, and moderate realignment would be required. · SMR project is incompatible with the proposed federal installation's long-term plan. Large revisions would be required.	· SMR project is incompatible with the proposed federal installation's mission. Realignment would be unlikely. · SMR project is incompatible with the proposed federal installation's long-term plan. Large revisions would be required

The Potential Site assessment, discussed in Section 5.0, resulted in the identification of five Candidate Sites. These five Candidate Sites are retained as alternatives to be carried forward for analysis in the Environmental Report (ER).

Following the Potential Site evaluation and resulting identification of five Candidate Sites to be carried forward for detailed analysis, key members of the technical team associated with preparation of the ER participated in a survey to develop weighting factors associated with resource areas considered in this Siting Study (Appendix A). Application of the final weighting factors to the resource area ratings did not change the five Candidate Sites identified to be carried forward for detailed analysis in the Early Site Permit Application (ESPA) ER.

2.5 Least Environmentally Damaging Practicable Alternative

The land use and water use associated with the project may require TVA to acquire a Clean Water Act Section 404 permit. Should this occur, the U.S. Army Corps of Engineers (USACE), as the permitting agency, would be required to make a determination that the preferred alternative is the Least Environmentally Damaging Practicable Alternative (LEDPA). Section 404(b)(1) guidelines describe how the issues of practicability, impacts to the aquatic environment (wetlands and jurisdictional waters of the United States), and other environmental impacts are considered by the USACE in making this determination. This Siting Study includes evaluations of these issues which will be considered by the USACE for the LEPDA determination.

The issue of whether alternative sites are practicable was considered in several stages of this Siting Study. Practicability assessment includes consideration of the ability of a site to meet the project objectives, whether it is feasible, whether its cost is reasonable, and whether the property is available to the project applicant. In this Siting Study, the identification of the six preliminary Candidate Areas discussed in Section 2.1 was based entirely on the identification of areas within the ROI which were capable of accomplishing the project objectives. The more detailed evaluation of the preliminary Candidate Areas in Section 3.0 then considered exclusionary criteria based on safety considerations provided in the NRC's DG-4021, "General Site Suitability Criteria for Nuclear Power Stations." Based on these exclusionary criteria, two of the preliminary Candidate Areas were determined to not be practicable, resulting in four Candidate Areas which were practicable.

Once the four Candidate Areas were defined, individual sites were identified on the four Candidate Areas based on additional practicability and environmental impact factors. The first phase of this, described in Section 4.0, was the use of NEPAssist and Google maps to identify sites which met a variety of constraints based both on practicability and avoidance of environmental impacts. This exercise included identification of sites which met the 120 ac minimum land use requirement, had favorable topography, and were in close proximity to a water source, transmission lines, and transportation infrastructure. Only individual sites which met these constraints were determined to be practicable.

In addition to identifying alternative sites which are practicable, the objective of LEDPA is to identify alternative sites which avoid impacts to the aquatic ecosystem. To do this, the USACE

will first be required to make a determination of whether the project is water dependent, which requires the project to be located in the water, thus making avoidance of aquatic impacts more difficult than for projects which are not water dependent. As a thermal electric power plant located in the southeast region of the United States, this plant will be designed to be water cooled, but it is not water dependent. As a result, proximity to water sources was one of the factors used in Section 4.0 to identify sites which were practicable.

In addition to practicability, the identification of Potential Sites on the Candidate Areas also included avoidance of wetland, floodplain, and aquatic ecology impacts. The desktop exercise included review of the presence of wetlands on National Wetland Inventory maps, impaired streams, and water bodies to select alternative sites which avoided or minimized impacts to these resources. A review of FEMA floodplain maps performed on the 24 preliminary Potential Sites resulted in elimination of six sites based on floodplain impacts, and elimination of five sites based on other impacts. The result of the preliminary Potential Sites identification process (described in Section 2.3) was identification of 13 Potential Sites which were determined to be practicable and to have avoided or minimized impacts to aquatic resources.

In Section 5.0 of this Siting Study, more detailed review of site data from state publications or existing environmental reports (such as previous Environmental Impact Statements [EISs]) was used to identify and, where possible, quantify impacts to wetlands and aquatic resources among the 13 Potential Sites. Separate ratings and weighting factors were developed for aquatic biological resources, land use and terrestrial ecology (both of which included presence of wetlands), and hydrology (which included presence of floodplains).

Tables 7.0-1 and 7.0-2 present the results of this final analysis, including quantitative scores for the individual factors associated with aquatic resources and total scores combined for all resources, including those associated with aquatic resources. These results identified five Candidate Sites which TVA proposes to carry forward for more detailed analysis of aquatic resources and other environmental impacts.

This Siting Study does not select a preferred alternative or proposed site for which the USACE needs to make a LEDPA determination. Those determinations will be based on additional analysis of the Candidate Sites in the ESPA ER. However, this Siting Study does narrow the field of Candidate Areas and Potential Sites based on LEDPA practicability criteria and assessment of environmental impacts. A review of those Candidate Areas and Potential Sites eliminated by this process demonstrates that no Candidate Areas or Potential Sites which would obviously be more suitable for a LEDPA determination have been eliminated, and that the Candidate Sites are capable of receiving an affirmative LEDPA determination.

3.0 CANDIDATE AREA EVALUATIONS

3.1 General Description of the Candidate Areas

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 (I-40; Figure 3.1-1). The ORR is located in the Tennessee Ridge and Valley geographic province and consists of generally hilly terrain (Figure 3.1-2). The majority of the site consists of forested and other undeveloped areas (Figure 3.1-3). 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(295 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) (Figure 3.1-3). 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.

Redstone Arsenal, Alabama

The 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 (Figure 3.1-4). 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 (Figure 3.1-5). Less than approximately 13 percent of the installation is undeveloped land and the majority of that area is forested (Figure 3.1-6).

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. (158 U.S. Army 2013) Additionally, the National Aeronautics and Space Administration's (NASA) Marshall Space Flight Center occupies approximately 1800 ac within the Redstone Arsenal reservation.

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 (Figure 3.1-7). Hopkinsville, Kentucky to the north and Clarksville, Tennessee to the east are the closest major towns to Fort Campbell. Figure 3.1-8 shows the topography at Fort Campbell. Elevations range from approximately 400 ft to over 700 ft msl (919 United States Geological Survey 2014). A comparatively flat area is present along the eastern boundary and approximately 5000 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 (Figure 3.1-9). The undeveloped land includes areas used as ranges, impact areas, and maneuver areas dedicated to training. (181 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. (181 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" (181 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". (181 EDAW/AECOM and Monrad Engineering 2009)

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 (Figure 3.1-10). 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 (Figure 3.1-11) and elevations generally range from 1000 ft to 1100 ft msl. Approximately 88 percent of land on Arnold AFB is undeveloped (Figure 3.1-12). 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 (551 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 3600 ac roughly in the center of Arnold AFB. These 43 facilities can simulate flight conditions from sea level to 300 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. (156 U.S. Air Force 2012) The University of Tennessee Space Institute is adjacent to Arnold AFB.

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 (Figure 3.1-13). The installation is relatively flat with elevations ranging from 260 to 300 ft msl (Figure 3.1-14). The site consists of mostly developed land such as parking lots, buildings, and landscaped open spaces (Figure 3.1-15). 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 7500 military, civilian, and contract personnel. (548 Commander, Navy Installations Command 2013)

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 (Figure 3.1-16). The topography is relatively flat, with an elevation of approximately 220 ft msl (Figure 3.1-17). The installation occupies 4931 ac, of which 4408 ac are federally owned. Approximately 16 percent of the site is undeveloped, including 190 ac of wetlands (560 Columbus Air Force Base 1993) (Figure 3.1-18).

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 (547 Columbus Air Force Base 2013).

3.2 Comparison of Safety Criteria for Candidate Areas

3.2.1 Geology/Seismology

Seismic hazards represent the most significant geologic concern associated with Potential Sites for nuclear projects. Though nuclear facilities are designed to withstand certain seismic hazards, at present, predictions of earthquake timing and severity are subject to much uncertainty. Therefore, an evaluation of the proximity of seismological hazards is an essential part of the process of evaluating Potential Sites for the location of new nuclear projects. The objective of this criterion is to avoid proximity to seismological hazards. Sites with the least seismic risk are rated the highest. Seismic activity can cause surface faulting, ground motion, ground deformation, and conditions including liquefaction, subsidence, and landslides.

The Modified Mercalli Scale is used within the United States to measure the intensity of an earthquake. The scale arbitrarily quantifies the effects of an earthquake based on the observed effects on people and the natural and built environment. Mercalli intensities are measured on a scale of I through XII, with I denoting the weakest intensity and XII denoting the strongest intensity. The lower degrees of the scale generally deal with the manner in which the earthquake is felt by people. The higher numbers of the scale are based on observed structural damage. This value is translated into a peak ground acceleration (PGA) value to measure the maximum force experienced. The PGA is the maximum acceleration experienced by a building or object at ground level during an earthquake on uniform, firm-rock site conditions. The PGA is measured in terms of percent of “g,” the acceleration due to gravity.

In accordance with the NRC’s “Reactor Site Criteria” (10 CFR 100) and “Domestic Licensing of Production and Utilization Facilities” (10 CFR 50), 10 percent g or less ground motion is consistent with safe nuclear plant shutdown and is therefore considered to be the conservative limit for the proposed Candidate Areas. The U.S. Geological Survey (USGS) Earthquake Hazards Program publishes seismic hazard map data layers that display the PGA with 10 percent (1-in 500-year event) probability of exceedance in 50 years. The locations of the

Candidate Areas with respect to the 10 percent probability of exceedance in 50 years hazard map is provided in Figure 3.2-1.

ORR is located within the southern part of the Valley and Ridge geologic province. Several earthquakes have occurred in the Valley and Ridge province in and around eastern Tennessee. The largest earthquakes in eastern Tennessee in the vicinity of the ORR range from Mercalli intensity V to VII. The PGA for the ORR ranges from 6 to 7 percent g (Figure 3.2-1).

The Redstone Arsenal lies within the southern part of the Appalachian Highlands geologic province. The largest recorded earthquake in the region occurred in 1916 in Irondale, Alabama, south of Huntsville and north of Birmingham. The Redstone Arsenal is located in a region that experienced a Mercalli intensity of IV during this quake. (533 U.S. Geological Survey 2012) The PGA for the Redstone Arsenal ranges from 4 to 5 percent g (Figure 3.2-1).

Fort Campbell is located within the Interior Plain geologic province. The Reelfoot rift of the New Madrid seismic zone, centered near the Tennessee/Missouri border west of Fort Campbell, presents the largest potential for earthquakes in the vicinity. The largest recorded earthquakes in the region occurred along the Reelfoot rift in 1811 and 1812. Fort Campbell is located in a region that may have experienced as much as a Mercalli intensity of VII during these quakes. (534 Lubick 2004) The majority of the potentially available land on the Fort Campbell installation, including the land adjacent to the only significant water body at the installation, is located in a zone with a PGA of approximately 10 percent g, which is the conservative limit for safe nuclear plant shutdown. Therefore, at a minimum, the portions of Fort Campbell within this zone are unacceptable for site selection. The remaining portions of Fort Campbell are within a zone with a PGA of 8 to 10 percent g and therefore would be less desirable for Potential Sites than those in other Candidate Areas located in lower seismic probability zones.

Arnold AFB is located on the boundary between the Appalachian Highlands and Interior Plains provinces. Several earthquakes have occurred in the southern part of the Appalachian Highlands province in and around eastern Tennessee. The largest earthquakes in central Tennessee in the vicinity of Arnold AFB range from Mercalli intensity V through VII. The PGA for Arnold AFB ranges from 4 to 5 percent g (Figure 3.2-1).

NSA Mid-South is located in the Mississippi Embayment portion of the Atlantic Plain province. The Reelfoot rift of the New Madrid seismic zone located north and west of NSA Mid-South along the Tennessee state line, presents the largest potential for earthquakes in the vicinity. The largest recorded earthquakes in the region occurred along the Reelfoot rift in 1811 and 1812. NSA Mid-South is located in a region that may have experienced as much as a Mercalli intensity of VIII to X during these quakes. (534 Lubick 2004) As shown on Figure 3.2-1, NSA Mid-South is located in an area with a PGA of 15 to 20 percent g, well above the conservative limit for safe nuclear plant shutdown. Therefore, NSA Mid-South is less than preferable for site selection due to safety considerations.

Columbus AFB is located in the Atlantic Plain province. The potential ground motion for Columbus AFB ranges from 0.08 to 0.12 g PGA (535 U.S. Geological Survey 2012). The

Atlantic Plain province is relatively quiescent. The eastern side of Mississippi where Columbus AFB is located is close to the southern end of the Appalachian Highlands province which is more seismically active. The largest earthquakes in in the vicinity of the Columbus AFB range from Mercalli intensity VI through VII. The PGA for Columbus AFB ranges from 4 to 5 percent g (Figure 3.2-1).

Assessment of the conditions at Fort Campbell and NSA Mid-South revealed safety concerns associated with proximity to the seismological hazards at these Candidate Areas. No limiting conditions beyond normal nuclear plant design considerations for earthquake hazard protection were identified for the other four Candidate Areas.

3.2.2 Atmospheric Dispersion

Nuclear power plants are typically designed to withstand the impacts of natural atmospheric extremes (e.g., tornadoes, exceptional icing conditions, etc.). However, the atmospheric characteristics at a site are an important consideration in evaluating the dispersion of radioactive effluents from both postulated accidents and routine releases in gaseous effluents. For atmospheric dispersion, meteorological conditions at a site are monitored and evaluated as part of determining suitability for siting of nuclear plants. The observation of temperature and wind conditions over time provides input into statistical models. The models can be used to help predict probable atmospheric dispersion of releases. Topographic conditions also influence extreme weather and temperature variations. Sites with better meteorological conditions are rated higher (e.g., limiting conditions affecting the transport and dispersion of plant emission would have a lower rating). Assessment of the meteorological conditions at the six Candidate Areas did not indicate any limiting conditions. However, the ridge and valley topography at ORR and two large topographic features in the northwestern part of the Redstone Arsenal could make siting at some locations within those Candidate Areas difficult.

3.2.3 Exclusion Area and Low-Population Zone

A reactor licensee is required by 10 CFR 100.21(a) to designate an exclusion area and to have authority to manage and control all activities within that exclusion area. The size of the exclusion area is based on regulatory dose limits to the receptor at the boundary of the exclusion area in a postulated accident. A radius of 1 mi is assumed to be an acceptable distance from the center of the plant area to define the exclusion area for the purpose of this Siting Study. As stated in DG-4021:

> *Transportation corridors such as highways, railroads, and waterways are permitted to traverse the exclusion area provided (1) these are not so close to the facility as to interfere with normal operation of the facility and (2) in case of emergency, appropriate and effective arrangements are made to control traffic on the highway, railroad, or waterway in order to protect public health and safety.*

Assuming a 1-mi radius for a circular exclusion area, the size of the area would be 3.1 square mi or approximately 2011 ac. Based on the size of the NSA Mid-South (2.3 square mi) and the available federal land at Columbus AFB (1.1 square mi), there is not enough available existing

federal land within either installation for an exclusion area that TVA could adequately control. However, there may be land adjacent to Columbus AFB that could be included in an exclusion area. Siting opportunities on land adjacent to NSA Mid-South would be very limited. Each of the other Candidate Areas has sufficient federally-owned property to establish a TVA-controlled exclusion area.

The perimeter of the low-population zone (LPZ) is defined as the distance from the plant where the radiological dose following a postulated accident does not exceed regulatory requirements. The LPZ is determined as a part of the Safety Analysis Report. The perimeter of the LPZ must be no closer to the boundary of a densely populated center (population of more than 25,000) than 1.33 times the distance from the center of the reactor plant to the perimeter of the LPZ. Assuming a 2-mi LPZ, the distance to the densely populated center must be more than 4.66 mi from the center of the reactor plant.

The census data provided in the following section indicate the following regarding potential limitations on Potential Site selection based on LPZ concerns:

- ORR: Siting would be limited on the northeastern side of the installation due to its proximity to the Oak Ridge population centers.
- Redstone Arsenal: Siting would be limited on the northern side of the installation due to its proximity to the City of Madison.
- Fort Campbell: Siting would be limited on the eastern side of the installation due to its proximity to Clarksville.
- Arnold AFB: Likely no limits on siting due to LPZ concerns. The nearest population center has fewer than 25,000 residents.
- NSA Mid-South: Likely no limits on siting due to LPZ concerns.
- Columbus AFB: Likely no limits on siting due to LPZ concerns.

As a result, it is reasonable to assume that should a Potential Site be identified on or adjacent to any of the six Candidate Areas, a suitable area could also be obtained to incorporate the exclusion area and LPZ.

3.2.4 Population

10 CFR 100.21(h) states that reactors should be located away from very densely populated centers and that areas of low population density are generally preferred. This criterion gives preference to a local site population density that is low (i.e., mean density less than 500 people per square mi out to a 20-mi radius). Each of the Candidate Areas was evaluated based on distances to nearby population centers and population totals within a 20-mi site radius.

ORR is located 25 mi west of Knoxville, Tennessee, which is the closest metropolitan area. The Knoxville, Tennessee 2010 city population is 178,874 (168 U.S. Census Bureau 2013). ORR is located within the city limits of Oak Ridge, Tennessee, which has a population of 29,330 (169 U.S. Census Bureau 2013). A total of approximately 837,471 people reside within a Census Bureau 20-mi radius of ORR (3470.8 square mi), with a population density of 241 people per square mi (525 U.S. Census Bureau 2013).

Redstone Arsenal is located immediately west of the city of Huntsville, Alabama, which has a 2010 population of 180,105 (155 U.S. Census Bureau 2013). The next closest community is the city of Madison, Alabama, approximately 1 mi to the northwest, with a population of 42,938 (225 U.S. Census Bureau 2013). The population within a Census Bureau 20-mi radius of Redstone Arsenal (3393.6 square mi) is approximately 642,726, with a population density of 189 people per square mi (526 U.S. Census Bureau 2013).

Fort Campbell, which straddles the Tennessee-Kentucky border, is located between Hopkinsville, Kentucky and Clarksville, Tennessee. The regional urban center of Clarksville, Tennessee, located immediately east of the installation, has a 2010 population of 132,929 (153 U.S. Census Bureau 2013). The community of Hopkinsville, Kentucky, located approximately 10 mi to the north, has a population of 31,577 (152 U.S. Census Bureau 2013). The population within a Census Bureau 20-mi radius of Fort Campbell (3977.8 square mi) is approximately 391,149; with a population density of 98 people per square mi (527 U.S. Census Bureau 2013).

Arnold AFB is located immediately east of the city of Tullahoma, Tennessee, which has a 2010 population of 18,655 (151 U.S. Census Bureau 2013). The next closest community is Shelbyville, Tennessee, approximately 15 mi northwest of the installation with a population of 20,335 (216 U.S. Census Bureau 2013). The population within a Census Bureau 20-mi radius of Arnold AFB (3489.4 square mi) is approximately 257,233, with a population density of 74 people per square mi (528 U.S. Census Bureau 2013).

NSA Mid-South is located in Millington, Tennessee, which has a 2010 population of 10,442 (519 U.S. Census Bureau 2013). Memphis, Tennessee, is located 20 mi south of the installation; with a population of 646,889, it is the closest metropolitan area (517 U.S. Census Bureau 2013). The population within a Census Bureau 20-mi radius of NSA Mid-South (2318.1 square mi) is 1,084,232, with a population density of 468 people per square mi (529 U.S. Census Bureau 2013). The population density could exceed 500 people per square mi during the construction period of the SMRs, making NSA Mid-South a less than preferable Candidate Area due to safety considerations.

Columbus AFB is located approximately 90 mi west of Birmingham, Alabama, which is the closest metropolitan area. The 2010 population of Birmingham, Alabama, is 212,288 (520 U.S. Census Bureau 2013). The city nearest Columbus AFB is Columbus, Mississippi, located approximately 5 mi south of the installation, which has a population of 23,640 (521 U.S. Census Bureau 2013). The population within a Census Bureau 20-mi radius of Columbus AFB (2962.6 square mi) is approximately 185,383, with a population density of 63 people per square mi (530 U.S. Census Bureau 2013).

Assessment of the population levels within a Census Bureau 20-mi radius of each installation did not indicate any limiting conditions that would prohibit the siting of the SMRs. However, populations within a 20-mi radius of NSA Mid-South make NSA Mid-South a less than preferable Candidate Area.

3.2.5 Emergency Planning

10 CFR 50.47(a)(1) requires that the applicant provide adequate protective measures in the event of a radiological emergency. Emergency planning activities must include the development of adequate plans for the plume exposure pathway emergency planning zone (EPZ) and ingestion pathway EPZ. Per 10 CFR 50.47, the plume exposure pathway EPZ for nuclear power plants generally consists of an area approximately 10 mi in radius and the ingestion pathway EPZ generally consists of an area approximately 50 mi in radius. Assessment of the demography, topography, land characteristics, access routes, and jurisdictional boundaries associated with the six Candidate Areas did not indicate any limiting conditions that would prohibit the development and implementation of appropriate emergency planning activities.

SMR designers believe that the EPZ for an SMR can be reduced to a 2-mi radius for the plume exposure and ingestion pathway. However, dose modeling for the smaller EPZ has not been conducted and such modeling must demonstrate compliance with applicable dose limits under accident scenarios.

3.2.6 Security Plans

The site characteristics of a licensable Candidate Area for nuclear power development must be suitable for the development of adequate security plans and measures. Assessment of the characteristics and hazards of natural, existing, or proposed man-made features located in the proximity with the six Candidate Areas did not indicate any limiting conditions that would prohibit the development and implementation of appropriate security plans. Additionally, since all of the Candidate Areas are federal installations, each Candidate Area has an existing security plan.

3.2.7 Hydrology

Flooding

The Federal Emergency Management Agency (FEMA) develops Flood Insurance Rate Maps (FIRMs) to determine which areas are Special Flood Hazard Areas subject to inundation by the 1 percent annual chance flood. FEMA defines the 1 percent annual chance flood (100-year flood), also known as the base flood, as the flood which has a 1 percent chance of being equaled or exceeded in any given year.

Assessment of the hydrological conditions based on the FEMA FIRMs at the Candidate Areas did not indicate any limiting conditions which would prohibit the selection of at least one Potential Site within each of the six Candidate Areas. However, based on site specific hydrology, some locations within the Candidate Areas may be unsuitable as a Potential Site based on flooding potential.

Water Availability

Nuclear power plants require that there be sufficient water available for cooling during plant operation and normal shutdown, for the ultimate heat sink, and for fire protection. Although this project involves the demonstration of two or more SMRs, which would require less water usage than a large nuclear plant, a dependable system of water supply is still required for system

operations. Preliminary data indicate that the bounding parameters for operation two or more SMRs would have a water demand of approximately 16,000 gpm.

The ORR is bounded to the west-southwest by the Clinch River arm of the Watts Bar Reservoir (Figure 3.1-2). There is sufficient water at this location to support the operation of the SMRs. Several watersheds are found on the ORR with surface water draining into the Watts Bar Reservoir. 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. (186 Oak Ridge National Laboratory, Y-12 National Security Complex, and URS/CH2M Oak Ridge LLC 2012) Daily mean flow from Melton Hill Dam passing the Potential Site on the Clinch River arm of the Watts Bar Reservoir was measured from October 2010 through October 2011. Recorded data showed a wide variation ranging from less than 1,000 cubic feet per second (cfs) to greater than 20,000 cfs due to releases from Melton Hill Dam, which is located upstream of the Potential Site. Releases from Melton Hill Dam typically range from no discharge to the maximum turbine capacity of about 20,000 cfs. Intervals of 12 to 22 hours with no releases are common. (77 Tennessee Valley Authority 2013)

The southern boundary of Redstone Arsenal is defined by the Wheeler Reservoir, an impoundment of the Tennessee River operated by TVA with sufficient water to support the operation of the SMRs (Figure 3.1-5) (166 Zondlo and Smith). The Tennessee River (Wheeler Reservoir) at Whitesburg, Alabama had an average monthly flow of approximately 42,230 cfs from 1924 to 1960 (328 U.S. Department of the Interior 1964). The groundwater enters the Redstone Arsenal property along the northern boundary and flows south toward the Tennessee River (Wheeler Reservoir). Depth to groundwater varies widely from a few feet to greater depths at the high elevations. (241 Shaw Environmental, Inc. 2007) Indian Creek, Huntsville Spring Branch, and McDonald Creek, all of which empty into the Tennessee River (Wheeler Reservoir), are the major systems flowing through the property (133 Shaw Environmental, Inc. 2004). The two intakes along the Tennessee River (Wheeler Reservoir) are used for domestic and industrial water systems by Redstone Arsenal (270 Agency for Toxic Substances & Disease Registry 2005).

All watersheds on Fort Campbell drain into the Barkley Reservoir, an impoundment of the Cumberland River; however, this water source is a considerable distance from the installation (Figure 3.1-8) and is not a viable water source for system operations. The Barkley Reservoir extends from west of Fort Campbell to just west of Nashville, Tennessee. This water source is located approximately 6 to 9 mi from Fort Campbell. The Cumberland River (Barkley Reservoir) at Clarksville, Tennessee had a flow rate ranging from 47,100 cfs to 58,000 cfs from June 9 to June 12, 2013 (407 National Oceanic and Atmospheric Administration 2013).

A number of water bodies exist on and around the Arnold AFB. A surface water divide is present from the northeast portion of the Base to the southwestern edge. Water to the north and west of the divide flows into Normandy Lake (Normandy Reservoir) while water on the south and east flows into Woods Reservoir and Tims Ford Reservoir, both impoundments of the Elk River (195

Agency for Toxic Substances & Disease Registry 2010). Tims Ford Reservoir is located south-southwest of Arnold AFB. Surface water bodies on or in the vicinity of the Arnold AFB which could provide suitable water resources to support the operation of the plants include the Normandy Reservoir, an impoundment of the Duck River; Woods Reservoir and Tims Ford Reservoir, both of which are impoundments of the Elk River; Rowland Creek; and Spring Creek (Figure 3.1-11). The designated uses for upper Rowland Creek, Woods Reservoir, Spring Creek and its tributaries, and Tims Ford Reservoir are fish and aquatic life, recreation, irrigation, livestock watering, and wildlife. (1179 Tennessee Government 2013) The Elk River (Tims Ford Reservoir) and the Rowland Creek embayment are also used for domestic industrial water supplies (195 Agency for Toxic Substances & Disease Registry 2010). Although not as preferable to support the operation of the plants due to its proximity to Arnold AFB as compared to the previously mentioned water bodies, Normandy Reservoir is located to the northwest of Arnold AFB and has a flood-storage capacity of 48,000 acre-feet (956 Tennessee Valley Authority 2014).

The NSA Mid-South property has no major water bodies within its boundary (Figure 3.1-14). NSA Mid-South water is supplied from the Memphis Sands and Fort Pillow Aquifers, which are located approximately 500 and 1,400 feet deep, respectively (910 NSA Mid-South 2013). Two small unnamed ponds exist on the eastern and southern edge of the property and Tanya Lake overlaps the northeastern edge of the property. Further investigation would be required to determine if these water bodies could support the project's water demand requirements. The NSA Mid-South property is bounded on the south by Big Creek. Casper Creek is located to the east of and North Fork Creek is located to the west of the property. None of these creeks are of sufficient size to provide water for the project. The site is approximately 11.5 mi east of the Mississippi River; however, this distance is too far from the Mississippi River to be considered a viable water source for system operations.

Columbus AFB is located approximately 1 mi east of the Tennessee-Tombigbee Waterway and 5.5 mi northeast of Columbus Lake, an impoundment of the Tennessee-Tombigbee Waterway (Figure 3.1-17). The Buttahatchee River is adjacent to the north side of the property. These water sources should be suitable to support the operation of the SMRs. There are no major surface water bodies present on the Columbus AFB property. Two minor streams exist on the southwest portion of the property. Water is supplied to Columbus AFB by eight wells drawing from the lower Tuscaloosa Aquifer (539 Columbus Light & Water 2012). The water level depth is approximately 105 feet below land surface in the area of the Columbus AFB (538 Shows 1970). Columbus Light & Water Company treats and distributes the water from the aquifer to Columbus AFB (537 Columbus Light & Water 2013). According to Columbus Light & Water's 2012 Water Quality Data Table & Test Results, the drinking water system either met or exceeded all federal and state requirements and reported zero violations from January 1 to December 31, 2011 (539 Columbus Light & Water 2012).

Water Quality

NRC issuance of an early site permit is dependent on the applicant providing certification or waiver from the State that discharges from the SMRs will comply with applicable effluent

limitations and other water pollution control requirements. Assessment of the water quality of the water bodies on the ORR, Redstone Arsenal, Fort Campbell, NSA Mid-South, and Columbus AFB did not indicate any limiting conditions which would prohibit obtaining the appropriate permits. An 11.9-mi section of Rowland Creek and Woods Reservoir, located on Arnold AFB property, was reported as impaired and not supporting designated uses due to thermal modifications and flow alterations from Arnold AFB (135 Tennessee Valley Authority 2001). Although not prohibitive, this issue would have to be addressed in site selection and in site specific design parameters for Potential Sites on Arnold AFB. The water quality of the Clinch River arm of the Watts Bar Reservoir is “good” for all designated groups other than recreation which has an “impaired” status (563 U.S. Environmental Protection Agency 2013).

3.2.8 Industrial, Military, and Transportation Facilities

Accidents associated with nearby industrial, military, and/or transportation facilities may affect the safety of a nuclear power station. With the exception of Redstone Arsenal and Fort Campbell, an assessment of the industrial, military, and/or transportation facilities surrounding the Candidate Areas did not indicate any limiting conditions that would prohibit the siting of the SMRs.

The primary mission of Redstone Arsenal is explosives training and research. The installation includes 25,860 ac of land dedicated to testing areas and 7200 ft of airfield runway.

As described in the Fort Campbell Joint Land Use Study, the majority of the undeveloped areas on Fort Campbell (more than 67,000 ac) are designated for use during training activities by ground and airborne forces. To support the training mission of Fort Campbell, the U.S. Army has designated military operations areas and Restricted Areas around and on the installation for the safety of the ground and airborne forces and the general public. As a further safety measure, the Federal Aviation Administration has established protected airspaces around the airborne training areas. Additionally, in partnership with the local communities and governments from the areas adjacent to Fort Campbell, a broad Area of Concern was established which identifies areas that “may be periodically subject to noise or other military related impacts.” (181 EDAW/AECOM and Monrad Engineering 2009)

Based on the military missions at Redstone Arsenal and Fort Campbell, 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.

3.2.9 Summary of Comparison of Safety Criteria for Candidate Areas

Table 3.2-1 presents the numerical ratings of the six Candidate Areas based on the eight safety considerations provided in DG-4021 General Site Suitability Criteria for Nuclear Power Stations. The totals are shown for comparison purposes only. For ORR, Redstone Arsenal, Arnold AFB, and Columbus AFB, there were no area-wide concerns regarding safety that would eliminate these installations from further consideration as Candidate Areas for potential SMR sites.

However, Fort Campbell and NSA Mid-South are eliminated from further consideration as Candidate Areas for potential SMR sites for the following reasons:

- The only significant water body at Fort Campbell is located within a seismic zone which exceeds the conservative limit of a PGA greater than a 10 percent g in any given 50-year time period. Because accessibility to a water source would be required for each Potential Site, Fort Campbell is a less than preferable Candidate Area for SMR siting with respect to safety considerations.

- All of the NSA Mid-South Candidate Area is located in a seismic zone which exceeds the conservative limit of a PGA greater than a 10 percent g in any given 50-year time period. NSA Mid-South also presents safety concerns due to its small size and limited water resources. In addition, the population density within a 20-mi radius of NSA Mid-South is 468 people per square mi. Although within the 500 people per square mi criterion, this population density is significantly greater than the other five Candidate Areas and could exceed 500 people per square mi within the time frame of the project's initial construction period.

Table 3.2-1
Numerical Ratings of the Candidate Areas

Candidate Area	Geology/ Seismology	Atmospheric Dispersion	Exclusion Area and LPZ	Population	Emergency Planning	Security Plans	Hydrology	Industrial, Military, and Transportation Facilities	Sum of Ratings
Oak Ridge Reservation	3	2	2	3	3	3	2	3	21
Redstone Arsenal	3	2	2	3	3	3	2	2	20
Fort Campbell	1	3	2	3	3	3	1	2	18
Arnold AFB	3	3	3	3	3	3	2	3	23
NSA Mid-South	0	3	3	2	3	3	1	3	18
Columbus AFB	3	3	3	3	3	3	2	3	23

4.0 IDENTIFICATION OF PRELIMINARY POTENTIAL SITES

Aerial images and topographic maps of the four final Candidate Areas and the land adjacent to these Candidate Areas were surveyed initially on NEPAssist and Google Maps to identify preliminary Potential Sites in topographically suitable (relatively flat terrain) areas located close to a water source and existing transportation and transmission line infrastructure. A team of environmental professionals (Professional Engineer, Biologist, Geologist, and Certified Health Physicist) then further reviewed the four final Candidate Areas to refine the preliminary list of preliminary Potential Sites using the following criteria: availability of land (minimum of 120 ac in a square configuration), proximity to water (within 2 mi), proximity to sensitive resources such as wetlands and historic sites, proximity to transmission lines (within 2 mi), proximity to transportation infrastructure, and topographic concerns. Once potentially suitable locations were identified, these sites were further examined for the presence of wetlands, known historic sites, land cover, and existing land uses. The following 24 preliminary Potential Sites were identified as shown in Figures 4.0-1 through 4.0-4:

1. ORR – 163 ac west of the ETTP.
2. ORR – 614 ac southeast of the ETTP.
3. ORR – 935 ac along the Clinch River arm of the Watts Bar Reservoir adjacent to ORR (Clinch River Site).
4. ORR – 226 ac east of the Clinch River Nuclear (CRN) Site.
5. ORR – 255 ac along the Clinch River arm of the Watts Bar Reservoir.
6. ORR – 295 ac along the Clinch River arm of the Watts Bar Reservoir.
7. ORR – 344 ac south of the Melton Hill Reservoir (Melton Hill Dam Reservation).
8. ORR – 424 ac on the right bank of Melton Hill Reservoir just upstream of Melton Hill Dam.
9. ORR – 431 ac on the left bank of Melton Hill Reservoir at approximately Clinch River Mile (CRM) 26.
10. ORR – 214 ac southeast of the X-10 area, along the Melton Hill Reservoir.
11. ORR – 222 ac southeast of the ORNL.
12. Redstone Arsenal – 130 ac north of Swan Pond.
13. Redstone Arsenal – 122 ac south of the landfill.
14. Redstone Arsenal – 130 ac south of Huntsville Spring Branch.
15. Redstone Arsenal – 124 ac west of Indian Creek, south of Swan Pond.
16. Redstone Arsenal – 129 ac east of Indian Creek, south of Huntsville Spring Branch.
17. Redstone Arsenal – 128 ac south of the wastewater treatment plant.
18. Redstone Arsenal – 119 ac along the east bank of Dry Creek.
19. Redstone Arsenal – 362 ac along the left descending bank of the Wheeler Reservoir, north of Dry Creek.
20. Arnold AFB – 185 ac west of Woods Reservoir.
21. Arnold AFB – 144 ac northwest of Woods Reservoir.
22. Arnold AFB – 227 ac north of Woods Reservoir.
23. Arnold AFB – 199 ac north of Woods Reservoir.
24. Columbus AFB – 386 ac northwest of base.

These 24 preliminary Potential Sites were further evaluated by an expanded team which included the original team plus an additional Biologist, Hydrologist, and Land Planner based on site-specific concerns related to safety considerations (NRC's DG-4021) and environmental resources (NUREG-1555, Section 9.3, Site Selection Process) to eliminate sites that were obviously less preferable for siting of two or more SMRs. Table 4.0-1 provides the rationale used to justify elimination of 11 of the preliminary Potential Sites.

Table 4.0-1
Preliminary Potential Site Screening and Elimination Justification

Potential Site No.	Eliminated or Retained	Rationale for Elimination
ORR Site 1	Eliminated	Access to this site could be compromised by the 1-percent-annual-chance (100-year) flood.
ORR Site 2	Retained	Not Applicable
ORR Site 3	Retained	Not Applicable
ORR Site 4	Eliminated	Within Surface Danger Zone associated with the Central Training Facility.
ORR Site 5	Retained	Not Applicable.
ORR Site 6	Eliminated	Overlaps a Natural Area with caves, Indian burial site, steep slopes, and two rare species; another Natural Area with sinkholes, caves, steep cliffs, springs, seeps, ponds, one threatened and endangered species, and four rare species and a Reference Area with the largest cave on the ORR and one rare species.
ORR Site 7	Eliminated	Established recreation area including the Melton Hill Dam facilities, visitor center, visitor overlook, TVA police office, boat launching ramp and parking lot, swimming beach, picnic pavilions, and campgrounds.
ORR Site 8	Retained	Not Applicable
ORR Site 9	Retained	Not Applicable
ORR Site 10	Retained	Not Applicable
ORR Site 11	Eliminated	Includes existing High Flux Isotope Reactor (HFIR).
Redstone Arsenal Site 12	Retained	Not Applicable
Redstone Arsenal Site 13	Eliminated	Limited adjacent land for support services such as staging and laydown areas.
Redstone Arsenal Site 14	Retained	Not Applicable
Redstone Arsenal Site 15	Retained	Not Applicable
Redstone Arsenal Site 16	Eliminated	Large areas subject to inundation by the 1-percent-annual- chance (100-year) flood exist on and adjacent to this site.
Redstone Arsenal Site 17	Eliminated	Large areas subject to inundation by the 1-percent-annual- chance (100-year) flood exist on and adjacent to this site.

Potential Site No.	Eliminated or Retained	Rationale for Elimination
Redstone Arsenal Site 18	Eliminated	The entire site is located within the 1-percent-annual-chance (100-year) floodplain.
Redstone Arsenal Site 19	Eliminated	The entire site is located within the 1-percent-annual-chance (100-year) floodplain.
Arnold AFB Site 20	Retained	Not Applicable
Arnold AFB Site 21	Retained	Not Applicable
Arnold AFB Site 22	Retained	Not Applicable
Arnold AFB Site 23	Retained	Not Applicable
Columbus AFB Site 24	Eliminated	The entire site is located within the 1-percent-annual-chance (100-year) floodplain.

Of the 24 preliminary Potential Sites identified, 13 Potential Sites (2, 3, 5, 8, 9, 10, 12, 14, 15, 20, 21, 22, and 23) in three of the four candidate areas (ORR, Redstone Arsenal, and Arnold AFB) were retained for a more detailed evaluation of environmental concerns per NUREG-1555, Section 9.3, Site Selection Process. Because this process resulted in the elimination of the single preliminary Potential Site at Columbus AFB (Site 24), Columbus AFB was eliminated as a Candidate Area.

5.0 EVALUATION OF POTENTIAL SITES

The 13 Potential Sites for the SMR project were evaluated using the criteria provided in Table 9.3-1 of NUREG-1555 in order to identify Candidate Sites. These criteria are listed below, and Sections 5.1 through 5.15 provide evaluations of the Potential Sites with respect to each of these criteria.

- Land use.
- Hydrology, water quality, and water availability.
- Terrestrial biological resources (including endangered species).
- Aquatic biological resources (including endangered species).
- Socioeconomics (including aesthetics, demography, and infrastructure).
- Environmental justice.
- Historic and cultural resources.
- Air quality.
- Human health.
- Postulated accidents.
- Fuel cycle impacts.
- Transmission corridors.
- Population distribution and density.
- Facility costs.
- Institutional constraints, as they affect site availability.

The evaluation rated each site on a scale of one to five. The rating scale is further defined in Table 2.4-1.

5.1 Land Use

The following subsections address land use at each of the Potential Sites, including availability, areas requiring special consideration, existing conditions, and future use. The Potential Sites were evaluated based primarily on the general compatibility of a demonstration energy production project with land use at the sites and with surrounding land uses.

Oak Ridge Reservation

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 (419 U.S. Department of Energy Oak Ridge Office 2007):

- Greenspace/Conservation/Research
  - National Environmental Research Park
    - Carbon Cycling and Management Research
    - Ecosystem Dynamics Research
    - Global Climate Change Research
    - Remediation Research and Monitoring
  - Three Bend Scenic and Wildlife Refuge Area

- Black Oak Ridge Conservation Easement

· Industrial/Commercial
  - ETTP
  - Y-12 Complex
  - Oak Ridge Institute for Science and Education
  - Office of Secure Transportation
  - Spallation Neutron Source Facility

· Security
  – Firing ranges and training facility

Based on the USGS land-cover classification standards and the 2006 National Land Cover Dataset, land use and land cover on the ORR is categorized and shown in Table 5.1-1 and Figure 5.1-1. Forested land (deciduous, evergreen, and mixed forest) accounts for approximately 66.5 percent of the reservation. Wetlands (emergent herbaceous and woody wetlands) occupy approximately 3.5 percent of the ORR. Other vegetated undeveloped land (grassland/herbaceous and shrub/scrub) occupies approximately 2.7 percent of the reservation. Land classified as cultivated crops and pasture/hay occupy approximately 5 percent of the ORR. Open water and barren land occupy approximately 5.4 percent of the reservation. Developed areas (high, medium, and low intensity and open space) occupy approximately 16.8 percent of the ORR. (903 U.S. Geological Survey 2006) The forested or undeveloped land, which surrounds the developed sites on the ORR, is used for a variety of purposes such as safety zones, research, wildlife management, reservation infrastructure, and public areas (419 U.S. Department of Energy Oak Ridge Office 2007).

Table 5.1-1
USGS Land-Use Categories on the ORR

USGS Description	Acres	Percent of Land Use
Barren Land (Rock/Sand/Clay)	168.3	0.5%
Cultivated Crops	25.5	~0.1%
Deciduous Forest	19099.5	56.8%
Developed, High Intensity	863.8	2.6%
Developed, Low Intensity	1855.2	5.5%
Developed, Medium Intensity	1150.3	3.4%
Developed, Open Space	1793.0	5.3%
Emergent Herbaceous Wetlands	1.4	~0.0%
Evergreen Forest	2320.7	6.9%
Grassland/Herbaceous	764.5	2.3%
Mixed Forest	957.7	2.8%
Open Water	1662.9	4.9%
Pasture/Hay	1645.5	4.9%
Shrub/Scrub	136.3	0.4%

USGS Description	Acres	Percent of Land Use
Woody Wetlands	1187.5	3.5%
Total	**33632.1**	**100%**

(903 U.S. Geological Survey 2006)

The six Potential Sites located on or adjacent to the ORR are evaluated below for land use compatibility. The location and size of the sites are shown on Figure 5.1-2.

ORR Site 2

ORR Site 2 consists of approximately 614 ac of primarily undeveloped land located northwest of Bear Creek Road on the Clinch River arm of the Watts Bar Reservoir. The site is owned by the federal government and managed by the DOE. Limited infrastructure development and structures are present on the site including the East Tennessee Technology Park Overlook and the Wheat Community African Burial Ground, both of which are publically accessible from TN58. Based on the USGS land-cover classification standards and the 2006 National Land Cover Dataset, land use and land cover on ORR Site 2 is categorized and shown in Table 5.1-2 and Figure 5.1-2. Forested land (deciduous, evergreen, and mixed forest) accounts for approximately 80.6 percent of the Site. Wetlands (emergent herbaceous and woody wetlands) occupy approximately 3.8 percent of the Site. Other vegetated undeveloped land (grassland/herbaceous and shrub/scrub) occupies approximately 2.0 percent of the Site. Land covers classified as cultivated crops and pasture/hay occupy approximately 3.3 percent of the Site. Open water and barren land occupy approximately 0.9 percent of the Site. Developed areas (high, medium, and low intensity and open space) occupy approximately 9.5 percent of the Site. (903 U.S. Geological Survey 2006)

Use of the site 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 the project. Consideration would have to be made for maintaining public access to the East Tennessee Technology Park Overlook and the Wheat Community African Burial Ground. Because these two sites are located immediately adjacent to TN 58, maintaining that access would not be anticipated to significantly impact the space availability for the proposed project. Accordingly, ORR Site 2 is considered suitable for siting and was assigned a rating of 4.

Table 5.1-2
USGS Land-Use Categories for ORR Potential Sites

USGS Description	ORR Site 2		ORR Site 3		ORR Site 5		ORR Site 8		ORR Site 9		ORR Site 10	
	Acres	Percent of Land Use	Acres	Percent of Land Use	Acres	Percent of Land Use	Acres	Percent of Land Use	Acres	Percent of Land Use	Acres	Percent of Land Use
Barren Land (Rock/Sand/Clay)	1.2	0.19%	20.2	2.17%	2.4	0.96%	3.7	0.88%	0	0.00%	0	0.00%
Cultivated Crops	0.3	0.05%	7.5	0.80%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Deciduous Forest	459.6	74.91%	320.6	34.28%	160.6	62.87%	365.3	86.18%	190.7	44.21%	175.3	81.83%
Developed, High Intensity	3.5	0.58%	0.2	0.02%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Developed, Low Intensity	23.3	3.79%	19.0	2.03%	17.8	6.96%	1.4	0.33%	0	0.00%	0.2	0.11%
Developed, Medium Intensity	19.3	3.14%	5.6	0.60%	4.9	1.93%	0	0.00%	0	0.00%	0	0.00%
Developed, Open Space	12.3	2.00%	41.9	4.48%	13.1	5.12%	0.6	0.14%	0	0.00%	10.5	4.89%
Emergent Herbaceous Wetlands	0	0.00%	0.0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Evergreen Forest	28.8	4.70%	67.4	7.21%	12.5	4.90%	12.6	2.96%	100	23.17%	12	5.61%
Grassland/ Herbaceous	4.3	0.69%	26.2	2.80%	1.3	0.49%	12.7	3.00%	1.9	0.44%	9	4.19%
Mixed Forest	5.9	0.96%	62.0	6.63%	26.1	10.22%	17.4	4.11%	54.3	12.58%	5.8	2.70%
Open Water	4.3	0.70%	16.8	1.80%	1.8	0.69%	5.1	1.19%	58.4	13.53%	1.4	0.67%
Pasture/Hay	20	3.25%	244.9	26.18%	8.4	3.31%	4.5	1.07%	18.3	4.24%	0	0.00%
Shrub/Scrub	7.8	1.26%	20.2	2.16%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Woody Wetlands	23.2	3.78%	82.8	8.85%	6.5	2.56%	0.6	0.14%	7.9	1.84%	0	0.00%
Total	**613.5**	**100%**	**935.3**	**100%**	**255.4**	**100%**	**423.9**	**100%**	**431.4**	**100%**	**214.3**	**100%**

(903 U.S. Geological Survey 2006)

ORR Site 3

ORR Site 3 consists of approximately 935 ac of primarily undeveloped land located on the Watts Bar Reservoir, immediately adjacent to the ORR. The site is owned by the federal government and managed by TVA. Limited infrastructure development and structures are present on the site. Based on the USGS land-cover classification standards and the 2006 National Land Cover Dataset, land use and land cover on ORR Site 3 is categorized and shown in Table 5.1-2 and Figure 5.1-2. Forested land (deciduous, evergreen, and mixed forest) accounts for approximately 48.1 percent of the Site. Wetlands (emergent herbaceous and woody wetlands) occupy approximately 8.9 percent of the Site. Other vegetated undeveloped land (grassland/herbaceous and shrub/scrub) occupies approximately 5.0 percent of the Site. Land classified as cultivated crops and pasture/hay occupy approximately 27.0 percent of the Site. Open water and barren land occupy approximately 4.0 percent of the Site. Developed areas (high, medium, and low intensity and open space) occupy approximately 7.1 percent of the Site. (903 U.S. Geological Survey 2006)

TVA currently manages ORR 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. (342 Tennessee Valley Authority 2009) Use of the site for an energy production and demonstration project is consistent with TVA designated land use for the site and with land use on adjacent areas of the ORR. There is sufficient area in Zone 2 for siting the project. Accordingly, ORR Site 3 is considered suitable for siting and was assigned a rating of 5.

ORR Site 5

ORR Site 5 consists of approximately 255 ac on the Clinch River arm of the Watts Bar Reservoir, within the ORR. ORR Site 5 includes two areas that straddle US 321 in a “V-shaped” configuration. The site is owned by the federal government and managed by DOE. Limited infrastructure development and structures are present on the site. Based on the USGS land-cover classification standards and the 2006 National Land Cover Dataset, land use and land cover on ORR Site 5 is categorized and shown in Table 5.1-2 and Figure 5.1-2. Forested land (deciduous, evergreen, and mixed forest) accounts for approximately 78.0 percent of the Site. Wetlands (emergent herbaceous and woody wetlands) occupy approximately 2.6 percent of the Site. Other vegetated undeveloped land (grassland/herbaceous and shrub/scrub) occupies approximately 0.5 percent of the Site. Land classified as cultivated crops and pasture/hay occupy approximately 3.3 percent of the Site. Open water and barren land occupy approximately 1.7 percent of the Site. Developed areas (high, medium, and low intensity and open space) occupy approximately 14.0 percent of the Site. (903 U.S. Geological Survey 2006)

Use of the site 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 the project; however the configuration of the site may not be compatible with layout of the proposed project. Accordingly, ORR Site 5 is considered suitable for siting but was assigned a rating of 4 based on site configuration concerns.

ORR Site 8

ORR Site 8 consists of approximately 424 ac on the Melton Hill Reservoir on the ORR. The site is owned by the federal government and managed by DOE. The site is located on a peninsula surrounded on three sides by the reservoir. Limited infrastructure development and structures are present on the site. Based on the USGS land-cover classification standards and the 2006 National Land Cover Dataset, land use and land cover on ORR Site 8 is categorized and shown in Table 5.1-2 and Figure 5.1-2. Forested land (deciduous, evergreen, and mixed forest) accounts for approximately 93.3 percent of the Site. Wetlands (emergent herbaceous and woody wetlands) occupy approximately 0.1 percent of the Site. Other vegetated undeveloped land (grassland/herbaceous and shrub/scrub) occupies approximately 3.0 percent of the Site. Land classified as cultivated crops and pasture/hay occupy approximately 1.1 percent of the Site. Open water and barren land occupy approximately 2.1 percent of the Site. Developed areas (high, medium, and low intensity and open space) occupy approximately 0.5 percent of the Site. (903 U.S. Geological Survey 2006)

Use of the site 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 the project and the site configuration/topography are suitable for construction. Accordingly, ORR Site 8 is considered suitable for siting and was assigned a rating of 5.

ORR Site 9

ORR Site 9 consists of approximately 431 ac on the Melton Hill Reservoir, across from the ORR. The site is owned by the federal government and managed by TVA. The site is located on a peninsula surrounded on three sides by the reservoir. The adjacent upland area to the southeast is agricultural land used for livestock pasture. Based on the USGS land-cover classification standards and the 2006 National Land Cover Dataset, land use and land cover on ORR Site 9 is categorized and shown in Table 5.1-2 and Figure 5.1-2. Forested land (deciduous, evergreen, and mixed forest) accounts for approximately 80.0 percent of the Site. Wetlands (emergent herbaceous and woody wetlands) occupy approximately 1.8 percent of the Site. Other vegetated undeveloped land (grassland/herbaceous and shrub/scrub) occupies 0.4 percent of the Site. Land classified as cultivated crops and pasture/hay occupies approximately 4.2 percent of the Site. Open water and barren land occupy approximately 13.5 percent of the Site. No portion of the Site is classified as developed (high, medium, or low intensity or open space). (903 U.S. Geological Survey 2006)

TVA currently manages ORR Site 9 and the Melton Hill Reservoir Land Management Plan specifies two land uses for the site. A large portion of the site (approximately 183 ac) is designated as Zone 4 – Natural Resource Conservation. The portion of the site along the reservoir shoreline is designated Zone 3 – Sensitive Resource Management. (570 Tennessee Valley Authority 1999) Use of the site for an energy production and demonstration project is not consistent with TVA designated land use for the site or with adjacent land use. There are concerns with incompatible land use proposed for the site and the site topography is marginally

suitable for construction. Mitigation of these concerns would require moderate to large design changes. Accordingly, ORR Site 9 was assigned a rating of 2.

ORR Site 10

ORR Site 10 encompasses approximately 214 ac on the Melton Hill Reservoir. The site is owned by the federal government and managed by the DOE. Based on the USGS land-cover classification standards and the 2006 National Land Cover Dataset, land use and land cover on ORR Site 10 is categorized and shown in Table 5.1-2 and Figure 5.1-2. Forested land (deciduous, evergreen, and mixed forest) accounts for approximately 90.1 percent of the Site. Wetlands (emergent herbaceous and woody wetlands) occupy approximately 0 percent of the Site. Other vegetated undeveloped land (grassland/herbaceous and shrub/scrub) occupies approximately 4.2 percent of the Site. Land covers classified as cultivated crops and pasture/hay occupy approximately 4.2 percent of the Site. Open water and barren land occupy approximately 0.7 percent of the Site. Developed areas (high, medium, and low intensity and open space) occupy approximately 5.0 percent of the Site. (903 U.S. Geological Survey 2006)

Current land use is Mixed Research/Future Initiatives (near the reservoir) and Institutional/Research (inland). ORR Site 10 is located in the portion of the ORR that contains relatively undisturbed watersheds suitable as potential environmental research sites. It is designated in the ORR 10-Year Site Plan for future aquatic-terrestrial interface studies. (419 U.S. Department of Energy Oak Ridge Office 2007) Because there is insufficient acreage within this site to avoid impacting the proposed ecological research areas, there are large concerns with incompatible land use and finding enough suitable acreage on which to site an SMR facility. Mitigation of this concern would likely be impractical. Accordingly, ORR Site 10 was assigned a rating of 1.

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 (138 Shaw Environmental, Inc 2009):

- Greenspace/Conservation
  - The United States Fish and Wildlife Service's (USFWS) Wheeler NWR.
- Industrial/Commercial
  - The NASA’s George C. Marshall Space Flight Center.
  - Family housing, and commercial, recreational, and medical centers.
- Military/Security
  - Munitions storage in the 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.

Based on the USGS land-cover classification standards and the 2006 National Land Cover Dataset, land use and land cover on Redstone Arsenal is categorized and shown in Table 5.1-3 and Figure 5.1-3. Forested land (deciduous, evergreen, and mixed forest) accounts for approximately 35.5 percent of the installation. Wetlands (emergent herbaceous and woody wetlands) occupy approximately 15.5 percent of the Redstone Arsenal. Other vegetated undeveloped land (grassland/herbaceous and shrub/scrub) occupies approximately 6.4 percent of the installation. Land classified as cultivated crops and pasture/hay occupy approximately 18.8 percent of the Redstone Arsenal. Open water and barren land occupy approximately 3.0 percent of the installation. Developed areas (high, medium, and low intensity and open space) occupy approximately 20.8 percent of the Redstone Arsenal. (903 U.S. Geological Survey 2006)

Table 5.1-3
USGS Land-Use Categories on Redstone Arsenal

USGS Description	Acres	Percent of Land Use
Barren Land (Rock/Sand/Clay)	20.0	~0.1%
Cultivated Crops	958.8	2.5%
Deciduous Forest	7369.1	19.3%
Developed, High Intensity	288.9	0.8%
Developed, Low Intensity	2126.2	5.6%
Developed, Medium Intensity	813.8	2.1%
Developed, Open Space	4692.2	12.3%
Emergent Herbaceous Wetlands	44.2	~0.1%
Evergreen Forest	4474.9	11.7%
Grassland/Herbaceous	526.8	1.4%
Mixed Forest	1692.0	4.4%
Open Water	1113.1	2.9%
Pasture/Hay	6225.7	16.3%
Shrub/Scrub	1915.8	5.0%
Woody Wetlands	5869.7	15.4%
Total	**38131.2**	**100%**

(903 U.S. Geological Survey 2006)

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). (558 AGEISS Environmental Inc. and J.M.Waller Associates 2006) Much of this limited undeveloped land is occupied by the Wheeler NWR, which includes 4085 ac within the Redstone Arsenal boundary (303 U.S. Fish and Wildlife Service 2009).

The three Potential Sites located on Redstone Arsenal are evaluated below for land use compatibility. The location and size of the sites are shown on Figure 5.1-4.

Redstone Arsenal Site 12

Redstone Arsenal Site 12 consists of approximately 130 ac of forest and grassland located in the western part of Redstone Arsenal adjacent to the arsenal boundary. This site and the surrounding area within the arsenal are undeveloped. Based on the USGS land-cover classification standards and the 2006 National Land Cover Dataset, land use and land cover on Redstone Arsenal Site 12 is categorized and shown in Table 5.1-4 and Figure 5.1-4. Forested land (deciduous, evergreen, and mixed forest) accounts for approximately 86.6 percent of the Site. Wetlands (emergent herbaceous and woody wetlands) occupy approximately 1.5 percent of the Site. Other vegetated undeveloped land (grassland/herbaceous and shrub/scrub) occupies approximately 2.8 percent of the Site. Land covers classified as cultivated crops and pasture/hay occupy approximately 0 percent of the Site. Open water and barren land occupy approximately 0 percent of the Site. Developed areas (open space) occupy approximately 9.2 percent of the Site. (903 U.S. Geological Survey 2006)

Table 5.1-4
USGS Land-Use Categories for Redstone Arsenal Potential Sites

USGS Description	Redstone Arsenal Site 12		Redstone Arsenal Site 14		Redstone Arsenal Site 15	
	Acres	Percent of Land Use	Acres	Percent of Land Use	Acres	Percent of Land Use
Barren Land (Rock/Sand/Clay)	0	0.00%	0	0.00%	0	0.00%
Cultivated Crops	0	0.00%	25.2	19.39%	0	0.00%
Deciduous Forest	12.8	9.87%	20.4	15.67%	71.9	58.02%
Developed, High Intensity	0	0.00%	0	0.00%	0	0.00%
Developed, Low Intensity	0	0.00%	0	0.00%	0	0.00%
Developed, Medium Intensity	0	0.00%	0	0.00%	0	0.00%
Developed, Open Space	11.9	9.16%	10	7.69%	7.5	6.03%
Emergent Herbaceous Wetlands	0	0.00%	0	0.00%	0	0.00%
Evergreen Forest	80.8	62.22%	0.8	0.65%	26.3	21.24%
Grassland/Herbaceous	0	0.00%	0.8	0.65%	0	0.00%
Mixed Forest	18.8	14.51%	5.1	3.92%	9.9	7.95%
Open Water	0	0.00%	0	0.00%	0	0.00%
Pasture/Hay	0	0.00%	37.1	28.56%	0	0.00%
Shrub/Scrub	3.6	2.75%	28.4	21.84%	8.4	6.77%
Woody Wetlands	1.9	1.49%	2.1	1.63%	0	0.00%
Total	**129.9**	**100%**	**129.9**	**100%**	**123.9**	**100%**

(903 U.S. Geological Survey 2006)

The western portion of Redstone Arsenal Site 12 is located in an area classified in the Redstone Real Property Master Plan as “Prime Developable Parcels.” The eastern portion of Redstone Arsenal Site 12 is located in an area classified as “Developable – Major Restrictions,” which includes property that is developable but has significant restrictions that first must be mitigated. Issues with the use of this site include high probabilities of the presence of surface danger zones (SDZ), quantity distance (QD) arcs, environmental restoration sites, cemeteries, and/or unexploded ordnance (UXO) areas. (1041 U.S. Army Garrison - Redstone Arsenal 2014) Land use at Redstone Arsenal Site 12 is designated as Test Range (558 AGEISS Environmental Inc. and J.M.Waller Associates 2006). Use of the site for an energy production and demonstration project may 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 this site is selected as the preferred location for the SMR facility.

Additionally, a residential area is located adjacent to the western boundary of Redstone Arsenal in close proximity to Redstone Arsenal Site 12. If this site is selected as the preferred location for the SMR facility, radiation dosage calculations would be performed at the site boundary and taken into consideration in the development of the site layout and facility design.

Therefore, the land use evaluation for Redstone Arsenal Site 12 was assigned a rating of 3 based on its “Developable – Major Restrictions” classification and its proximity to a residential area (moderate adjacent land use concerns).

Redstone Arsenal Site 14

Redstone Arsenal Site 14, consisting of 130 acres, is located in the south central part of Redstone Arsenal south of Huntsville Spring Branch. The site and the surrounding area within the arsenal are undeveloped. Based on the USGS land-cover classification standards and the 2006 National Land Cover Dataset, land use and land cover on Redstone Arsenal Site 14 is categorized and shown in Table 5.1-4 and Figure 5.1-4. Forested land (deciduous, evergreen, and mixed forest) accounts for approximately 20.2 percent of the Site. Wetlands (emergent herbaceous and woody wetlands) occupy approximately 1.6 percent of the Site. Other vegetated undeveloped land (grassland/herbaceous and shrub/scrub) occupies approximately 22.5 percent of the Site. Land covers classified as cultivated crops and pasture/hay occupy approximately 48.0 percent of the Site. Open water and barren land occupy approximately 0 percent of the Site. Developed areas (high, medium, and low intensity and open space) occupy approximately 7.7 percent of the Site. (903 U.S. Geological Survey 2006)

Redstone Arsenal Site 14 is located in an area classified in the Redstone Real Property Master Plan as “Developable – Major Restrictions.” This classification includes property that is developable but has significant restrictions that first must be mitigated. Issues with use of these properties include high probabilities of the presence of SDZ, QD arcs, environmental restoration sites, cemeteries, and/or UXO areas. (1041 U.S. Army Garrison - Redstone Arsenal 2014) Land use at Redstone Arsenal Site 14 is designated as Test Range (558 AGEISS Environmental Inc. and J.M.Waller Associates 2006). Use of the site for an energy production and demonstration

project may 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 will be modified to meet the land use requirements in the event that this site is selected as the preferred location for the SMR facility. Therefore, the land use evaluation for Redstone Arsenal Site 14 was assigned a rating of 3.

Redstone Arsenal Site 15

Redstone Arsenal Site 15, consisting of approximately 124 ac, is located in the western part of Redstone Arsenal adjacent to a portion of the Wheeler NWR. The site and the surrounding area are undeveloped. Based on the USGS land-cover classification standards and the 2006 National Land Cover Dataset, land use and land cover on Redstone Arsenal Site 15 is categorized and shown in Table 5.1-4 and Figure 5.1-4. Forested land (deciduous, evergreen, and mixed forest) accounts for approximately 87.2 percent of the Site. Wetlands (emergent herbaceous and woody wetlands) occupy approximately 0 percent of the Site. Other vegetated undeveloped land (grassland/herbaceous and shrub/scrub) occupies approximately 6.8 percent of the Site. Land classified as cultivated crops and pasture/hay occupy approximately 0 percent of the Site. Open water and barren land occupy approximately 0 percent of the Site. Developed areas (high, medium, and low intensity and open space) occupy approximately 6.0 percent of the Site. (903 U.S. Geological Survey 2006)

Redstone Arsenal Site 15 is located in an area classified as “Developable – Major Restrictions”. This classification includes property that is developable but has significant restrictions that first must be mitigated. Issues with use of these properties include high probabilities of the presence of SDZ, QD arcs, environmental restoration sites, cemeteries, and/or UXO areas. (1041 U.S. Army Garrison - Redstone Arsenal 2014) Land use at Redstone Arsenal Site 15 is designated as Test Range (558 AGEISS Environmental Inc. and J.M.Waller Associates 2006). Use of the site for an energy production and demonstration project may 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 will be modified to meet the land use requirements in the event that this site is selected as the preferred location for the SMR facility. Therefore, the resource evaluation for Redstone Arsenal Site 15 was assigned a rating of 3.

Arnold AFB

Arnold AFB occupies an area of approximately 39,000 ac in central Tennessee in Coffee and Franklin Counties. Existing land use at Arnold AFB includes the following categories and facilities (195 Agency for Toxic Substances & Disease Registry 2010):

- Greenspace/Conservation
  - Tennessee Wildlife Resource Agency (TWRA)-managed land (32,000 ac).
- Industrial/Commercial
  - AEDC (3600 ac)
- Military/Security
  - AEDC (3600 ac)

Based on the USGS land-cover classification standards and the 2006 National Land Cover Dataset, land use and land cover on the Arnold AFB is categorized and shown in Table 5.1-5 and Figure 5.1-5. Forested land (deciduous, evergreen, and mixed forest) accounts for approximately 59.6 percent of the installation. Wetlands (emergent herbaceous and woody wetlands) occupy approximately 8.3 percent of the Arnold AFB. Other vegetated undeveloped land (grassland/herbaceous and shrub/scrub) occupies approximately 7.2 percent of the installation. Land classified as cultivated crops and pasture/hay occupy approximately 3.9 percent of the Arnold AFB. Open water and barren land occupy approximately 9.9 percent of the installation. Developed areas (high, medium, and low intensity and open space) occupy approximately 11.3 percent of the Arnold AFB. (903 U.S. Geological Survey 2006)

Table 5.1-5
USGS Land-Use Categories on Arnold AFB

USGS Description	Acres	Percent of Land Use
Barren Land (Rock/Sand/Clay)	41.7	~0.1%
Cultivated Crops	510.4	1.3%
Deciduous Forest	19524.3	50.1%
Developed, High Intensity	74.0	0.2%
Developed, Low Intensity	456.1	1.2%
Developed, Medium Intensity	347.7	0.9%
Developed, Open Space	3505.9	9.0%
Emergent Herbaceous Wetlands	20.0	~0.1%
Evergreen Forest	2684.1	6.9%
Grassland/Herbaceous	1045.3	2.7%
Mixed Forest	1018.9	2.6%
Open Water	3800.4	9.8%
Pasture/Hay	1007.1	2.6%
Shrub/Scrub	1735.1	4.5%
Woody Wetlands	3181.7	8.2%
Total	**38952.7**	**100%**

(903 U.S. Geological Survey 2006)

The majority of the installation is undeveloped. The AEDC WMA occupies the 32,000 ac surrounding the AEDC facility and is managed by TWRA for hunting of small game, big game, and waterfowl as well as for fishing, biking, and horseback riding (135 Tennessee Valley Authority 2001) (196 CH2MHill 2009). Woods Reservoir is located in the southern part of the installation. The TWRA leases 1900 ac of the reservoir land as a waterfowl refuge (314 Lamb 2006).

The four Potential Sites located on Arnold AFB are evaluated below for land use compatibility. The location and size of the sites are shown on Figure 5.1-6.

Arnold AFB Site 20

Arnold AFB Site 20 includes approximately 185 ac located on the western shoreline of Woods Reservoir within the AEDC WMA. The site is located partially within the Arnold AFB boundary on property owned by the federal government and managed by Arnold AFB and partially outside of the Arnold AFB boundary on private land. Based on the USGS land-cover classification standards and the 2006 National Land Cover Dataset, land use and land cover on Arnold AFB Site 20 is categorized and shown in Table 5.1-6 and Figure 5.1-6. Forested land (deciduous, evergreen, and mixed forest) accounts for approximately 19.1 percent of the Site. Wetlands (emergent herbaceous and woody wetlands) occupy 0 percent of the Site. Other vegetated undeveloped land (grassland/herbaceous and shrub/scrub) occupies approximately 31.6 percent of the Site. Land classified as cultivated crops and pasture/hay occupy approximately 39.1 percent of the Site. Open water and barren land occupy approximately 6.1 percent of the Site. Developed areas (high, medium, and low intensity and open space) occupy approximately 4.1 percent of the Site. (903 U.S. Geological Survey 2006)

A major portion of the Arnold AFB Site 20 is within a TWRA waterfowl refuge. Arnold AFB Site 20 was assigned a rating of 3 based on its location within a WMA and waterfowl refuge, which are somewhat inconsistent with use of the site for an energy production and demonstration project. A change in these land use designations would likely be required.

Table 5.1-6
USGS Land-Use Categories for Arnold AFB Potential Sites

USGS Description	Arnold AFB Site 20		Arnold AFB Site 21		Arnold AFB Site 22		Arnold AFB Site 23	
	Acres	Percent of Land Use	Acres	Percent of Land Use	Acres	Percent of Land Use	Acres	Percent of Land Use
Barren Land (Rock/Sand/Clay)	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Cultivated Crops	10.4	5.6%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Deciduous Forest	19.8	10.7%	129.1	89.3%	133.6	58.8%	66.4	33.3%
Developed, High Intensity	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Developed, Low Intensity	0.1	~0.1%	0.0	0.0%	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	7.4	4.0%	9.5	6.6%	0.1	0.0%	21.3	10.7%
Emergent Herbaceous Wetlands	0.0	0.0%	0.3	0.2%	0.0	0.0%	0.0	0.0%
Evergreen Forest	8.9	4.8%	0.0	0.0%	21.4	9.4%	53.1	26.6%
Grassland/Herbaceous	10.6	5.7%	0.6	0.4%	0.0	0.0%	23.6	11.8%
Mixed Forest	6.6	3.5%	0.0	0.0%	15.3	6.7%	14.2	7.1%
Open Water	11.3	6.1%	4.2	2.9%	0.1	~0.0%	0.2	~0.1%
Pasture/Hay	61.9	33.5%	0.0	0.0%	14.5	6.4%	0.0	0.0%
Shrub/Scrub	47.8	25.9%	0.9	0.6%	42.4	18.7%	20.5	10.3%
Woody Wetlands	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.1	~0.1%
Total	**184.9**	**100%**	**144.4**	**100%**	**227.3**	**100%**	**199.4**	**100%**

(903 U.S. Geological Survey 2006)

Arnold AFB Site 21

Arnold AFB Site 21 consists of approximately 144 ac of predominantly forestland located on the western shoreline of Woods Reservoir within the AEDC WMA. The site is located partially within the Arnold AFB boundary on property owned by the federal government and managed by Arnold AFB and partially outside of the Arnold AFB boundary on private land. Based on the USGS land-cover classification standards and the 2006 National Land Cover Dataset, land use and land cover on Arnold AFB Site 19 is categorized and shown in Table 5.1-6 and Figure 5.1-6. Forested land (deciduous, evergreen, and mixed forest) accounts for approximately 89.3 percent of the Site. Wetlands (emergent herbaceous and woody wetlands) occupy approximately 0.2 percent of the Site. Other vegetated undeveloped land (grassland/herbaceous and shrub/scrub) occupies approximately 1.0 percent of the Site. Land classified as cultivated crops and pasture/hay occupy 0 percent of the Site. Open water and barren land occupy approximately 2.9 percent of the Site. Developed areas (high, medium, and low intensity and open space) occupy approximately 6.6 percent of the Site. (903 U.S. Geological Survey 2006)

A portion of Arnold AFB Site 21 is within a TWRA waterfowl refuge. The site is located across an arm of Woods Reservoir from the University of Tennessee Space Institute campus (559 University of Tennessee 2013). Arnold AFB Site 21 was assigned a rating of 2 based on its location in the vicinity of an established university campus and partially within a WMA and waterfowl refuge, which are moderate concerns for use of the site for an energy production and demonstration project.

Arnold AFB Site 22

Arnold AFB Site 22 includes approximately 227 ac of predominantly forestland located on the northwestern shoreline of Woods Reservoir within the AEDC WMA. The site is located partially within the Arnold AFB boundary on property owned by the federal government and managed by Arnold AFB and partially outside of the Arnold AFB boundary on private land. Based on the USGS land-cover classification standards and the 2006 National Land Cover Dataset, land use and land cover on Arnold AFB Site 22 is categorized and shown in Table 5.1-6 and Figure 5.1-6. Forested land (deciduous, evergreen, and mixed forest) accounts for approximately 74.9 percent of the Site. Wetlands (emergent herbaceous and woody wetlands) occupy 0 percent of the Site. Other vegetated undeveloped land (grassland/herbaceous and shrub/scrub) occupies approximately 18.7 percent of the Site. Land classified as cultivated crops and pasture/hay occupy approximately 6.4 percent of the Site. Open water and barren land occupy 0 percent of the Site. Developed areas (high, medium, and low intensity and open space) occupy less than 0.1 ac or approximately 0 percent of the Site. (903 U.S. Geological Survey 2006)

A portion of Arnold AFB Site 22 is within a TWRA waterfowl refuge. The site is located immediately north of the University of Tennessee Space Institute campus (559 University of Tennessee 2013). Arnold AFB Site 22 was assigned a rating of 2 based primarily on its location in close proximity (adjacent) to an established university campus. This is a large concern for use

of the site for an energy production and demonstration project. Also, a portion of the site lies within a WMA and waterfowl refuge, which is a moderate concern.

Arnold AFB Site 23

Arnold AFB Site 23 includes approximately 199 ac of predominantly forestland located on the northern shoreline of Woods Reservoir within the AEDC WMA. Based on the USGS land-cover classification standards and the 2006 National Land Cover Dataset, land use and land cover on Arnold AFB Site 23 is categorized and shown in Table 5.1-6 and Figure 5.1-6. Forested land (deciduous, evergreen, and mixed forest) accounts for approximately 67.0 percent of the Site. Wetlands (emergent herbaceous and woody wetlands) occupy approximately 0.1 percent of the Site. Other vegetated undeveloped land (grassland/herbaceous and shrub/scrub) occupies approximately 22.1 percent of the Site. Land classified as cultivated crops and pasture/hay occupy 0 percent of the Site. Open water and barren land occupy approximately 0.1 percent of the Site. Developed areas (high, medium, and low intensity and open space) occupy approximately 10.7 percent of the Site. (903 U.S. Geological Survey 2006)

Arnold AFB Site 23 is located immediately west of Arnold Village, a residential and recreational area containing military family housing and recreational facilities such as a beach, marina, and athletic fields and immediately east of the Arnold AFB family camp facility (196 CH2MHill 2009). Arnold AFB Site 23 was assigned a rating of 2 based on its location adjacent to established residential and recreational areas and within a WMA. These are significant concerns for use of the site for an energy production and demonstration project.

5.2 Hydrology, Water Quality, and Water Availability

Preliminary data indicate that the bounding parameters for operation of two or more SMRs would have a water demand of approximately 17,000 gpm. Due to the preliminary nature of the potential plant design, a number of items needed for accurate assessment of this resource area are still unknown, unavailable, or in the process of being developed. Specific data gaps include the following:

- Flow information for rivers or streams, or more specifically, 7Q10 data is necessary to evaluate the effect withdrawal or discharge of cooling water will have on the source water bodies.
- Low water level information on lakes or reservoirs is necessary for the determination of the practicability of the water source.
- Specific water quality parameters required by the manufacturer need to be defined because these criteria could effectively eliminate certain water sources.
- The quality of water being discharged from the modular reactor cooling process is also necessary for the discharge permit application.

Recognizing these gaps, the following subsections describe hydrology, water quality, and water availability as well as potential effects at each of the federal installations.

FEMA FIRMs were analyzed to determine each site's potential for inundation by the 100-year, or 1 percent chance, flood. Studies of the FEMA maps show the Potential Sites fall into one of three FEMA defined Zones: A, AE, or X. Zone A is defined by FEMA as "no base flood elevations determined". Zone AE is defined by FEMA as "base flood elevations determined." Where Zone AE affects the Potential Site, the elevation is noted in the site summary. Zone X is defined similarly on the legends for each of the FEMA maps as "areas determined to be outside the 0.2 percent annual chance floodplain." Depending on the shading associated with Zone X, it is also defined as "areas of 0.2 percent annual chance flood; areas of 1 percent annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mi; and areas protected by levees from 1 percent annual chance flood."

ORR

The ORR is bounded to the east-southeast by the Clinch River arm of the Watts Bar Reservoir. Several watersheds are found on the ORR with surface water draining through a series of tributaries, streams, and creeks into the Clinch River arm of the Watts Bar Reservoir. 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 it is used locally for domestic water supplies. (186 Oak Ridge National Laboratory, Y-12 National Security Complex, and URS/CH2M Oak Ridge LLC 2012)

Several ORR operating components 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. (240 U.S. Department of Energy 2010; 186 Oak Ridge National Laboratory, Y-12 National Security Complex, and URS/CH2M Oak Ridge LLC 2012) 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. (186 Oak Ridge National Laboratory, Y-12 National Security Complex, and URS/CH2M Oak Ridge LLC 2012)

Streams and water bodies designated by the U.S. Environmental Protection Agency (EPA) as impaired have been identified within the ORR boundary, including the Clinch River arm of Watts Bar Reservoir, Whiteoak Creek, and Melton Hill Reservoir. A variety of Causes of Impairment were listed for Reporting Year 2010 for which a Total Maximum Daily Load was either completed or needed. (252 U.S. Environmental Protection Agency 2013)

Since its creation in 1933, TVA operates a 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 the 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 and aquatic biological resources, provide year-round navigation, and provide water for power production and municipal and industrial use. (142 Tennessee Valley Authority 2013; 411 Tennessee Valley Authority 2013)

As part of TVA's river operations program, TVA has monitored the ecological health of the Watts Bar Reservoir since 1994 (143 Tennessee Valley Authority 2013). 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 (410 Tennessee Valley Authority 2010).

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 (409 Tennessee Valley Authority 2010).

The Clinch River arm of the Watts Bar Reservoir and the Melton Hill Reservoir are possible sources of cooling water for potential sites on the ORR. Melton Hill Reservoir, created by the construction of the Melton Hill Dam on the Clinch River, consists of approximately 5,470 ac of water surface. (344 Tennessee Valley Authority 2013) The Clinch River run below Melton Hill Dam is part of the Watts Bar Reservoir. (269 Tennessee Wildlife Resources Agency 2011) Various sources indicate that the flow of the Clinch River (Clinch River arm of the Watts Bar Reservoir) in the vicinity of ORR is in excess of 1000 cfs (323 Tennessee Valley Authority 2013; 322 United States Geological Service 2013). This stretch carries a high volume of water and it is assumed that it would be able to provide the additional capacity necessary. Each of these water sources is currently used as a water supply and appears to be a feasible option for cooling water for the SMR project (269 Tennessee Wildlife Resources Agency 2011).

ORR Site 2

ORR Site 2 is located adjacent to and immediately northwest of ORR Site 3 and is adjacent to the Clinch River arm of the Watts Bar Reservoir. Based on hydrology, water quality, depth to aquifers in use, and water availability, ORR Site 2 is suitable for siting the SMR project. The Clinch River arm of the Watts Bar Reservoir appears to be capable of handling anticipated thermal discharges. Although some streams and water bodies in the area have been identified as impaired by the EPA, these designations should not prohibit further industrial development; however, these issues may be reflected in the site specific NPDES permit. This site is designated as Zone X (Figure 5.2-1) and is a suitable site based on its lack of flooding potential. However, the short distance between the potential intake and discharge locations could result in thermal issues for the site. ORR Site 2 was assigned a rating of 4.

ORR Site 3

ORR Site 3 is located on the southwest portion of the ORR, between Sites 2 and 4. The site is bounded to the west, south, and east by the Clinch River arm of Watts Bar Reservoir. Based on hydrology, water quality, depth to aquifers in use, and water availability, ORR Site 3 is suitable

for siting the SMR project. The Clinch River arm of the Watts Bar Reservoir appears to be capable of handling anticipated thermal discharges. Although some streams and water bodies in the area have been identified as impaired by the EPA, these designations should not prohibit further industrial development; however, these issues may be reflected in the site specific National Pollutant Discharge Elimination System (NPDES) permit. Flooding potential exists on ORR Site 3 and in the immediate vicinity of ORR Site 3 along the banks of the Clinch River arm of Watts Bar Reservoir at elevations up to 749 ft. However, the majority of the site is designated as Zone X (Figure 5.2-2), indicating it is a suitable site based on its lack of flooding potential. Due to the small potential for minor flooding ORR Site 3 was assigned a rating of 4.

ORR Site 5

ORR Site 5 is located along the north bank of the Clinch River arm of Watts Bar Reservoir west of ORR Site 8. Based on hydrology, water quality, depth to aquifers in use, and water availability, ORR Site 5 is suitable for siting the SMR project. Both the Clinch River arm of the Watts Bar Reservoir and the Melton Hill Reservoir appear to be capable of handling anticipated thermal discharges. Although some streams and water bodies in the area have been identified as impaired by the EPA, these designations should not prohibit further industrial development; however, these issues may be reflected in the site specific NPDES permit. Flooding potential exists on ORR Site 5 and in the immediate vicinity of ORR Site 5 along the banks of the Clinch River arm of Watts Bar Reservoir at elevations up to 751 ft. and along Whiteoak Creek on the northwest portion of the Site, which is labeled as Zone A. However, a large enough portion of this site is designated as Zone X (Figure 5.2-3) to accommodate an SMR facility. Due to the small potential for minor flooding ORR Site 5 was assigned a rating of 4.

ORR Site 8

ORR Site 8 is located on a peninsula along the north bank of the Clinch River arm of Watts Bar Reservoir and Melton Hill Reservoir, just west of ORR Site 9. Based on hydrology, water quality, depth to aquifers in use, and water availability, ORR Site 8 is suitable for siting the SMR project. Both the Clinch River arm of the Watts Bar Reservoir and the Melton Hill Reservoir appear to be capable of handling anticipated thermal discharges. Although some streams and water bodies in the area have been identified as impaired by the EPA, these designations should not prohibit further industrial development; however, these issues may be reflected in the site specific NPDES permit. Flooding potential exists on ORR Site 8 and in the immediate vicinity of ORR Site 8 along the banks of the Clinch River arm of Watts Bar Reservoir at elevations up to 752 ft. For areas above the Melton Hill Dam, the flooding potential exists to an elevation of 796 ft. However, a large enough portion of this site is designated as Zone X (Figure 5.2-4) to accommodate an SMR facility. Due to the small potential for minor flooding ORR Site 8 was assigned a rating of 4.

ORR Site 9

ORR Site 9 is located on TVA managed property to the south and east of Melton Hill Reservoir on the Knox and Loudon County line and is approximately 3 river mi upstream of Melton Hill Dam. Based on hydrology, water quality, depth to aquifers in use, and water availability as a

resource for Potential Site rating, ORR Site 9 is suitable for siting the SMRs. Both the Clinch River arm of the Watts Bar Reservoir and the Melton Hill Reservoir appear to be capable of handling anticipated thermal discharges. Although some streams and water bodies in the area have been identified as impaired by the EPA, these designations should not prohibit further industrial development; however, these issues may be reflected in the site specific NPDES permit. Flooding potential exists on ORR Site 9 and in the immediate vicinity of ORR Site 9 along the banks of the Melton Hill Reservoir at elevations up to 796 ft. Potential flood zones also exist from the Hope Creek arm of Melton Hill Reservoir also to an elevation of approximately 796 ft. However, the majority of the property is designated as Zone X (Figure 5.2-5), indicating it is a suitable site based on its lack of flooding potential. Due to the small potential for minor flooding ORR Site 9 was assigned a rating of 4.

ORR Site 10

ORR Site 10 is located in the south-central portion of the ORR. It is bound to the south by Melton Hill Reservoir. Based on hydrology, water quality, depth to aquifers in use, and water availability, ORR Site 10 is suitable for siting the SMR project. Melton Hill Reservoir appears capable of handling anticipated thermal discharges. Although some streams and water bodies in the area have been identified as impaired by the EPA, these designations should not prohibit further industrial development; however, these issues may be reflected in the site specific NPDES permit. Flooding potential exists on ORR Site 10 and in the immediate vicinity of ORR Site 10 along the banks of the Melton Hill Reservoir at elevations up to 796 ft. However, the majority of the property is designated as Zone X (Figure 5.2-6), indicating it is a suitable site based on its lack of flooding potential. Due to the small potential for minor flooding, ORR Site 10 was assigned a rating of 4.

Redstone Arsenal

The southern boundary of Redstone Arsenal is defined by the Wheeler Reservoir, an impoundment of the Tennessee River operated by TVA (166 Zondlo and Smith). The Tennessee River (Wheeler Reservoir) at Whitesburg had an average monthly flow of approximately 42,230 cfs from 1924 to 1960 (328 U.S. Department of the Interior 1964). The Wheeler Reservoir at Whitesburg is approximately 1400 ft wide (253 U.S. Environmental Protection Agency 2013). Groundwater flows southward under the Redstone Arsenal property toward the Wheeler Reservoir. Depth to groundwater varies widely from a few feet to greater depths at the high elevations. (241 Shaw Environmental, Inc. 2007) Indian Creek, Huntsville Spring Branch, and McDonald Creek, all of which empty into the Wheeler Reservoir, are the major systems flowing through the property (133 Shaw Environmental, Inc. 2004). Intakes along the Wheeler Reservoir are used for domestic and industrial water systems by Redstone Arsenal (270 Agency for Toxic Substances & Disease Registry 2005).

As part of TVA's river operations program, TVA has monitored the ecological health of the Wheeler Reservoir since 1994 (143 Tennessee Valley Authority 2013). 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 (143 Tennessee Valley Authority 2013).

Because of TVA power operations and flood control measures, daily, weekly, and seasonally cyclic fluctuations occur a considerable distance upstream. The result is highly transient groundwater flow. (166 Zondlo and Smith) Groundwater is not used onsite for drinking water or industrial uses (133 Shaw Environmental, Inc. 2004).

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)

Three water sources within the Redstone Arsenal boundary appear to be sufficient for cooling water use for the proposed modular reactors. A flood-storage capacity of 326,500 ac-ft is listed for Wheeler Reservoir (271 Tennessee Valley Authority 2013), which shows ample capacity for the potential cooling water withdrawal. The Tennessee River also carries an abundant volume of water and could also be considered as a source. These two water bodies, along with the run of Indian Creek between Huntsville Spring Branch and its drainage into the Wheeler Reservoir, appear to be the most likely potential water sources at the Redstone Arsenal.

Redstone Arsenal Site 12

Redstone Arsenal Site 12 is located adjacent to the western edge of the Redstone Arsenal property. Swan Pond is located to the south and Indian Creek to the east of the site. Based on hydrology, water quality, depth to aquifers in use, and water availability as a resource Potential Site rating, Redstone Arsenal Site 12 is suitable for siting the SMRs. There are multiple options for use as a potential cooling water source. The various sources appear capable of handling anticipated thermal discharges. 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. Portions of the site adjacent to Indian Creek are designated as Zone A; Swan Pond shows a potential flood elevation of 569.0 ft. However, a majority of the property is located in Zone X, indicating it is a suitable site based on its lack of flooding potential (Figure 5.2-7). Due to the small potential for minor flooding Redstone Arsenal Site 12 was assigned a rating of 4.

Redstone Arsenal Site 14

Redstone Arsenal Site 14 is located in the south central portion of the Arsenal just south of Huntsville Spring Branch. Based on hydrology, water quality, depth to aquifers in use, and water availability as a resource for Potential Site rating, Redstone Arsenal Site 14 is moderately suitable for siting the SMRs. There are multiple options for use as a potential cooling water source and the various sources appear capable of handling anticipated thermal discharges. 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. A large portion of the site is

designated as Zone A (Figure 5.2-8); Wheeler Reservoir shows a potential flood elevation of approximately 575.0 ft. Although there are several positive aspects of this site mentioned above, due to the large portion of the site being designated as Zone A or AE and concerns relating to the potential for access roads being inundated by the 100-year flood, Redstone Arsenal Site 14 was assigned a rating of 3.

Redstone Arsenal Site 15

Redstone Arsenal Site 15 is located on the western portion of the property and is bounded to the south and east by Indian Creek and to the west by Swan Pond. Based on hydrology, water quality, depth to aquifers in use, and water availability as a resource for Potential Site rating, Redstone Arsenal Site 15 is suitable for siting the SMRs. There are multiple options for use as a potential cooling water source. The various sources appear capable of handling anticipated thermal discharges. 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. Indian Creek is designated as Zone A; Swan Pond shows a potential flood elevation of approximately 569.0 ft. A large portion of the property is designated as Zone X (Figure 5.2-9); however, Redstone Arsenal Site 15 was assigned a rating of 4 based on minor resource concerns relating to the potential for access roads being inundated by the 100-year flood.

Arnold AFB

Surface water bodies on the Arnold AFB include the Elk River arm of the Tims Ford Reservoir, Rowland Creek (also known as Rollins Creek), Spring Creek, and Woods Reservoir. The designated uses for the Elk River arm of the Tims Ford Reservoir, upper Rowland Creek, Woods Reservoir, and Spring Creek and its tributaries are fish and aquatic life, recreation, irrigation, livestock watering, and wildlife. (135 Tennessee Valley Authority 2001) The Elk River arm of the Tims Ford Reservoir and the Rowland Creek embayment are also used for domestic industrial water supplies (195 Agency for Toxic Substances & Disease Registry 2010). However, in the Final EIS for the Addition of Electric Generation Baseload Capacity in Franklin County, Tennessee (submitted in 2001), an 11.9-mi section of Rowland Creek and Woods Reservoir was reported as impaired and not supporting designated uses due to thermal modifications and flow alterations from Arnold AFB. In 2001 Arnold AFB instituted a water recycling program. Due to polychlorinated biphenyls contamination, sediments in Rowland Creek embayment were sampled in 2001. Only Aroclor 1260 was detected, and it was detected at concentrations less than 0.2 milligrams per kilogram (mg/kg). (135 Tennessee Valley Authority 2001)

Woods Reservoir comprises approximately 4000 ac in the southern part of the installation, supplies most of the drinking water for the AFB, and forms the southern border of the base boundary. The Retention Reservoir is a 175 ac unlined impoundment on the western edge of the AEDC testing center, and receives runoff and discharge from many areas of the test facility and the J-4 testing area. Bradley Creek, Brumalow Creek, and Rowland Creek all receive runoff and discharge from AEDC facilities. (195 Agency for Toxic Substances & Disease Registry 2010)

Average groundwater depths in the southern edge of Arnold AFB north of the Elk River arm of the Tims Ford Reservoir and Woods Reservoir are reported to range from 10 ft to 40 ft. More than 75 percent of wells in the region have estimated yields of less than 1 cfs, are less than 100 ft deep, and are used for residential purposes. No water supply wells were reported within a 2-mi radius of locations evaluated in the 2001 Final EIS. Water supply springs were identified in the region, but not within proximity of the areas evaluated in the EIS. Groundwater contaminated with chlorinated organics has been reported at Arnold AFB. (135 Tennessee Valley Authority 2001)

A small portion of the Elk River located on Arnold AFB property has been designated by the EPA as an impaired stream. Causes of Impairment are reported to be dissolved oxygen and low flow alterations. No other EPA-designated impaired water bodies have been identified within the property boundaries. (255 U.S. Environmental Protection Agency 2013)

Arnold AFB offers multiple cooling water source options for the modular reactors. The flow rate of the Elk River above Fayetteville is approximately 600 cfs and approximately 3600 cfs at Prospect (323 Tennessee Valley Authority 2013; 322 United States Geological Service 2013). The width of Elk River in the vicinity of Arnold AFB is approximately 630 ft (255 U.S. Environmental Protection Agency 2013). Elk River and the Rowland Creek embayment are currently used as water supplies. In addition to these two water sources, Woods Reservoir was originally created to be used as a cooling water supply for Arnold AFB and is the base's primary drinking water supply. (273 U.S. Environmental Protection Agency 2012; 195 Agency for Toxic Substances & Disease Registry 2010) Each of these water sources within Arnold AFB could be considered for potential cooling water use for the modular reactors.

Arnold AFB Site 20

Arnold AFB Site 20 is located to the west of the Elk River Dam on Woods Reservoir. An 11.9-mi section of Rowland Creek and Woods Reservoir was reported as impaired and not supporting the designated uses due to thermal modifications and flow alterations from Arnold AFB. Although not prohibitive, this concern would have to be addressed in site selection and site specific design parameters. The Elk River arm of the Tims Ford Reservoir is located to the south of this site and is designated as Zone A. However, a majority of the property is designated as Zone X (Figure 5.2-10), indicating it is a suitable site based on its lack of flooding potential. Due to the small potential for minor flooding and water supply/quality issues, Arnold AFB Site 20 was assigned a rating of 3.

Arnold AFB Site 21

Arnold AFB Site 21 is located to west of the Rollins Creek arm of Woods Reservoir. An 11.9-mi section of Rowland Creek and Woods Reservoir were reported as impaired and not supporting the designated uses due to thermal modifications and flow alterations from Arnold AFB. Although not prohibitive, this concern would have to be addressed in site selection and site specific design parameters. Although the Rollins Creek arm of Woods Reservoir is designated as Zone A, the majority of this site is designated Zone X (Figure 5.2-11), indicating it is a

suitable site based on its lack of flooding potential. Due to the small potential for minor flooding and water supply/quality issues, Arnold AFB Site 21 was assigned a rating of 3.

Arnold AFB Site 22

Arnold AFB Site 22 is located on the east side of the Rowland Creek arm of Woods Reservoir. An 11.9-mi section of Rowland Creek and Woods Reservoir was reported as impaired and not supporting the designated uses due to thermal modifications and flow alterations from Arnold AFB. Although not prohibitive, this concern would have to be addressed in site selection and site specific design parameters. Although the Rowland Creek arm of Woods Reservoir is designated as Zone A, the majority of this site is designated Zone X (Figure 5.2-12), indicating it is a suitable site based on its lack of flooding potential. Due to the small potential for minor flooding and water supply/quality issues Arnold AFB Site 22 was assigned a rating of 3.

Arnold AFB Site 23

Arnold AFB Site 23 borders the northern edge of Woods Reservoir. An 11.9-mi section of Rowland Creek and Woods Reservoir was reported as impaired and not supporting the designated uses due to thermal modifications and flow alterations from Arnold AFB. Although not prohibitive, this concern would have to be addressed in site selection and site specific design parameters. Although the Woods Reservoir portion of the site is designated as Zone A, majority of this site is designated as Zone X (Figure 5.2-13), indicating it is a suitable site based on its lack of flooding potential., Due to the small potential for minor flooding and water supply/quality issues Arnold AFB Site 23 was assigned a rating of 3.

5.3 Terrestrial Biological Resources

Factors considered in evaluating the suitability of the Potential Sites with respect to terrestrial biological resources included the presence of attributes such as numbers of federally and state-listed species in the counties surrounding each Potential Site and numbers of protected natural areas on or adjacent to each Potential Site. The possibility of effects on terrestrial biological resources at any of the Potential Sites would be highly dependent on localized, site-specific conditions: the rare species occurrences, unique habitats, protected natural areas, and other resources present on and adjacent to the Potential Site selected in each area. It was assumed that SMRs would be sited and construction and operation of the SMRs would be designed to prevent or minimize impacts to endangered, threatened, and other important species and to wildlife refuges, parks, and other natural areas protective of unique terrestrial biological resources. Ratings were assigned subjectively based on the potential that siting SMRs on each Potential Site could result in effects on such important terrestrial biological resources. It was also assumed that the greater the numbers and areal extent of these resources on or adjacent to a Potential Site, the greater the constraints that would be associated with minimizing or avoiding impacts when siting the SMRs. The following subsections describe terrestrial biological resources at each of the 13 Potential Sites.

ORR Sites 2, 3, 5, 8, 9, and 10

ORR Site 2 is within the Southern Dissected Ridges and Knobs and ORR Sites 3, 5, 8, 9, and 10 are mainly within the Southern Limestone/Dolomite Valleys and Low Rolling Hills of the Ridge and Valley ecoregion of eastern Tennessee (321 U.S. Environmental Protection Agency 2012). ORR Site 3 is located on TVA-managed property adjacent to the ORR. ORR Site 9 is located across Melton Hill Reservoir from the ORR on TVA-managed property. ORR Sites 2, 5, 8, and 10 are located on the ORR. 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. (294 Griffen, Evans, and Parr 2012) Approximately 600 ac of wetlands have been identified on the ORR “in riparian zones of headwater streams and receiving streams and in the Clinch River embayments.” The majority of these wetlands, which range in size from several square feet to about 25 ac, are classified as forested palustrine, scrub/shrub, or emergent wetlands. (186 Oak Ridge National Laboratory, Y-12 National Security Complex, and URS/CH2M Oak Ridge LLC 2012)

The ORR is jointly managed by TWRA and DOE as a 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 2920 ac 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. Approximately 3000 ac in the northwestern area of the ORR are included in the Black Oak Ridge Conservation Easement. (295 Parr and Hughes 2006)

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. (296 Baranski 2009) In addition, five state natural areas within the ORR have been proposed for future protection (297 Hart 2011).

ORR Sites 2, 5, 8, and 10 each overlap at least one designated natural area that includes terrestrial biological resources. ORR 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 ORR 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. (296

Baranski 2009) However, marsh habitat was not observed in this forested area during a site visit in August 2014. The portion of ORR 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 ORR 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. ORR 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. (296 Baranski 2009)

ORR 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 managed by TVA. It shares a majority of the ecological characteristics described for the ORR. ORR Site 3 adjoins the TVA Grassy Creek Habitat Protection Area along the northern boundary of ORR Site 3. The riparian zone along most of the shoreline of ORR 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.” (342 Tennessee Valley Authority 2009)

ORR Site 9 is located across Melton Hill Reservoir from the ORR on TVA-managed land that includes two parcels. Parcel 10 comprises 182.7 ac of forested upland that is covered by planted pines and stands of young pine and hardwood that have colonized abandoned fields, as well as one of the oldest stands of hardwoods on the reservoir. The riparian forest along the shoreline of Parcel 10 supports reservoir ecosystems and was the reason TVA included Parcel 10 in its Zone 4 designation for natural resource conservation. Parcel 11 comprises 62.4 ac of forested upland and shoreline adjoining Parcel 10. The forest covering Parcel 11 includes natural and planted pines and a variety of hardwoods. (570 Tennessee Valley Authority 1999) Parcel 11 also supports pink lady-slipper (*Cypripedium acaule*), which is state-listed as a species of special concern because it is commercially exploited (561 Cox 2011; 570 Tennessee Valley Authority 1999). The presence of this orchid was one of the reasons Parcel 11 was included by TVA in its Zone 3 designation for sensitive resource management (570 Tennessee Valley Authority 1999).

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 (296 Baranski 2009). As noted above, rare species with a state status occur within ORR Sites 2, 5, and 8. ORR Site10 is not known to support listed terrestrial or wetland species (296 Baranski 2009). As discussed above, ORR Site 9 is across Melton Hill Reservoir from the ORR and includes a population of a state-listed plant species. The likelihood of occurrence of federally or state-listed species or other special status terrestrial or wetland species on these sites would need to be determined by contacting the Tennessee

Department of Environment and Conservation (TDEC) and the USFWS for site-specific information.

ORR 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. Therefore, ORR Site 2 was assigned a rating of 2 for terrestrial biological resources. ORR Site 3 is larger than required for the SMR facility and includes no known occurrences of rare species or designated natural areas. Accordingly, ORR Site 3 was assigned a rating of 5 for its minimal potential to have adverse effects on terrestrial biological resources.

Approximately half of ORR Site 5 is within a large Natural Area containing diverse habitats and landscape elements, and several rare species. ORR Site 5 was assigned a rating of 3 based on its potential to have adverse effects on the terrestrial biological resources within this Natural Area. Similarly, ORR Site 8 is almost entirely within two large Natural Areas that include diverse communities and several rare species. ORR Site 8 was assigned a rating of 2 because of its substantial potential to adversely affect terrestrial biological resources within major portions of these Natural Areas. Mitigation effort would be moderate to large.

Because ORR 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. Similarly, terrestrial resource concerns are moderate at ORR Site 9, which includes areas designated by TVA for natural resource conservation and sensitive species management. Depending on the results of site-specific surveys for rare species and habitats, it would take moderate effort to address these concerns through siting design considerations or mitigation. ORR Sites 9 and 10 were each assigned a rating of 3 based on their substantial potential for adverse effects on terrestrial biological resources.

Redstone Arsenal Sites 12, 14, and 15

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. (299 Griffith, Omernik, Cornstock, Lawrence, Martin, Goddard, Hulcher, and Foster 2001) In northern Alabama and at Redstone Arsenal, pines are also present in association with the hardwoods and in isolated stands (302 Bryant, McComb, and Fralish 1993). 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. (300 U.S. Army 2002) Wetlands cover over 20 percent of Redstone Arsenal (301 U.S. Army 1999).

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 (299 Griffith, Omernik, Cornstock, Lawrence, Martin, Goddard, Hulcher, and Foster 2001). 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. (302 Bryant, McComb, and Fralish 1993) Wheeler NWR includes 4085 ac within the Redstone Arsenal boundary (303 U.S. Fish and Wildlife Service 2009). 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 (Figure 3.1-4).

Numerous terrestrial or wetland species that are federally listed as endangered or threatened, or designated as candidates for federal listing, have the potential to occur in Madison County, where the Potential Sites are located. In Madison County, five terrestrial or wetland species are federally listed. 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. (417 Alabama Natural Heritage Program 2012)

Redstone Arsenal Sites 12 and 15 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 appears to have a negligible potential to support rare terrestrial species or habitats. 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 and 15 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. Accordingly, Redstone Arsenal Sites 12 and 15 were each assigned a rating of 4 for their limited potential to have adverse effects on terrestrial biological resources. Redstone Arsenal Site 14 has been affected by ongoing firing range activities and supports minimal biological diversity; therefore, it was assigned a rating of 5 based on its marginal potential for adverse effects on terrestrial biological resources.

Arnold AFB Sites 20, 21, 22, and 23

Arnold AFB is located in the barrens grassland region of the Eastern Highland Rim ecoregion of central Tennessee. In most of the ecoregion, former barrens and prairie areas now are mainly covered by oak thickets, cropland, or pasture. The base includes several hundred acres of open grasslands resembling tallgrass prairie, as well as grassy openings with scattered trees

resembling savannah. These grasslands (barrens), which are a rare habitat in Tennessee, occur mainly on the airfield and along powerline and railroad rights-of-way. (314 Lamb 2006) Other plant communities on Arnold AFB include dry and mesic oak forests; pine forests; ravine, creek, floodplain, and swamp forests; early successional habitats; and planted/cultivated vegetation (135 Tennessee Valley Authority 2001).

Approximately 30,000 ac on Arnold AFB are forested, with most in native hardwoods and around 5800 ac in planted, non-native pines (314 Lamb 2006). The forest communities of the base and vicinity typically are characterized by closed canopies dominated by oaks with a variety of trees and shrubs in the understory. Arnold AFB also contains numerous wetlands ranging from swamps to marshes. (314 Lamb 2006) The natural communities on Arnold AFB support a diverse assemblage of animals, including wildlife characteristic of deciduous forest, wetland, and grassland habitats in the region. Wetlands and reservoirs also support concentrations of waterfowl, particularly in winter. The AEDC WMA is a 32,000 ac area adjacent to Woods Reservoir within Arnold AFB that is managed by the TWRA and the U.S. Air Force for hunting of small game, big game, and waterfowl. (135 Tennessee Valley Authority 2001) Woods Reservoir is a 3632-ac impoundment on the Elk River along the south border of the base. The TWRA leases 1900 ac of the reservoir as a waterfowl refuge. Sinking Pond, a 400 ac forested wetland on the base, supports one of the largest great blue heron breeding colonies in Tennessee, and a smaller heronry also is present on Elder Island in Woods Reservoir. (314 Lamb 2006)

Arnold AFB Sites 20, 21, 22, and 23 are located on the shoreline of Woods Reservoir. Portions of Arnold AFB Sites 20 and 21 and all of Arnold AFB Sites 22 and 23 are within the AEDC WMA. In addition, portions of Arnold AFB Sites 20, 21, and 22 are within the waterfowl refuge. The four sites are covered predominantly by forest, with grassland covering approximately a quarter of Arnold AFB Site 20.

Numerous terrestrial or wetland species that are federally or state-listed as endangered or threatened, or designated as candidates for federal listing, have the potential to occur in Franklin County, the county in which the four Arnold AFB Potential Sites are located. In this county, four terrestrial species are federally listed and one species is designated by the USFWS as a federal candidate for listing. Also in this county, 52 terrestrial or wetland species are state-listed as endangered or threatened. (298 Tennessee Department of Environment and Conservation 2012) The likelihood of occurrence of federally or state-listed terrestrial or wetland species on these sites would need to be determined by contacting Arnold AFB, the TDEC, and the USFWS for site-specific information.

Each of the four Potential Sites on Arnold AFB has a potential to support rare terrestrial or wetland species or habitats. However, a determination of whether this potential is minimal or substantial is inconclusive and dependent on the results of site-specific surveys. Accordingly, Arnold AFB Sites 20, 21, 22, and 23 were each assigned a rating of 4 based on their potential for adverse effects on terrestrial biological resources.

5.4 Aquatic Biological Resources

Factors considered in evaluating the suitability of the Potential Sites with respect to aquatic biological resources included the presence of attributes such as numbers of federally and state-listed aquatic species in the county surrounding the Potential Sites and numbers of protected natural areas on or adjacent to each Potential Site. It was assumed that SMRs would be sited and construction and operation of the SMRs would be designed to prevent or minimize impacts to endangered, threatened, and other important species and to wildlife refuges, parks, and other natural areas protective of unique aquatic biological resources. Ratings were assigned subjectively based on the potential that siting SMRs on each Potential Site could result in effects on such important aquatic biological resources. It was assumed that the greater the numbers and areal extent of these resources on a Potential Site, the greater the constraints that would be associated with minimizing or avoiding impacts when siting the SMRs. The potential for effects on aquatic biological resources at any of the Potential Sites would be highly dependent on localized, site-specific conditions: the water bodies that would be affected by water withdrawals and discharges, rare species occurrences, unique aquatic habitats, protected natural areas, and other resources present on and adjacent to the Potential Site. The following subsections describe aquatic biological resources at each of the Potential Sites.

ORR Sites 2, 3, 5, 8, 9, and 10

The cold water released through Norris Dam upstream of the ORR contributes to the relatively cool water characteristic of Melton Hill Reservoir. Although the cooler water slows the growth of warm water fish such as largemouth bass, white crappie, and bluegill, it allows higher oxygen levels to be maintained in summer, supporting populations of smallmouth bass, striped bass, and muskellunge. (269 Tennessee Wildlife Resources Agency 2011) The fish community of Watts Bar Reservoir below Melton Hill Dam includes similar species (317 Tennessee Valley Authority 2013). The invertebrate community of these reservoirs in the vicinity of the ORR includes native freshwater mussels and snails (501 Howard and Phillips 2012) .

ORR Sites 2, 3, and 5 include shoreline along the Clinch River arm of Watts Bar Reservoir, and Sites 8, 9, and 10 include shoreline along Melton Hill Reservoir. Sites 3, 8 and 9 are peninsulas that have relatively extensive shorelines. ORR Site 3 borders a designated natural area that includes aquatic habitats: the TVA Grassy Creek Habitat Protection Area adjoins the northern boundary of ORR Site 3 (296 Baranski 2009).

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 (296 Baranski 2009). The evaluation of aquatic natural areas on the ORR by Baranski indicated that ORR Sites 2, 5, 8, and 10 are not known to support listed aquatic species (562 Baranski 2011). The evaluation of water bodies on ORR Site 3 by TVA identified only a few, small streams, which do not provide habitat suitable for the potential occurrence of listed aquatic species (501 Howard and Phillips 2012). The likelihood of occurrence of federally or state-listed species or other special status aquatic species on ORR Sites 2, 5, 8, and 10 would need to be confirmed based on information available for the ORR and by contacting the TDEC and the USFWS for any site-specific information that may exist for these areas.

Siting an SMR facility on all six of the ORR Sites on or adjacent to the ORR would have adverse effects on the Clinch River arm of Watts Bar Reservoir or Melton Hill Reservoir due to similar effects from cooling water withdrawals and discharges. ORR Site 3 is much larger than required for the SMR facility, and the facility could be located on a portion of the site that does not affect onsite streams except for one small perennial stream. Because site-specific surveys at ORR Site 3 indicate that no listed species or suitable habitat, no unique or sensitive natural areas or habitats are present, it was assigned a rating of 5. No known aquatic resource concerns have been identified within ORR Sites 2, 5, 8, 9, or 10; however, 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. Because suitable habitat is present on some sites, and there is less space to site an SMR facility for avoidance on some sites, ORR Sites 2, 5, 8, 9, and 10 were assigned a rating of 4.

Redstone Arsenal Sites 12, 14, and 15

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 ac are within the 100-year floodplain. Other aquatic habitats on the installation include manmade ponds (excavations for gravel and quarrying), streams, and springs. (318 U.S. Army 2002) The largest streams within the installation are Indian Creek, McDonald Creek, and Huntsville Spring Branch (301 U.S. Army 1999).

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. (414 U.S. Fish and Wildlife Service 2007)

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 listing, and 58 aquatic species are state-listed as protected (417 Alabama Natural Heritage Program 2012). The potential for occurrence of listed or other special status aquatic species on these three sites is minimal due to the absence of significant aquatic biological resources on the sites. 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.

Redstone Arsenal Sites 12, 14, and 15 potentially would have similar, limited effects on Wheeler Reservoir from cooling water withdrawals and discharges. None of the three Potential Sites on Redstone Arsenal encompass notable aquatic habitats or appear to have a substantial potential to support rare aquatic species or habitats. However, confirmation of this assessment is dependent on the results of site-specific surveys. Accordingly, Redstone Arsenal Sites 12, 14, and 15 were each assigned a rating of 4 based on their limited potential to adversely affect aquatic biological resources.

Arnold AFB Sites 20, 21, 22, and 23

The principal aquatic resource on Arnold AFB is Woods Reservoir, which provides cooling water for the AEDC (314 Lamb 2006). Woods Reservoir supports a recreational fishery for species such as the largemouth bass, smallmouth bass, and white crappie (257 Lake-Maps.com 2013). The invertebrate community is expected to include native freshwater mussels, which are common in rivers and reservoirs of the Tennessee River system (412 Tennessee Valley Authority 2001).

The next largest water body on the base is the Retention Reservoir, in which fishing is not allowed. The Retention Reservoir discharges to Rowland Creek. The Retention Reservoir, Bradley Creek, Brumalow Creek, and Rowland Creek receive runoff and/or discharges from AEDC facilities and flow into Woods Reservoir. (195 Agency for Toxic Substances & Disease Registry 2010) Many other surface water bodies in the area are headwater tributaries, which are subject to seasonal intermittent flows due to fluctuating groundwater levels and, as a result, support relatively low fish species diversity (135 Tennessee Valley Authority 2001).

Arnold AFB Sites 20, 21, 22, and 23 are located on the shoreline of Woods Reservoir. Portions of Arnold AFB Sites 20 and 21 and all of Arnold AFB Sites 22 and 23 are within the AEDC WMA. In addition, portions of Arnold AFB Sites 20, 21, and 22 are within the waterfowl refuge. The four Potential Sites are predominantly upland with no significant aquatic biological resources on the sites.

Several aquatic species that are federally or state-listed as endangered or threatened have the potential to occur in Franklin County, the county in which the four Arnold AFB Potential Sites are located. In Franklin County, six aquatic species (mussels) are federally and state-listed, and three additional species are state-listed (298 Tennessee Department of Environment and Conservation 2012). Occurrence of these federally or state-listed aquatic animal species on these four Potential Sites is considered unlikely based on the absence of their stream and riverine habitats on the Potential Sites or within Woods Reservoir; however, the state-listed plant cutleaf water-milfoil potentially could occur in the reservoir. Their potential for occurrence would need to be confirmed by contacting Arnold AFB, the TDEC, and the USFWS for site-specific information.

Each of the four Potential Sites on Arnold AFB has a potential to support rare aquatic species or habitats within Woods Reservoir. However, a determination of whether this potential is minimal or substantial is inconclusive and dependent on the results of site-specific surveys. Accordingly, Arnold AFB Sites 20, 21, 22, and 23 were each assigned a rating of 3 for their potential to adversely affect aquatic biological resources.

5.5 Socioeconomics

The primary effects considered in this evaluation of socioeconomic impacts relate to plant construction, in particular, the capacity of the surrounding area to absorb those workers who would move into the plant vicinity and to support movement of construction supplies and equipment as well as workers. An influx of construction workers would result in increased

demand on housing, community services (such as utilities, schools, hospitals, and police and fire protection), and the transportation infrastructure. Additionally, construction and increased population could affect the aesthetics of the area and the site specifically. Socioeconomic impacts of operation primarily relate to benefits derived from the plant's presence. Therefore, this factor was not considered in evaluation of the 13 Potential Sites.

Population levels and the size of the area workforce (based on employment levels) in relation to the estimated plant construction workforce were evaluated. Estimates of the construction workforce for the SMR project are not available at this time. For the purposes of this comparison, a maximum construction workforce of 2000 was conservatively assumed, based on professional judgement and required workforce levels for other (non-SMR) nuclear power plant construction projects. Relative impacts were determined by comparing the number of plant construction jobs with total employment in the surrounding area. The adequacy of the existing transportation infrastructure was evaluated in regard to its capability of supporting the movement of persons and materials during plant construction.

The following subsections describe socioeconomic conditions at each of the Potential Sites.

ORR Sites 2, 3, 8, 9, and 10

The total population of the four counties surrounding the ORR in 2010 was 610,092 (206 U.S. Census Bureau 2010). As projected by the state of Tennessee, the total population of these counties would be about 759,052 by the year 2040 (210 Tennessee State Data Center).

Roane, Knox, Loudon, and Anderson Counties have 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. (230 U.S. Bureau of Economic Analysis 2012; 231 U.S. Bureau of Economic Analysis 2012; 265 U.S. Bureau of Economic Analysis 2012; 266 U.S. Bureau of Economic Analysis 2012)

A rural principal arterial, I-40, is located south of the installation beyond the Clinch River arm of the Watts Bar Reservoir. Two rural principal arterials traverse the installation providing access to the center of the installation from I-40. The northwestern portion of the installation is traversed by TN 58 and the northeastern portion of the installation is traversed by TN 95. TN 58 and TN 95 intersect near the center of the installation. 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 (258 City of Oak Ridge, Tennessee 2013).

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 U.S. metropolitan areas. Southern Freight Railroad is a "handling line" for Norfolk Southern Railroad. (288 Minton and Shearin 2013)

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. No truck or rail service is currently provided from this terminal. (289 Tennessee Valley Authority 2013) 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 (411 Tennessee Valley Authority 2013). Commercial navigation occurs on the Clinch River for 61 mi (594 Tennessee Valley Authority 2013). 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 feet. (344 Tennessee Valley Authority 2013) Therefore, barge access from all ORR Sites should be feasible.

In Oak Ridge, Energy Solutions, LLC operates the 11.5-mi Heritage Railroad shortline serving the East Tennessee Technology Park (ETTP) (704 Heritage Center 2013). A second shortline, operated by Knoxville and Holston River Railroad, extends 18 mi from Knoxville through Knox County (703 Tennessee Department of Transportation 2005). 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 ORR Site 3. The line to the southeast runs through Knoxville, Tennessee, connecting Chattanooga, Tennessee with Johnson City and Kingsport, Tennessee. (705 Norfolk Southern Railway Company 2011) There are currently no rail spurs to any of the ORR Sites. However, the southern terminus of the Heritage Railroad short line is located near Bear Creek Road west of TN 58 in the vicinity of all of the ORR Sites.

The construction workforce assumed for the SMR project accounts for less than 5 percent of the total workforce within the four counties surrounding the ORR; therefore, socioeconomic effects are considered small. When the estimated plant construction workforce was compared to area construction employment levels, the ORR area would experience less than a 10 percent increase (9 percent) and the increased demands on housing and community services, such as utilities, schools, hospitals, and police and fire protection would be small.

Visual and aesthetic impacts associated with the construction process may occur as a result of the introduction of a structure or facility that is not consistent with the existing viewshed. The ORR sites are generally undeveloped, containing few man-made structures. Views of the sites from surrounding areas are characterized by the waters within the winding channel of the Clinch River Arm of the Watts Bar Reservoir; forested shorelines, bluffs, and ridges; and areas of old fields. Views of the sites are generally blocked by riparian vegetation; however, several residences directly across the reservoir from Sites 2 and 3 have a good view.

Most of the construction activities at the ORR sites are not expected to be visible to the general public. Construction of the SMR Plant at any of the ORR sites would entail the use of large cranes, which would be visible above the tree line. Additional site activities such as large earth-moving equipment, supply stockpiles and the transportation of large materials onto the site may be visible to members of the public from the surrounding area. Night time lighting may be used during construction if work is to proceed at night and for security purposes.

Construction activities related to the proposed SMR project may be visible at times to recreational users on the Clinch River arm of the Watts Bar Reservoir, the Melton Hill Reservoir and Melton Hill Dam Reservation, the Gallaher Recreation Area, the East Tennessee Technology Park Visitor's Overlook and the Oak Ridge State Wildlife Management Area (WMA) (509 AECOM 2013). These impacts will be most severe while the intake and outfall structures are being built. Due to ORR's location among the ridges and valleys of the natural terrain and the forested nature of the landscape, this impact will be minimal and temporary.

Based on the small size of the SMR project construction workforce relative to the local workforce in the four counties surrounding the ORR and minimal or no impacts on community services, transportation, and visual resources, the Potential Sites associated with the ORR are considered suitable and were each assigned a rating of 5.

Redstone Arsenal Sites 12, 14, and 15

The two counties adjacent to Redstone Arsenal had a total population of 454,301 in 2010 (206 U.S. Census Bureau 2010). Population projections by the state of Alabama estimate a total population for these counties of 612,655 by the year 2040 (211 University of Alabama, Center for Business and Economic Research).

Madison and Morgan Counties have 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. (232 U.S. Bureau of Economic Analysis 2012; 233 U.S. Bureau of Economic Analysis 2012)

At Redstone Arsenal in Huntsville, Alabama, I-565 borders the northern portion of the installation and the US 231 freeway borders the east. The western portion of the installation is bordered by Zierdth Road. Traversing the installation are Martin Road that runs east/west, and Rideout Road that runs north/south. The Wheeler Reservoir forms the southern boundary of Redstone Arsenal. Barge access is available in Decatur, Alabama, approximately 22 mi southwest of Huntsville. In 2006, more than 54 million tons of goods were shipped on the Tennessee River (Wheeler Reservoir) and barge traffic was increasing (160 Tennessee Valley Authority 2013; 162 Life on the Water 2010).

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 (259 City of Huntsville Planning Division 2013):

- 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.

A major concern in the Tennessee Valley has been the lack of limited-access interstate highways connecting Huntsville, Alabama, with other east-west cities, such as Memphis, Tennessee; Atlanta, Georgia; and Chattanooga, Tennessee. Although I-565is an east-west interstate, it 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 route to connect these urban areas, but funding for the project is pending (259 City of Huntsville Planning Division 2013).

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 (259 City of Huntsville Planning Division 2013).

Further consideration for conventional intercity rail service has been studied concerning Amtrak between Huntsville, Alabama, and Birmingham, Alabama. However, during the past several years, Amtrak has struggled with insolvency and will not be adding any new service in the immediate future (259 City of Huntsville Planning Division 2013).

The construction workforce assumed for the SMR project accounts for less than 5 percent of the total workforce within the two counties adjacent to Redstone Arsenal; therefore, socioeconomic effects are considered small. When the estimated plant construction workforce was compared to area construction employment levels, the Redstone Arsenal area would experience a 16 percent increase and the increased demands on housing and community services, such as utilities, schools, hospitals, and police and fire protection, would be small.

Visual changes in the area due to construction may occur. The Redstone Arsenal is significantly more developed than ORR, including large and small military structures and roads. An increase in construction traffic and views of a large construction site would not be as noteworthy to observers on the arsenal property. The sites are not accessible to the public, so views of any of the potential sites would be limited to residences and businesses located on the periphery of the arsenal and to boaters on Wheeler Reservoir. The general upland area surrounding Redstone Arsenal is suburban and rural, and there is a visual buffer consisting of trees along the periphery of the facility. Additionally, although the area is relatively flat topographically, the potential sites are not elevated with respect to the surrounding area, and the slight undulations of the land surface would assist in hiding the construction project from sight. The ridge to the east of the arsenal is approximately 500 feet higher than the potential sites. The views from this area, however, are also blocked by dense tree stands. Direct lines of site are generally not available from the residential areas closest to the potential sites on the arsenal property. Due to the

limited views of the potential sites from the surrounding area, visual and aesthetic effects due to construction would be considered small and would be temporary.

The SMR project construction workforce is small in relation to the local workforce in the counties adjacent to Redstone Arsenal and there would be minimal or no impacts on community services and visual resources. 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. Accordingly, the three Potential Sites associated with Redstone Arsenal are considered suitable, with minor concerns related to interstate access, and were each assigned a rating of 4.

Arnold AFB Sites 20, 21, 22 and 23

The total population of the two counties surrounding Arnold AFB was 93,848 in 2010 (206 U.S. Census Bureau 2010). Projections by the state of Tennessee indicate a total 2040 population in these counties of 128,592 (210 Tennessee State Data Center).

Coffee and Franklin Counties have a total 2011 employment of 46,766 jobs. Government and government enterprises provide 12.5 percent of the jobs and manufacturing provides 12.4 percent. Retail trade is the next largest employment sector, providing 11.1 percent of the jobs. Professional, scientific, and technical services represent 8.3 percent of employment. The construction sector employs 2454 persons, representing 5.2 percent of employment in the two counties. (238 U.S. Bureau of Economic Analysis 2012; 239 U.S. Bureau of Economic Analysis 2012)

Arnold AFB is located between Tullahoma, Tennessee and Manchester, Tennessee. Major roadways border the perimeter of the installation, including I-24 on the northeast and TN 55 (New Manchester Highway) on the northwest. US 41 (Tullahoma Highway) is located to the west. Minor arterial roadways include TN 127 (AEDC Road), which borders the southeastern side of the installation and crosses through the installation over Woods Reservoir, and Wattendorf Memorial Highway, which traverses east-west through the installation. Woods Reservoir borders the south as well. The installation contains paved roads, and gravel roads 18-feet wide and 16-feet wide. Logging trucks travel along installation roads (135 Tennessee Valley Authority 2001).

According to the City of Tullahoma Comprehensive Draft Transportation Plan, dated February 2013, the City of Tullahoma, Tennessee, has an active general aviation municipal airport in the northwest quadrant of the city. The airport is important to the economic growth of the community due to the existence of airport-related businesses, industries, and general tourism. A project to develop an airport business park to generate additional commercial businesses, industries, and private aircraft hangars for the facility is planned (262 St. John Engineering 2013).

A railroad spur off-loading area is located on Arnold AFB just north of Wattendorf Memorial Highway. It travels east from Tullahoma from the mainline junction between CSX Railroad and Western Railroad. The CSX Railroad goes northwest to Nashville, Tennessee, and the Caney

Fork and Western Railroad travels northeast to Sparta, Tennessee (135 Tennessee Valley Authority 2001).

The closest barge terminal to Arnold AFB is the Port of Nickajack Warf Port Facility on the Nickajack Reservoir, which is approximately 50 mi from Arnold AFB.

The construction workforce assumed for the SMR project accounts for less than 5 percent of the total workforce within the two counties surrounding Arnold AFB; therefore, socioeconomic effects are considered small. When the estimated plant construction workforce was compared to area construction employment levels, the Arnold AFB area would experience an 82 percent increase. Conservatively assuming all of the plant construction workers would in-migrate to the area, the increase in population would be 2 percent. This increase in population would likely result in minor resource concerns that could require mitigation by the surrounding communities. The effects of this increase in population on community services would likely result in an increase in housing demand, increased traffic on roads and the potential need for increased services such as education and health care.

The visual effects of a large construction site would be moderate as the potential sites at Arnold Air Force Base are in undeveloped areas. Additionally, these areas are visible from surrounding recreation areas on Woods Reservoir and potentially from Arnold Village. Franklin County Park, which includes a boat ramp, is just across the reservoir from all four sites. The surrounding area is mostly rural, consisting of farmland, open areas and forested land. The potential SMR sites are all located immediately adjacent to the reservoir, and would thus be visible from the roads and residences in the area. The sight of large construction equipment and increased road traffic, including supplies and equipment would constitute a major difference from the existing aesthetic conditions. However, the construction project would be temporary, and views of the plant post-construction would likely be moderately disparate to the surrounding viewsheds.

The SMR project would have minimal or no impacts on the visual resources in the counties surrounding Arnold AFB, although on AFB itself, there could be visual impacts to residences and the community college. Because the area would experience an 82 percent increase in the construction workforce within the ROI, community services would be moderately affected. Although the area surrounding Arnold AFB appears to have suitable accessibility for road and rail traffic, there is no nearby access to a barge terminal. Accordingly, the four Potential Sites associated with Arnold AFB were each assigned a rating of 3.

5.6 Environmental Justice

The following subsections describe environmental justice conditions near each of the Potential Sites. The environmental justice evaluation as defined by Executive Order 12898 focuses on potential disproportionately high and adverse impacts on minority and low-income populations. Numerical ratings are not applicable to the question of whether an impact is disproportionate or it is not disproportionate to a particular population. Therefore, numerical ratings were not assigned for environmental justice.

Executive Order 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. This section provides demographic information that characterizes the distribution of minority populations and low-income populations in the areas surrounding each of the federal installations.

In identifying minority and low-income populations, the following Council on Environmental Quality (CEQ) definitions of minority individuals and populations and low-income populations were used:

Minority individuals. Individuals who identify themselves as members of the following population groups: American Indian or Alaskan Native, Asian, Native Hawaiian or Other Pacific Islander, Black, Hispanic, or two or more races.

Minority populations. Minority populations are identified where (1) the minority population of an affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

Low-income populations. Low-income populations in an affected area are identified with the annual statistical poverty thresholds from the Census Bureau's Current Population Reports, Series P-60, on Income and Poverty.

According to CEQ guidance, U.S. Census data are typically used to determine minority and low-income population percentages in the affected area of a project in order to conduct a quantitative assessment of potential environmental justice impacts.

Factors considered in evaluation of the 13 Potential 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: whether the proposed action results in significant adverse health or environmental impacts and, if so, whether disproportionate adverse impacts would be experienced by minority or low-income populations found within any of the communities near the Potential Sites and whether those impacts differ between sites.

ORR Sites 2, 3, 8, 9, and 10

The 2010 demographic profile of the four counties surrounding the ORR is presented in Table 5.6-1. Minorities constitute less than 10 percent of the total population in three of these counties, according to the 2010 U.S. Census of Population. Anderson, Loudon, and Roane Counties have a total minority population of 9.3, 9.8, and 6.3 percent, respectively. Knox County has a total minority population of 16.1 percent. These levels are well below the Tennessee state average of 24.4 percent and the national average of 36.3 percent. (214 U.S. Census Bureau 2010)

Table 5.6-1
Demographic Profile of the 2010 Population near ORR

	Anderson County	Knox County	Loudon County	Roane County
Total Population	75,129	432,226	48,556	54,181
Race (percent of total non-Hispanic population)				
White	92.9	86.9	96.9	94.9
Black or African American	3.8	9.0	1.1	2.7
American Indian and Alaska Native	0.3	0.2	0.2	0.3
Asian	1.1	1.9	0.6	0.5
Native Hawaiian and Other Pacific Islander	0.0	0.1	0.0	0.0
Some other race	0.1	0.1	0.1	0.0
Two or more races	1.8	1.7	0.9	1.5
Ethnicity				
Hispanic or Latino	1768	15,012	3395	710
Percent of total population	2.4	3.5	7.0	1.3
Minority Population (including Hispanic or Latino ethnicity)				
Total minority population	6995	69,646	4780	3429
Percent minority	9.3	16.1	9.8	6.3

(214 U.S. Census Bureau 2010)

According to census data (2007-2011 American Community Survey), 16.8 percent of individuals residing within Anderson County are identified as living below the federal poverty threshold (218 U.S. Census Bureau 2013). In Knox, Loudon, and Roane counties, the proportion is 13.7, 14.0, and 15.2 percent, respectively (219 U.S. Census Bureau 2013; 267 U.S. Census Bureau 2013; 268 U.S. Census Bureau 2013). These levels are below the Tennessee state average of 16.9 percent; two of the counties are above the national average of 14.3 percent (217 U.S. Census Bureau 2013; 218 U.S. Census Bureau 2013).

The minority population percentage in the vicinity of the ORR is less than the state average and the number of persons living below the poverty level is similar to the Tennessee state average. No disproportionate impacts to environmental justice communities are anticipated and the Potential Sites associated with the ORR are considered suitable for SMR siting. If any of the ORR sites are selected as a Candidate Site, a detailed demographic evaluation will be conducted in the ESPA ER to identify specific minority or low-income populations in those areas with the potential for impacts from construction or operation of the SMRs. The evaluation will be performed for the area within a 50-mi radius of the Candidate Site.

Redstone Arsenal Sites 12, 14, and 15

As presented in the 2010 demographic profile of the two counties adjacent to Redstone Arsenal, minorities constitute 33.9 percent of the population in Madison County and 22.5 percent in Morgan County (Table 5.6-2). The minority population in Madison County is similar to the Alabama state average of 33.0 percent and less than the national average of 36.3 percent. In

Morgan County, the minority population is below both the Alabama state average and the national average. (214 U.S. Census Bureau 2010)

Table 5.6-2
Demographic Profile of the 2010 Population near Redstone Arsenal

	Madison County	Morgan County
Total Population	334,811	119,490
Race (percent of total non-Hispanic population)		
White	69.3	83.9
Black or African American	24.9	12.7
American Indian and Alaska Native	0.7	0.8
Asian	2.6	0.6
Native Hawaiian and Other Pacific Islander	0.1	0.1
Some other race	0.1	0.1
Two or more races	2.2	1.8
Ethnicity		
Hispanic or Latino	15,404	9156
Percent of total population	4.6	7.7
Minority Population (including Hispanic or Latino ethnicity)		
Total minority population	113,366	26,905
Percent minority	33.9	22.5

(214 U.S. Census Bureau 2010)

In Madison County, 12.4 percent of the population and in Morgan County, 14.9 percent of the population was identified as living below the official poverty level during the period 2007-2011 (224 U.S. Census Bureau 2013; 154 U.S. Census Bureau 2013). In the state of Alabama, 17.6 percent of the population and in the United States, 14.3 percent of the population was identified as living below the official poverty level during the period 2007-2011 (154 U.S. Census Bureau 2013; 217 U.S. Census Bureau 2013) .

Minority population in the two counties adjacent to Redstone Arsenal is similar to or less than the Alabama state average and the number of people living in poverty is less than the state average. No disproportionate impacts to environmental justice communities are anticipated and the Potential Sites associated with Redstone Arsenal are considered suitable for siting SMRs. If any of the Redstone Arsenal sites are selected as a Candidate Site, a detailed demographic evaluation will be conducted in the ESPA ER to identify specific minority or low-income populations in those areas with the potential for impacts from construction or operation of the SMRs. The evaluation will be performed for the area within a 50-mi radius of the Candidate Site.

Arnold AFB Sites 20, 21, 22, and 23

The 2010 demographic profile of the two counties surrounding Arnold AFB is presented in Table 5.6-3. Minorities constitute approximately 10 percent of the total population in each of these counties as of the 2010 U.S. Census of Population. Coffee County and Franklin County have a

total minority population of 10.0 and 10.3 percent, respectively. These levels are well below the Tennessee state average of 24.4 percent and the national average of 36.3 percent. (214 U.S. Census Bureau 2010)

Table 5.6-3
Demographic Profile of the 2010 Population near Arnold AFB

	Coffee County	Franklin County
Total Population	52,796	41,052
Race (percent of total non-Hispanic population)		
White	93.6	92.0
Black or African American	3.6	5.2
American Indian and Alaska Native	0.3	0.3
Asian	0.9	0.7
Native Hawaiian and Other Pacific Islander	0.0	0.0
Some other race	0.0	0.1
Two or more races	1.6	1.5
Ethnicity		
Hispanic or Latino	2007	1029
Percent of total population	3.8	2.5
M**inority Population (including Hispanic or Latino ethnicity)**		
Total minority population	5257	4213
Percent minority	10.0	10.3

(214 U.S. Census Bureau 2010)

In Coffee County, 18.8 percent of the population and in Franklin County, 13.8 percent of the population was identified as living below the official poverty level during the period 2007-2011 (146 U.S. Census Bureau 2013; 147 U.S. Census Bureau 2013). In the state of Tennessee, 16.9 percent of the population and in the United States, 14.3 percent of the population was identified as living below the official poverty level during the period 2007-2011 (146 U.S. Census Bureau 2013; 217 U.S. Census Bureau 2013).

In the two counties adjacent to Arnold AFB, minority populations are well below the Tennessee average and in Franklin County the number of persons living below the poverty level is less than the state average. In Coffee County the percentage of persons living in poverty is greater than the state and national averages. No disproportionate impacts to environmental justice communities are anticipated and the Potential Sites associated with Arnold AFB are considered suitable for siting SMRs. If any of the Arnold AFB sites are selected as a Candidate Site, a detailed demographic evaluation will be conducted in the ESPA ER to identify specific minority or low-income populations in those areas with the potential for impacts from construction or operation of the SMRs. The evaluation will be performed for the area within a 50-mi radius of the Candidate Site.

5.7 Historic and Cultural Resources

The following subsections describe historic and cultural resources at each of the Potential Sites.

ORR Site 3

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 ORR 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 National Register of Historic Places (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. (467 Barrett, Hockersmith, Karpynec, and McKee 2011; 78 Barrett, Hockersmith, Karpynec, and McKee 2011) A total of 26 NRHP listed properties are located within a 10-mi radius of ORR Site 3 (243 U.S. Environmental Protection Agency 2013).

ORR Site 3 was assigned a rating of 3 because some of the potentially eligible sites may be affected by the SMR project. Although many of the sites can be avoided, some potentially eligible sites may be unavoidable. It is expected that most concerns could be mitigated with small design changes.

ORR Sites 2, 5, 8, 9 and 10

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 (186 Oak Ridge National Laboratory, Y-12 National Security Complex, and URS/CH2M Oak Ridge LLC 2012):

- 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

No NRHP sites are located within ORR Sites 2, 5, 8, 9 or 10. The number of recorded and previously unrecorded archaeological sites within ORR Sites 2, 5, 8, 9 and 10 is not publically available. Further information would be required to determine the potential affects to archaeological resources as a result of siting the SMRs if any of these Potential Sites are selected as a Candidate Site.

An additional 35 NRHP sites are located within 10 mi of the ORR boundary (243 U.S. Environmental Protection Agency 2013).

The potential ORR Sites 2, 5, 8, 9 and 10 were each assigned a rating of 3 based on the assumption that cultural resources could be avoided or mitigated with small design changes.

Redstone Arsenal Sites 12, 14, and 15

Approximately 1000 archaeological sites have been identified at Redstone Arsenal and approximately 418 of these sites are potentially eligible for listing on the NRHP (150 U.S. Army Environmental Command 2008).

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
- Saturn V Dynamic Test Stand

No NRHP sites are located within Redstone Arsenal Sites 12, 14, or 15. Although 418 archaeological sites potentially eligible for the NRHP are known to exist within the Redstone Arsenal boundary, the number of recorded and previously unrecorded archaeological sites within Redstone Arsenal Sites 12, 14 and 15 is not publically available. Further information would be required to determine the potential affects 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 (244 U.S. Environmental Protection Agency 2013).

The potential Redstone Arsenal Sites 12, 14, and 15 were each assigned a rating of 3 based on the assumption that cultural resources could be avoided and that most concerns could be mitigated with small design changes.

Arnold AFB Sites 20, 21, 22, and 23

Based on the information currently available, there are seven archaeological and historic sites in the vicinity of Sites 20, 21, and 22. One site has been recommended to be avoided during ground disturbing activities; it is presumed that this site is considered potentially eligible or eligible for the NRHP. (135 Tennessee Valley Authority 2001; 1049 Thomas, Nichols, and Holland 2015) No information on archaeological resources for other areas at Arnold AFB has been identified at this time. Further evaluation of cultural resources would be required to determine the suitability of Arnold AFB as a Potential Site for the SMR project.

No NRHP sites have been identified within the Arnold AFB boundary. A total of 22 NRHP sites are located within 10 mi of the Arnold AFB boundary. (245 U.S. Environmental Protection Agency 2013)

Arnold AFB Sites 20, 21, 22, and 23 were each assigned a rating of 3 based on the assumption that cultural resources could be avoided and that most concerns could be mitigated with small design changes.

5.8 Air Quality

The following subsections describe air quality near each of the Potential Sites. In addition to the standard criteria pollutants (One-hour Ozone [1-h O_3], Eight-Hour Ozone [8-h O_3], Carbon Monoxide [CO], Nitrogen Dioxide [NO_2], Sulfur Dioxide [SO_2], Particulate Matter-10 micrometers [PM_{10}], Particulate Matter - 2.5 micrometers [$PM_{2.5}$], and lead), the proximity to Class I Areas needs to be evaluated. Class I Areas are National Parks and Wilderness areas that have been designated as special status by the EPA through the Regional Haze Program. The Regional Haze Rule requires states to coordinate with the EPA, the National Park Service, USWFS and the U.S. Forest Service to reduce the pollution that causes visibility impairment. (290 U.S. Environmental Protection Agency 2012)

ORR Sites 2, 3, 5, 8, 9, and 10

Industrial point sources of air emissions within 10 mi of the ORR boundary include asphalt operations, a quarry, dry cleaners, metals recovery/refining facilities, and other industrial companies. Two TVA operated fossil plants are located within 10 mi of the ORR boundary. The Bull Run Fossil Plant is located less than 0.5 mi from the ORR boundary and the Kingston Fossil Plant is located less than five mi from the ORR boundary (188 U.S. Environmental Protection Agency 2013). As of 2007, approximately 13 Clean Air Act (CAA) major source operating permits have been issued on the ORR for the three major facilities: the ORNL, the Y-12 Complex, and the ETTP (187 U.S. Department of Energy 2008). The three facilities have operated in compliance with the CAA Title V Operating Permit Program (186 Oak Ridge National Laboratory, Y-12 National Security Complex, and URS/CH2M Oak Ridge LLC 2012). EPA has designated Anderson County and Roane County as non-attainment areas for the $PM_{2.5}$ air quality standard. The ORR is an attainment area for all other National Ambient Air Quality Standards criteria pollutants (186 Oak Ridge National Laboratory, Y-12 National Security Complex, and URS/CH2M Oak Ridge LLC 2012; 188 U.S. Environmental Protection Agency 2013). Knox County is in attainment for the following criteria pollutants: 8-h O_3, 1-h O_3, lead, CO, NO_2, SO_2 and PM_{10} (291 U.S. Environmental Protection Agency 2013).

The Great Smoky Mountains National Park is a Class I Regional Haze area, located approximately 30 mi south-southeast of ORR. Additionally, the Joyce Kilmer – Slickrock Wilderness, also a Class I area, is a portion of this park, located approximately 50 mi south-southeast of ORR. (290 U.S. Environmental Protection Agency 2012)

The construction and operation of the SMR will contribute a very small quantity of criteria pollutants; however, these air quality concerns can be addressed through mitigation and permitting actions. Because ORR is located in EPA designated non-attainment areas for $PM_{2.5}$, but not close to a Class 1 area, the Potential Sites associated with ORR were each assigned a rating of 4.

Redstone Arsenal Sites 12, 14, and 15

Industrial point sources of air emissions within 10 mi of the installation include solid waste disposal authorities, multiple dry cleaners, automotive manufacturing and systems companies, a hospital, and other industrial facilities (189 U.S. Environmental Protection Agency 2013). The

Redstone Arsenal operates under a CAA Title V major source operating permit issued by the Alabama Department of Environmental Management in 2003 (139 URS Corporation and LW Redstone Company LLC 2008).

Madison County is in attainment for all of the air quality criteria pollutants; 1-h O_3, 8-h O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, and lead (291 U.S. Environmental Protection Agency 2013).

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 (290 U.S. Environmental Protection Agency 2012).

Redstone Arsenal is located in an attainment area for all criteria air quality pollutants. The construction and operation of the SMR will contribute a very small quantity of criteria pollutants; however, these air quality concerns can be addressed through mitigation and permitting actions. Because the area is in attainment and not close to a Class 1 area, the Potential Sites associated with Redstone were each assigned a rating of 5.

Arnold AFB Sites 20, 21, 22, and 23

Industrial point sources of air emissions within 10 mi of the AFB include a landfill, multiple dry cleaners, fabrication and manufacturing facilities, asphalt companies, a tannery, and other industrial companies (191 U.S. Environmental Protection Agency 2013). The CAA Title V operating permit status of Arnold AFB is unknown. Coffee and Franklin Counties, Tennessee are in attainment for all air quality criteria pollutants (291 U.S. Environmental Protection Agency 2013).

The Cohutta Wilderness Area in Georgia is a Class I Regional Haze area located approximately 90 mi south east of Arnold AFB (290 U.S. Environmental Protection Agency 2012).

Arnold AFB is located in an attainment area for all criteria air quality pollutants. The construction and operation of the SMR will contribute a very small quantity of criteria pollutants; however, these air quality concerns can be addressed through mitigation and permitting actions. Because the area is in attainment and not close to a Class 1 area, the Potential Sites associated with Arnold AFB were each assigned a rating of 5.

5.9 Human Health

Human health impacts associated with the plant's construction, reactor operation, and cooling system operation for each Potential Site would be similar as the technology to be deployed would be the same for each location. Occupational human health concerns include occupational injuries, noise, odors, vehicle exhaust, dust, electrical fields, and exposures to gaseous and liquid radioactive effluents. None of the alternative sites has site characteristics that would be expected to lead to fewer or more operational health impacts than would be expected for any of the other alternative sites.

Off-site human health concerns from operations include impacts from thermophilic microorganisms and from noise resulting from the operation of the cooling system and

exposures to gaseous and liquid radioactive effluents. Thermophilic microorganisms are microorganisms that are associated with cooling towers and thermal discharges can have negative impacts on human health. The presence and numbers of these organisms can be increased by the addition of heat. However, based on the fact that facility design and cooling requirements would be the same at any of the sites, there would be no difference in human health impacts from thermophilic organisms between the sites.

Occupational exposures to radioactive and hazardous materials or environments during construction or operation would also be similar for all sites provided the design is not adjusted simply because there is more space available. Site-specific baseline noise assessments analyses for site-to-site comparisons are beyond the scope of this Siting Study. The same bounding liquid and gaseous effluent releases would likely be used to evaluate doses to the maximally exposed individual and the population at each alternative site.

Because it is likely that small human health concerns could arise for any or all of the 13 Potential Sites, and these concerns are expected to be addressed with small design or operational changes, compliance with applicable regulations and use of best management practices, all were each assigned a rating of 4..

5.10 Postulated Accidents

Postulated accidents involving radioactive materials at the Potential Sites and/or transportation of radioactive materials to and from each Potential Site would be similar because the technology to be deployed would be the same for each location and the radiological sources terms would be consistent. The potential dose consequences from postulated accidents cannot be evaluated without the collection and analysis of site-specific meteorological data and without determining the distances from the SMRs to the site boundary, which are beyond the scope of this Siting Study. The general climatological conditions are sufficiently similar at each of the Potential Sites that it is unlikely that differences in local meteorological conditions would result in significant differences in doses following a design-basis accident.

However, as provided in Section 3.5.1.6 of NUREG 0800, the probability of an aircraft accident resulting in a radiological consequence greater than the 10 CFR 100 exposure guidelines is greater for sites close to airports and military airfields. If the following criteria are met, the probability of exceeding the radiological consequence is considered to be less than 10^{-7} per year:

A. The plant-to-airport distance D is between 5 and 10 mi, and the projected annual number of operations is less than 500 D^2, or the plant-to-airport distance D is greater than 10 mi, and the projected annual number of operations is less than 1000 D^2

B. The plant is at least 5 mi from the nearest edge of military training routes, including low-level training routes, except for those associated with usage greater than 1000 flights per year, or where activities (such as practice bombing) may create an unusual stress situation

C. The plant is at least 2 mi beyond the nearest edge of a federal airway, holding pattern, or approach pattern.

In addition, as discussed in Section 3.2.1 (Geology/Seismology), the proximity of seismological hazards is an essential part of the process of evaluating Potential Sites for the location of new nuclear projects. Sites with a higher PGA rate are also considered as having a greater potential for having an accident resulting in an environmental impact.

ORR Sites 2, 3, 5, 8, 9, and 10

All ORR sites are considered to be equal distance from regional airports. The nearest 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) (1332 McGhee Tyson Airport 2015; 1333 McGhee Tyson Airport 2015). 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) (1334 AirNav.com 2015). The PGA for the ORR ranges from 6 to 7 percent g (Figure 3.2-1). Although the ORR sites are an adequate distance from airports in the region, the relatively high PGA rating resulted in the ORR sites receiving a rating of 3

Redstone Arsenal Sites 12, 14, and 15

Redstone Arsenal Sites 12 and 14 are located within 5 m of the Huntsville International Airport, which has an average of 160 operations per day (58,400 per year). Additionally, Sites 12 and 14 are located less than 5 mi from the Redstone Army Airfield (1335 AirNav.com 2015). Site 15 is located within 10 mi of the Huntsville International Airport and the Redstone Army Airfield. The PGA for the Redstone Arsenal ranges from 4 to 5 percent g (Figure 3.2-1). None of the Redstone Arsenal sites meet all three criteria listed in 10 CFR. Therefore, Sites 12, 14, and 15 were assigned a rating of 4 based on both their proximity to Huntsville International Airport or the Redstone Army Airfield and a PGA range of 4 to 5 percent g.

Arnold AFB Sites 20, 21, 22, and 23

Each of the Arnold AFB sites is located within 5 mi of the base airfield. The Tullahome, Tennessee Regional Airport, with an average of 73 operations per day (26,645 per year), is 5 to 10 mi from each of the Potential Sites. The PGA for Arnold AFB ranges from 4 to 5 percent g (Figure 3.2-1). Therefore, Sites the Arnold AFB sites were assigned a rating of 4 based on not meeting the aircraft accident criteria and the PGA range of 4 to 5 percent g.

5.11 Fuel Cycle Impacts

Fuel cycle impacts for each Potential Site would be similar because the technology to be deployed would be the same for each location with each requiring similar amounts of fuel over the lifetime of the reactors. Each Potential Site would have sufficient space and adequate security for an independent spent fuel dry storage facility. The Potential Sites are all located within two adjoining states with easy to moderate access to I-40 for transportation to western low level radioactive waste disposal sites in Texas, Utah, and Idaho or the only proposed spent

fuel repository in Nevada. However, the ORR Sites have easy access to I-40; Redstone Arsenal and Arnold AFB Sites have more moderate travel routes to I-40. Distances from each federal installation to the same location on I-40 west of Nashville, Tennessee vary by no more than approximately 100 mi. Therefore, the ORR Sites have a slight advantage over Redstone Arsenal and Arnold AFB Sites with regard to spent fuel and radioactive waste transportation.

New fuel, which poses a much lower risk in transportation accidents, will likely be shipped to the Potential Sites from a location in the southeastern United States. Currently, the only fuel fabrication facilities in the United States are in South Carolina, North Carolina, Tennessee, and Virginia. Because these fuel fabrication facilities are located closer to the Potential Sites than the spent fuel and radioactive waste disposal sites, the percent difference of transportation distances will be greater from site to site for the new fuel shipments than for the spent fuel and radioactive waste shipments. However, because the fuel supplier is not yet known, there is no significant advantage that can be assigned to one Potential Site over another with regard to new fuel transportation.

Based on this analysis, the ORR Sites were assigned ratings of 4 and the Redstone Arsenal and Arnold AFB Sites were assigned ratings of 3 based similar transportation distances but easier access to the primary east-west interstate highway from ORR Sites.

5.12 Transmission Corridors

All 13 Potential Sites are on or adjacent to direct-served TVA customers, so existing transmission lines are associated with each of the installations. Although the specific configuration and available capacity of the existing transmission lines are unknown at this time, it is assumed that each of the 13 Potential Sites would have access to transmission corridors. ORR Sites 2, 3, 5, 8, and 10 have access to transmission lines within the site boundary and were each assigned a rating of 5. ORR Site 9 has access to transmission lines within 1 mi of the site boundary and was assigned a rating of 4. Redstone Arsenal Sites 12, 14, and 15 have access to transmission lines within 5 mi and were assigned a rating of 4. Arnold AFB Sites 20, 21, 22, and 23 have access to transmission lines within the site boundary and were assigned a rating of 5.

5.13 Population Distribution and Density

Relevant factors considered for evaluation of the suitability of the 13 Potential Sites with respect to population distribution and density are the distance to the nearest population center and the population density in the area. 10 CFR 100.21(h) states that reactors should be located away from very densely populated centers and areas of low population density are generally preferred. This site suitability criterion gives preference to a local population density that is low (i.e., mean density of 500 or fewer people per square mi out to a 20-mi radius) (61 Draft Regulatory Guide DG-4021 (Proposed Revision 3 to Regulatory Guide 4.7, dated April 1998) General Site Suitability Criteria for Nuclear Power Stations 2011). Transient populations, which are people who work at an installation and spend a fraction of the day there, but who may not necessarily reside within a 20-mi radius, were also considered. The following evaluation was

based on 2010 U.S. Census population data for nearby population centers and for the 20-mi radius around the three federal installations containing the Potential Sites.

ORR Sites 2, 3, 5, 8, 9, and 10

The ORR is located within the city limits of Oak Ridge, Tennessee, which has a population of 29,330 (169 U.S. Census Bureau 2013). The closest metropolitan area is Knoxville, Tennessee, located approximately 25 mi east of the ORR. The Knoxville, Tennessee city population is 178,874 (168 U.S. Census Bureau 2013). A total of approximately 837,471 people reside within a Census Bureau 20-mi radius of the ORR (3470.8 square mi), with a population density of 241 persons per square mi (525 U.S. Census Bureau 2013) Approximately 9,600 people are employed at ORNL and Y-12 Complex, the major employers at ORR, and spend a portion of each workday within ORR and nearby areas (688 East Tennessee Economic Development Agency and Clear 2013).

The six Potential Sites associated with ORR were each assigned a rating of 5 based on a population density within a 20-mi radius of less than 250 persons per square mi and the relatively small size of Oak Ridge, Tennessee (less than 30,000), the largest community within a 20-mile radius.

Redstone Arsenal Sites 12, 14, and 15

Redstone Arsenal is located in Madison County adjacent to the city of Huntsville, Alabama. The population of Huntsville, Alabama, is 180,105 (155 U.S. Census Bureau 2013). The city of Madison, Alabama, located approximately one mi to the northwest, has a population of 42,938 (225 U.S. Census Bureau 2013). The population within a Census Bureau 20-mi radius of Redstone Arsenal (3393.6 square mi) is approximately 642,726, with a population density of 189 persons per square mi (526 U.S. Census Bureau 2013). Redstone Arsenal employs approximately 35,000 people who spend a fraction of each workday in the area (158 U.S. Army 2013).

The three Potential Sites associated with Redstone Arsenal were each assigned a rating of 4. Although the 20-mi-radius population density is less than 250 persons per square mi, the facility is in a metropolitan area adjacent to a large city (Huntsville, Alabama) with a population greater than 150,000 (just over 180,000) and a transient population of approximately 35,000 Redstone Arsenal employees. Additional resource concerns will need to be evaluated during Candidate Site evaluations.

Arnold AFB Sites 20, 21, 22, and 23

Arnold AFB is located in Coffee and Franklin Counties, Tennessee. It is adjacent to the city of Tullahoma, Tennessee, and approximately 15 mi southeast of Shelbyville, Tennessee. The population of Tullahoma, Tennessee, is 18,655 (151 U.S. Census Bureau 2013). Shelbyville, Tennessee, has a population of 20,335 (216 U.S. Census Bureau 2013). The population within a Census Bureau 20-mi radius of Arnold AFB (3489.4 square mi) is approximately 257,233, with a population density of 74 persons per square mi (528 U.S. Census Bureau 2013).

Approximately 2,500 people are employed at Arnold AFB and spend a portion of each workday in the area (999 U.S. Department of Defense 2014).

The four Potential Sites associated with Arnold AFB were each assigned a rating of 5 based on a population density within a 20-mi radius less than 250 persons per square mi and the small size of nearby cities (approximately 20,000).

5.14 Facility Costs

The costs for the SMR components and supporting facilities at each Potential Site would be similar because the technology to be deployed would be the same for each location. However, the costs associated with site acquisition and site preparation would be site specific. Because TVA manages the land at ORR Site 3 and 9, no property transfer or purchase would be incurred for ORR Sites 3 or 9. ORR Site 3 has also been previously cleared and has some infrastructure remains from the uncompleted Clinch River Breeder Reactor construction project (26 Breeder Reactor Corporation 1985). ORR Site 3 was therefore assigned a rating of 5. Since ORR Site 9 is also managed by TVA and would not have any associated purchase or transfer costs but it is undeveloped and has no existing infrastructure, it was assigned a rating of 2.

Locating the SMRs on or adjacent to the other four Potential Sites associated with ORR, the three Redstone Arsenal sites, or the four Arnold AFB sites would require the purchase of property or federal-to-federal transfer of existing property and additional time and costs would be incurred. All three installations have access to infrastructure but additional tie-ins to individual sites would have to be constructed. ORR sites 2, 5, and 10 are on undulating to hilly terrain and would require moderate grading and were assigned a rating of 3. Locating the SMRs on the Redstone Arsenal Sites 14 or 15 would require the relocation of the Test Range currently operated in this area of the arsenal. The portion of Redstone Arsenal Site 12 is in the buffer zone of the Test Range and, although some reconfiguration of the range would be required if this site is selected as the preferred site, it is unlikely that the Test Range would need to be relocated. Based on these contributing elements, Redstone Arsenal Sites 14 and 15 were assigned a rating of 3. The other Potential Sites (ORR Sites 8; Redstone Arsenal Site 12; and Arnold AFB Sites 20, 21, 22, and 23) were each assigned a rating of 4.

5.15 Institutional Constraints

The following subsections describe the institutional constraints at each of the federal installations.

ORR Sites 3 and 9

ORR Sites 3 and 9 are currently managed by TVA and power generation is compatible with TVA's mission. The majority of ORR Site 3 is currently designated for TVA project operations and was considered a suitable location for nuclear reactor siting under the Liquid Metal Fast Breeder Reactor program (Clinch River Breeder Reactor project) (26 Breeder Reactor Corporation 1985). There are no known institutional constraints associated with the siting of a SMR demonstration project at ORR Site 3; therefore, it was assigned a rating of 5. ORR Site 9 is currently designated for natural resource conservation and sensitive resource management.

Although TVA could potentially re-designate ORR Site 9 for other uses, it is not currently intended for project operations and was therefore assigned a rating of 2.

ORR Site 2, 5, 8, and 10

The ORR is an industrial park that includes three DOE campuses with a recognized heritage in nuclear technology. Initially associated with World War II's Manhattan Project, the installation has continued its nuclear focus, conducting research in nuclear technologies and systems to improve human health; explore safer, more environmentally friendly power; and better understand the structure of matter. (557 Oak Ridge National Laboratory 2013) With its past history associated with nuclear research, ORR Site 2 would have minimal institutional constraints associated with the siting of a SMR demonstration project; therefore, ORR Site 2 was assigned a rating of 4. ORR Sites 5, 8, and 10 are 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. Therefore, ORR Sites 5, 8, and 10 are assigned a rating of 2.

Redstone Arsenal Sites 12, 14, and 15

The primary mission of Redstone Arsenal is explosives training and research, serving as a garrison for the U.S. Army Aviation and Missile Command; U.S. Army Materiel Command; U.S. DOD Missile Defense Agency; U.S. Army Space and Missile Defense Command; and Aviation & Missile Research, Development and Engineering Center. Additionally, the NASA's Marshall Space Flight Center occupies about 1800 ac within the Redstone Arsenal reservation. Industrial and explosives operations, test areas, warehousing, and ammunition storage, which support the primary mission, are located within the Industrial Zone of the area where the Potential Sites are located.

Although Redstone Arsenal's mission is directly associated with research and development of innovative sciences and technologies, the research is focused on space operations and defense systems rather than nuclear energy or power development. 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. Therefore, based on the letter provided to TVA, Redstone Arsenal Sites 12, 14 and 15 were assigned a rating of 4.

Arnold AFB Sites 20, 21, 22, and 23

Arnold AFB is the home of AEDC, which focuses on conducting research and to develop advanced testing techniques and instrumentation and to support the design of new test facilities. Although Arnold AFB's mission is directly associated with research and development, the research is focused on weapon, propulsion, aerodynamic and space systems rather than nuclear energy or power development. Therefore, the Arnold AFB sites were each assigned a rating of 3.

6.0 WEIGHTING FACTORS

A survey for development of weighting factors associated with resource areas considered in this Siting Study was conducted between January 8 and February 5, 2014. Using the basic Delphi Method approach, nine (9) key members of the technical team associated with preparation of the ER for the Small Modular Reactor Early Site Permit Application were selected to independently weight the importance of each of the criteria specified in NUREG-1555, Section 9.3, Site Selection Process.

The Small Modular Reactor Weighting Factor Survey Summary report, including a list of survey participants, detailed description of the weighting factor development process, and the results of the survey, is provided in Appendix A.

7.0 SUMMARY AND CONCLUSION

The results of the numerical rating from the initial Potential Site screening criteria evaluation are provided in Table 7.0-1. These results indicate that ORR Sites 2, 3, and 8 and Redstone Site 12 generated the highest total scores, and ORR Site 3 received the highest score.

The weighting factors, which were determined by two rounds of independent surveys among nine participants (Appendix A), were then applied to the Potential Site assessment. Table 7.0-2 presents the preliminary assessment of Potential Sites with weighting factors applied. The application of the weighting factors did not change the order of the top four highest scoring sites. In conclusion, ORR Sites 2, 3 and 8 and Redstone Site 12 are in the upper quartile of the Potential Site weighted scores and will be carried forward for more detailed evaluation as Candidate Sites for siting two or more SMRs.

Table 7.0-1
Preliminary Assessment of Potential Sites

Subject Area for Potential Site Evaluation	Candidate Areas												
	ORR						Redstone Arsenal			Arnold AFB			
	2	**3**	**5**	**8**	**9**	**10**	**12**	**14**	**15**	**20**	**21**	**22**	**23**
Land Use, including availability, and areas requiring special consideration	4	5	4	5	2	1	3	3	3	3	2	2	2
Hydrology, Water Quality, and Water Availability	4	4	4	4	4	4	4	3	4	3	3	3	3
Terrestrial biological resources (including endangered species)	2	5	3	2	3	3	4	5	4	4	4	4	4
Aquatic biological resources (including endangered species)	4	5	4	4	4	4	4	4	4	3	3	3	3
Socioeconomics (including population, employment, and transportation)	5	5	5	5	5	5	4	4	4	3	3	3	3
Historic and Cultural Resources	3	3	3	3	3	3	3	3	3	3	3	3	3
Air Quality	4	4	4	4	4	4	5	5	5	5	5	5	5
Human Health	4	4	4	4	4	4	4	4	4	4	4	4	4
Postulated Accidents	3	3	3	3	3	3	4	4	4	4	4	4	4
Fuel Cycle Impacts	4	4	4	4	4	4	3	3	3	3	3	3	3
Transmission Corridors	5	5	5	5	4	5	4	4	4	5	5	5	5
Population distribution and density	5	5	5	5	5	5	4	4	4	5	5	5	5
Facility Costs	3	5	3	4	2	3	4	3	3	4	4	4	4
Institutional Constraints	4	5	2	2	2	2	4	4	4	3	3	3	3
Totals	**54**	**62**	**52**	**54**	**49**	**50**	**54**	**53**	**53**	**52**	**51**	**51**	**51**

Table 7.0-2
Preliminary Assessment of Potential Sites (Weighting Factors Applied)

Subject Area for Potential Site Evaluation	Weighting Factor	Candidate Areas												
		ORR				Redstone Arsenal					Arnold AFB			
		2	3	5	8	9	10	12	14	15	20	21	22	23
Land Use, including availability, and areas requiring special consideration	8.1	40.5	40.5	24.3	40.5	16.2	8.1	24.3	24.3	24.3	24.3	16.2	16.2	16.2
Hydrology, Water Quality, and Water Availability	8.7	34.8	43.5	43.5	43.5	43.5	43.5	43.5	34.8	34.8	26.1	26.1	26.1	26.1
Terrestrial biological resources (including endangered species)	5.7	11.4	28.5	17.1	11.4	17.1	17.1	22.8	28.5	22.8	22.8	22.8	22.8	22.8
Aquatic biological resources (including endangered species)	5.5	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	16.5	16.5	16.5	16.5
Socioeconomics (including population, employment, and transportation)	4.5	22.5	22.5	22.5	22.5	22.5	22.5	18.0	18.0	18.0	13.5	13.5	13.5	13.5
Historic and Cultural Resources	5.4	21.6	16.2	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6
Air Quality	4.5	18.0	18.0	18.0	18.0	18.0	18.0	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Human Health	4.4	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6
Postulated Accidents	4	12.0	12.0	12.0	12.0	12.0	12.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Fuel Cycle Impacts	2.7	10.8	10.8	10.8	10.8	10.8	10.8	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Transmission Corridors	7.4	37.0	37.0	37.0	37.0	29.6	37.0	29.6	29.6	29.6	37.0	37.0	37.0	37.0
Population distribution and density	6.9	34.5	34.5	34.5	34.5	34.5	34.5	27.6	27.6	27.6	34.5	34.5	34.5	34.5
Facility Costs	7	28.0	35.0	28.0	28.0	14.0	28.0	28.0	21.0	21.0	28.0	28.0	28.0	28.0
Institutional Constraints	7.6	30.4	38.0	15.2	15.2	15.2	15.2	30.4	15.2	30.4	22.8	22.8	22.8	22.8
Totals		**320.6**	**372.9**	**303**	**320.5**	**280.5**	**286.8**	**317.9**	**307.9**	**310.9**	**305.9**	**297.8**	**297.8**	**297.8**

8.0 LIST OF PREPARERS

A list of preparers for the Small Modular Reactor Siting Study is provided in Table 8.0-1.

Table 8.0-1
List of Preparers

Name	Organization	Education	Role
Bobbie Hurley	AECOM	MA, Chemistry; BS, Biology; BS, Chemistry	Project Manager; Introduction; Summary of Screening Process; Candidate Area Evaluations; Potential Site Screening; Facility Costs; Transmission Corridors; Summary and Conclusion
Kevin Taylor, PE, CHP	AECOM	MS, Nuclear Engineering; BS, Physics	Summary of Screening Process; Candidate Area Evaluations; Atmospheric Dispersion; Exclusion Area and Low-Population Zone; Emergency Planning; Security Plans; Potential Site Screening; Human Health; Postulated Accidents; Fuel Cycle Impacts; Institutional Constraints
Carol Butler Freeman	AECOM	MS, Geological Sciences; MS, Space Studies; BS, Geology	Candidate Area Evaluations; Geology/Seismology; Industrial, Military, and Transportation Facilities; Potential Site Screening; Land Use; Historic and Cultural Resources
Susan Provenzano, AICP	AECOM	MS, Marine Environmental Sciences; BA, Earth and Space Sciences	Potential Site Screening; Land Use; Socioeconomics; Environmental Justice; Population Distribution and Density
Steve Dillard	AECOM	MS, Environmental Systems Engineering; BS, Zoology	Potential Site Screening; Terrestrial and Aquatic Biological Resources
David Rankin, PE	AECOM	MS, Environmental Engineering; BS Biological Sciences	Potential Site Screening; Hydrology, Water Quality, Water Availability
Zoe Knesl	AECOM	MS, Marine Science; BA, Integrative Biology/Ecology; BA, Studio Art	Air Quality
Francine Beck, PhD	Enercon	PhD, Geography	Peer Review
Evelyn Rogers, PE	AECOM	BS, Chemical Engineering	Quality Assurance

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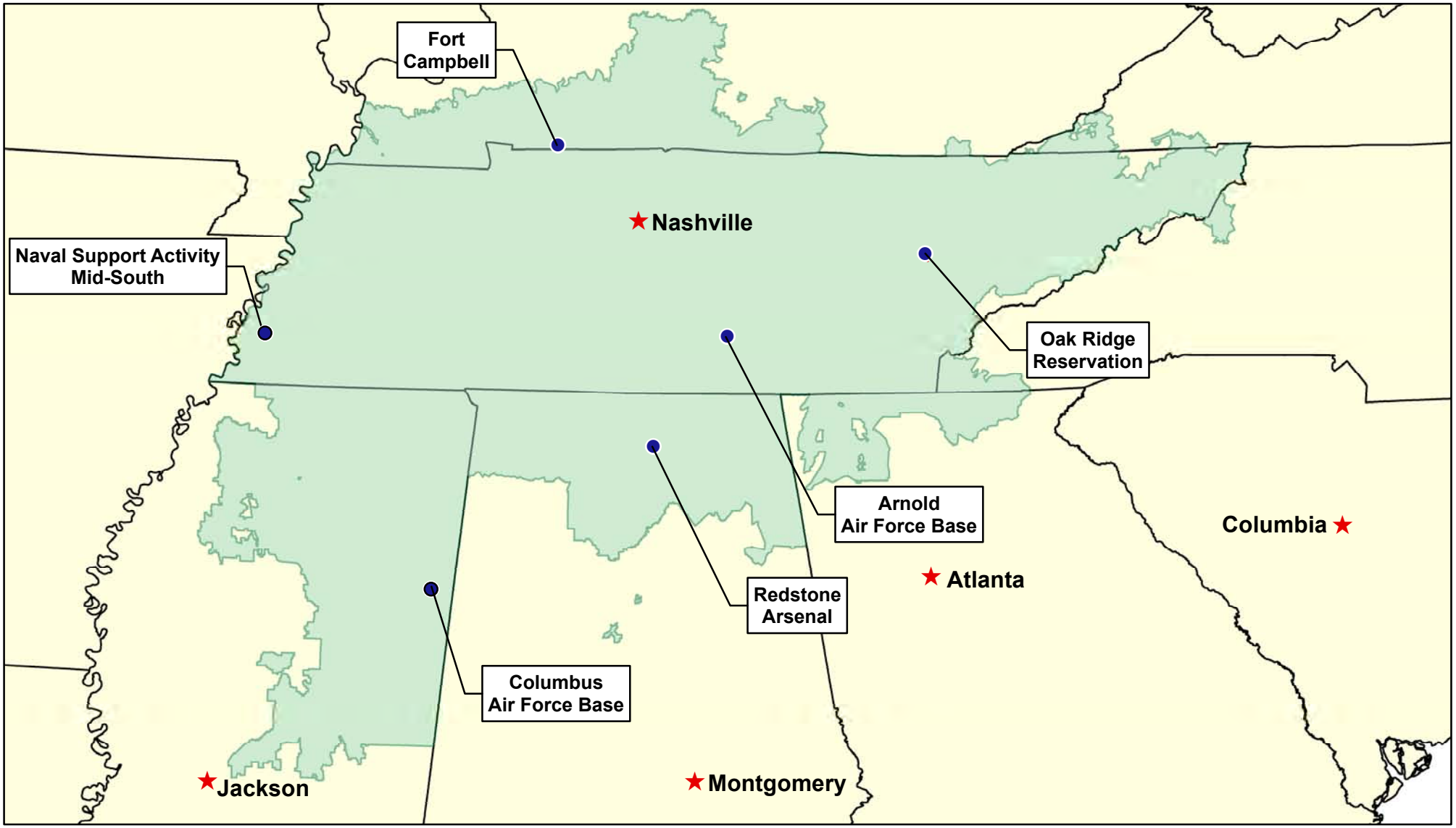

Legend

- TVA SMR Candidate Areas
- State Capitals
- TVA Power Service Area (Region of Interest [ROI])

0 32.5 65 130 Miles

N W E S

Source: State Boundaries ESRI, 2013

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Figure 2.1-1
Small Modular Reactor (SMR) Candidate Areas
SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	2/28/2014	Figure 2.1-1

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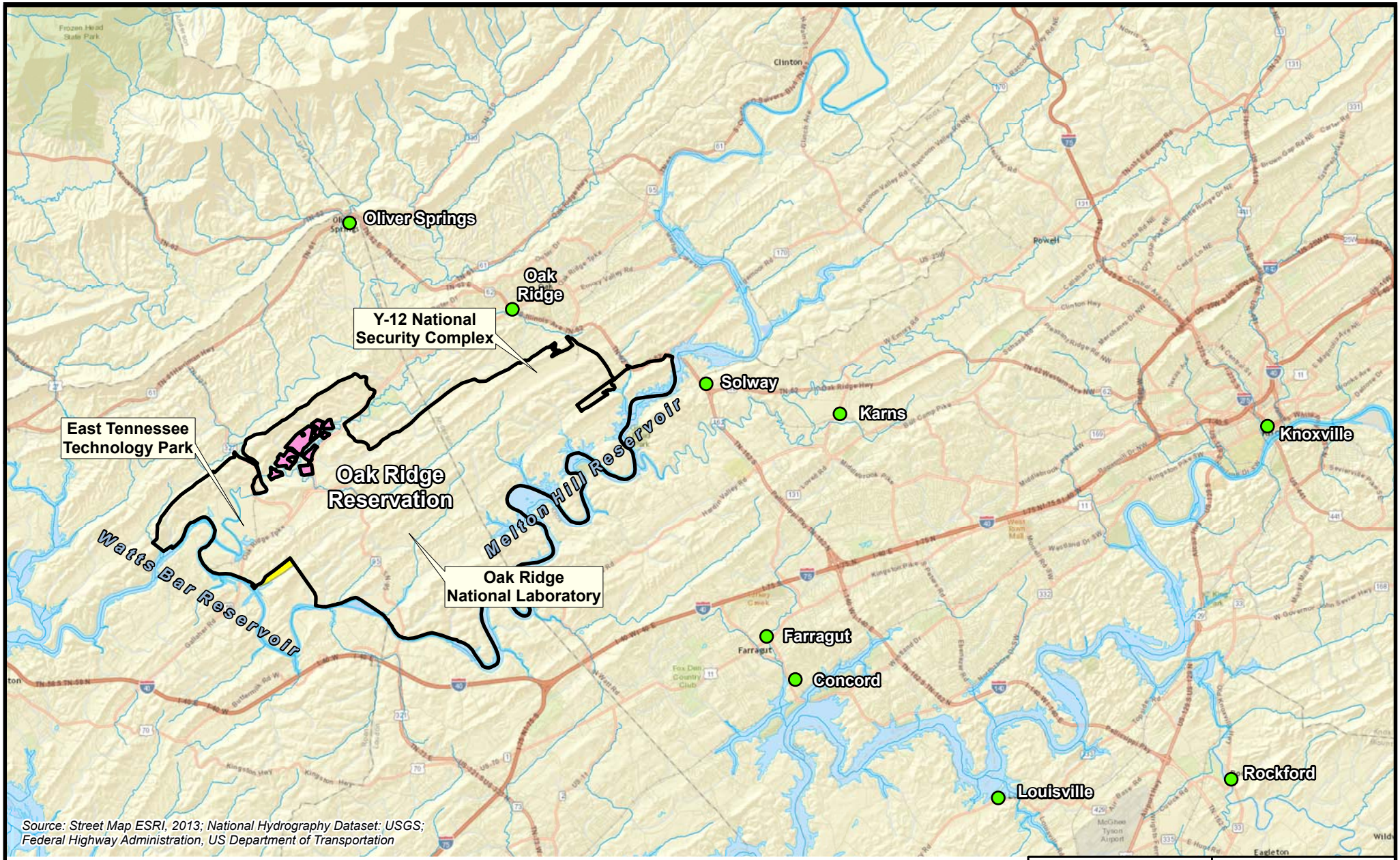

Legend

- Candidate Area Boundary
- City
- County Line
- ORR Leased Land (CROET)
- Clinch River Industrial Area

0 9,000 18,000 36,000 Feet

N W E S

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Figure 3.1-1
Oak Ridge Reservation (ORR) Location Map
SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	8/20/2015	Figure 3.1-1

Path: X:\Admin\BD_Projects\TVA\TVA Figures March 2015\Task 15 Siting Study\60279942_009 ORR_Location Map.mxd

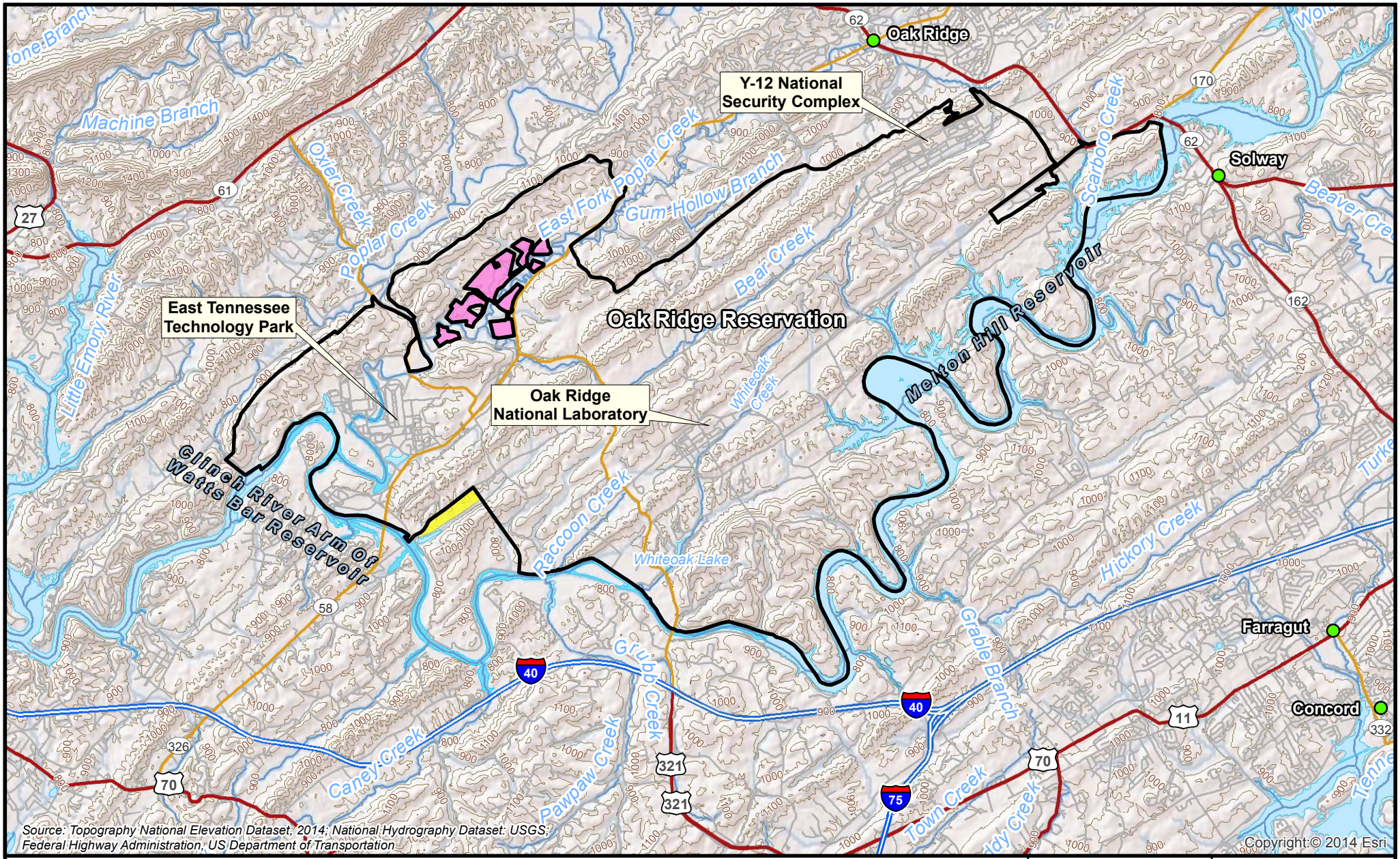

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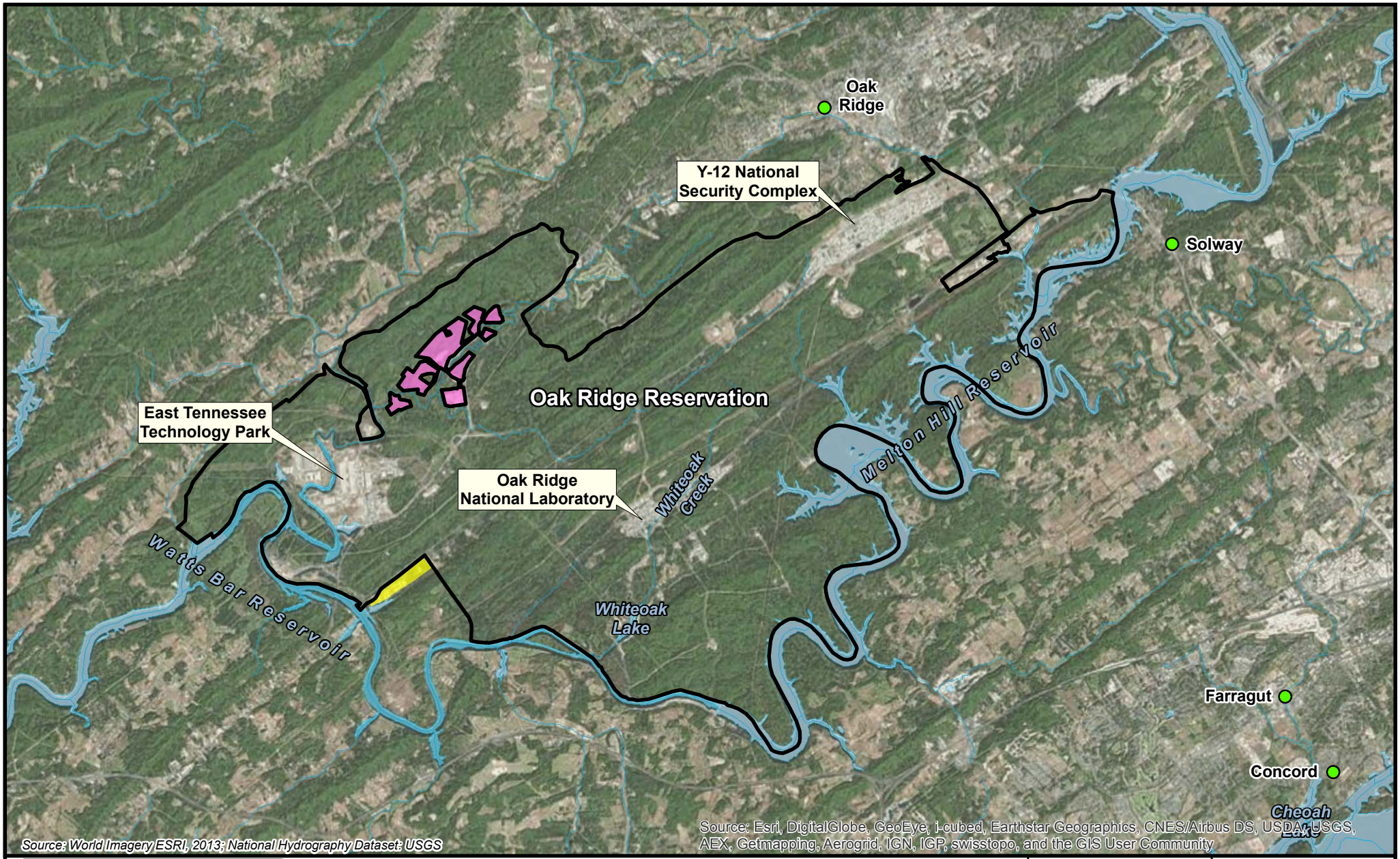
Figure 3.1-2
Oak Ridge Reservation (ORR) Topographic Map
SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	8/20/2015	Figure 3.1-2

Path: X:\Admin\BD_Projects\TVA\TVA Figures March 2015\Task 15 Siting Study\60279942_010 ORR_Topographic Map_Rev1.mxd



Legend

- Candidate Area Boundary
- City
- ORR Leased Land (CROET)
- Clinch River Industrial Area

0 5,000 10,000 20,000 Feet

N W E S

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Figure 3.1-3
Oak Ridge Reservation (ORR) Aerial

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	8/20/2015	Figure 3.1-3

Path: X:\Admin\BD_Projects\TVA\TVA Figures March 2015\Task 15 Siting Study\60279942_011 ORR_Aerial.mxd

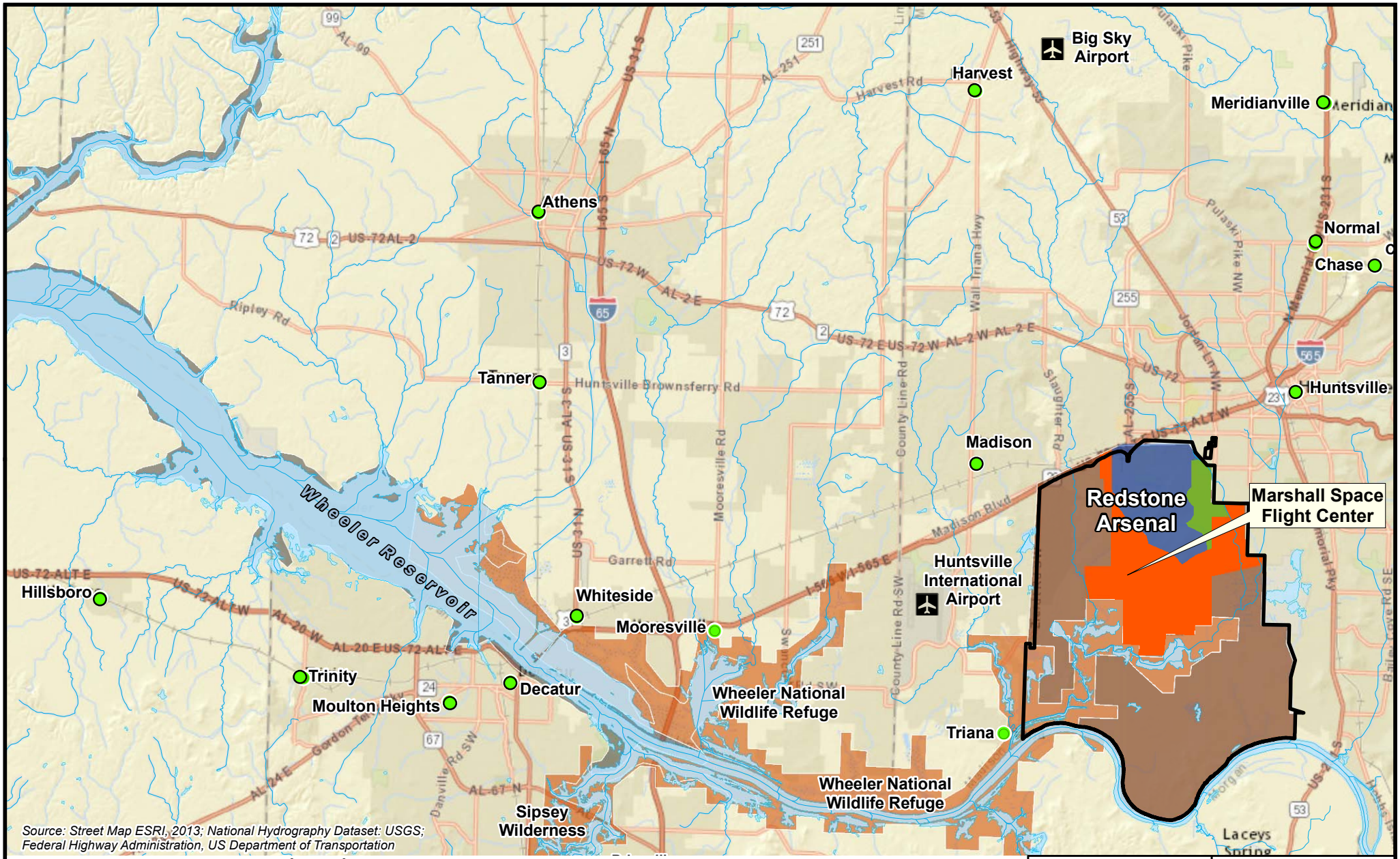

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Figure 3.1-4
Redstone Arsenal Location Map

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60224964	MLS	8/18/2015	Figure 3.1-4

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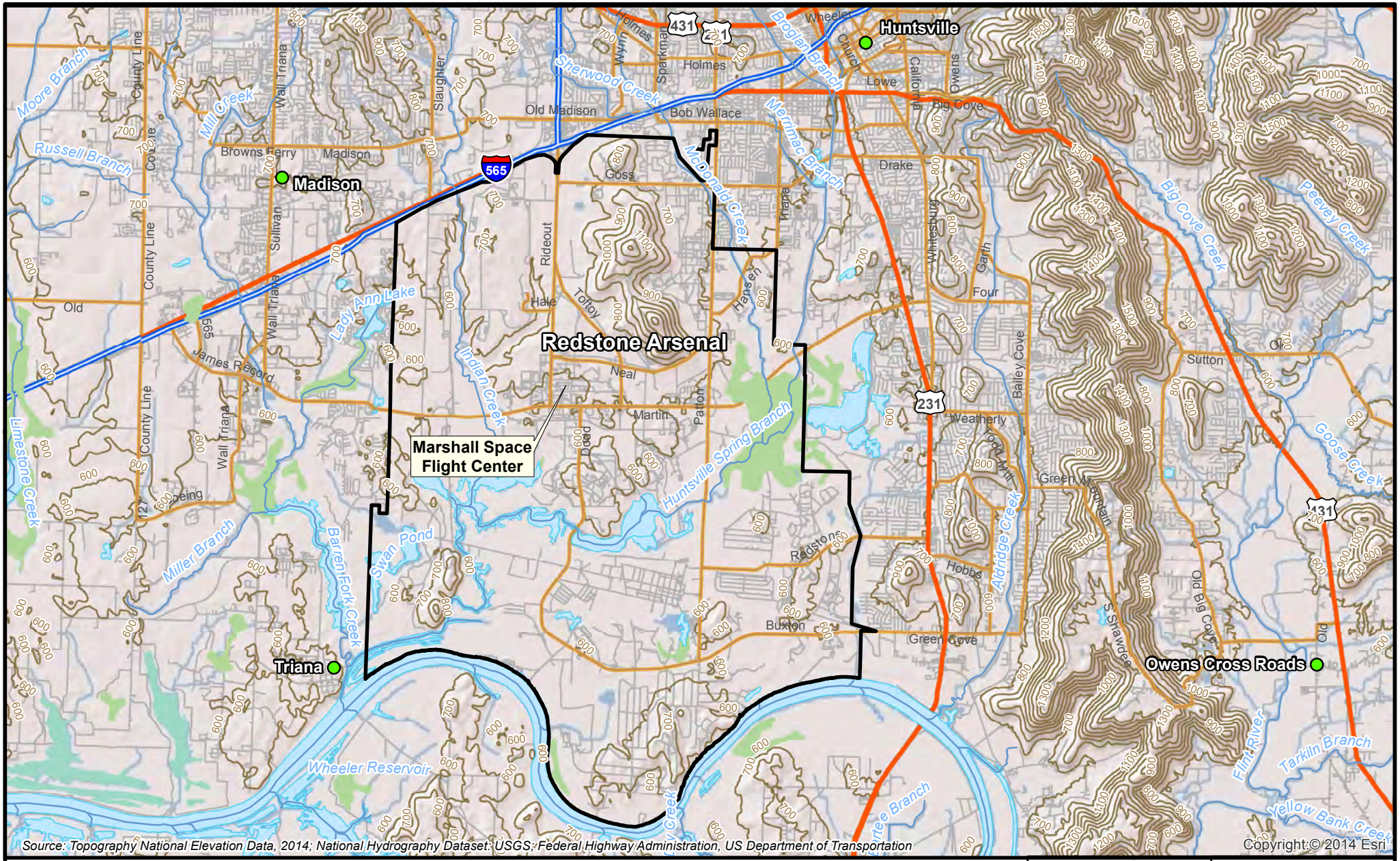

Legend

- Candidate Area Boundary
- City
- Contour Interval - 100 ft.

0 5,500 11,000 22,000 Feet

N W E S

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Figure 3.1-5
Redstone Arsenal Topographic Map

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60224964	MLS	4/23/2015	Figure 3.1-5

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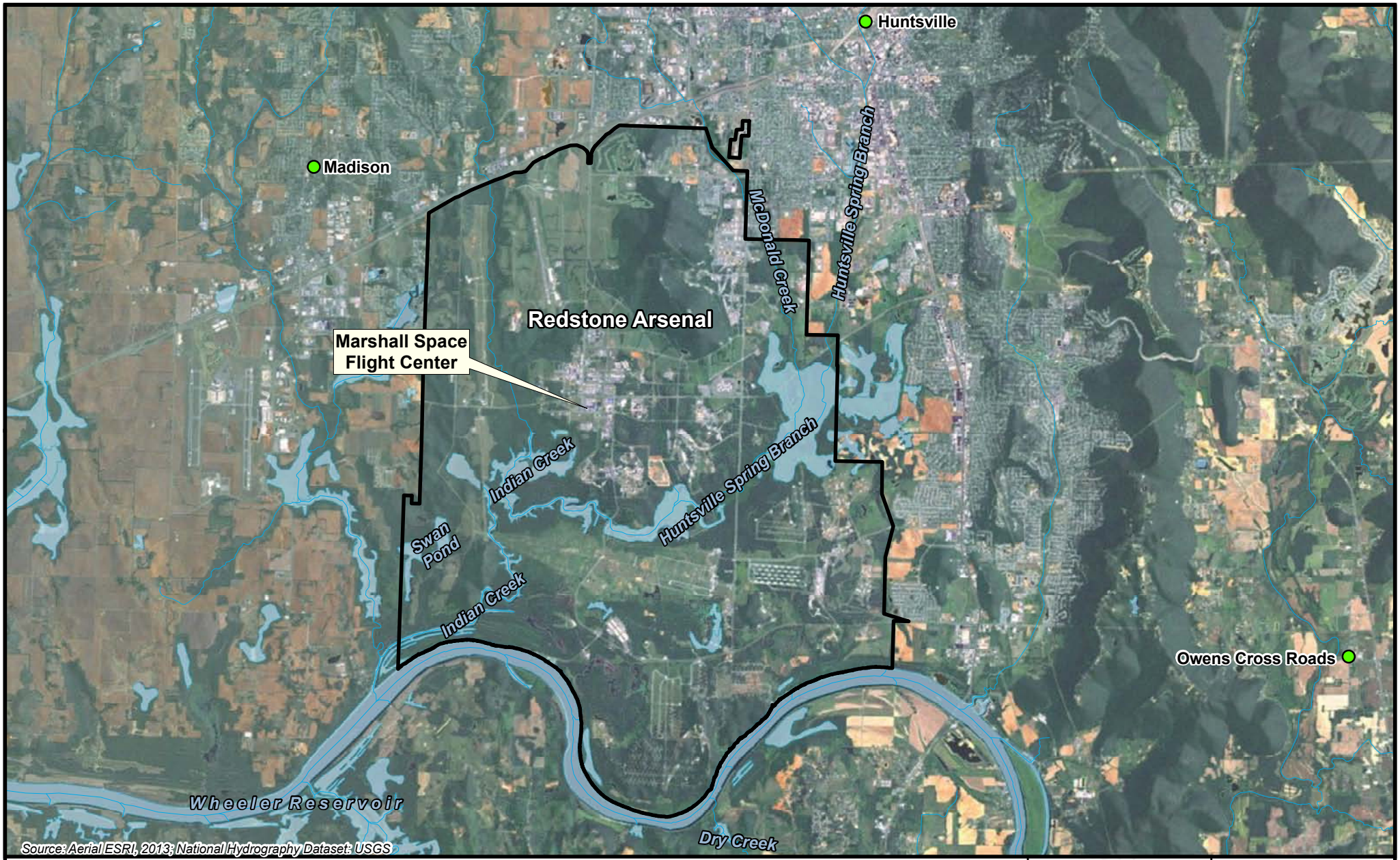

Legend

- Candidate Area Boundary
- Waterbodies
- City

0 5,500 11,000 22,000 Feet

N W E S

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Figure 3.1-6
Redstone Arsenal Aerial

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60224964	MS	9/2/2014	**Figure 3.1-6**

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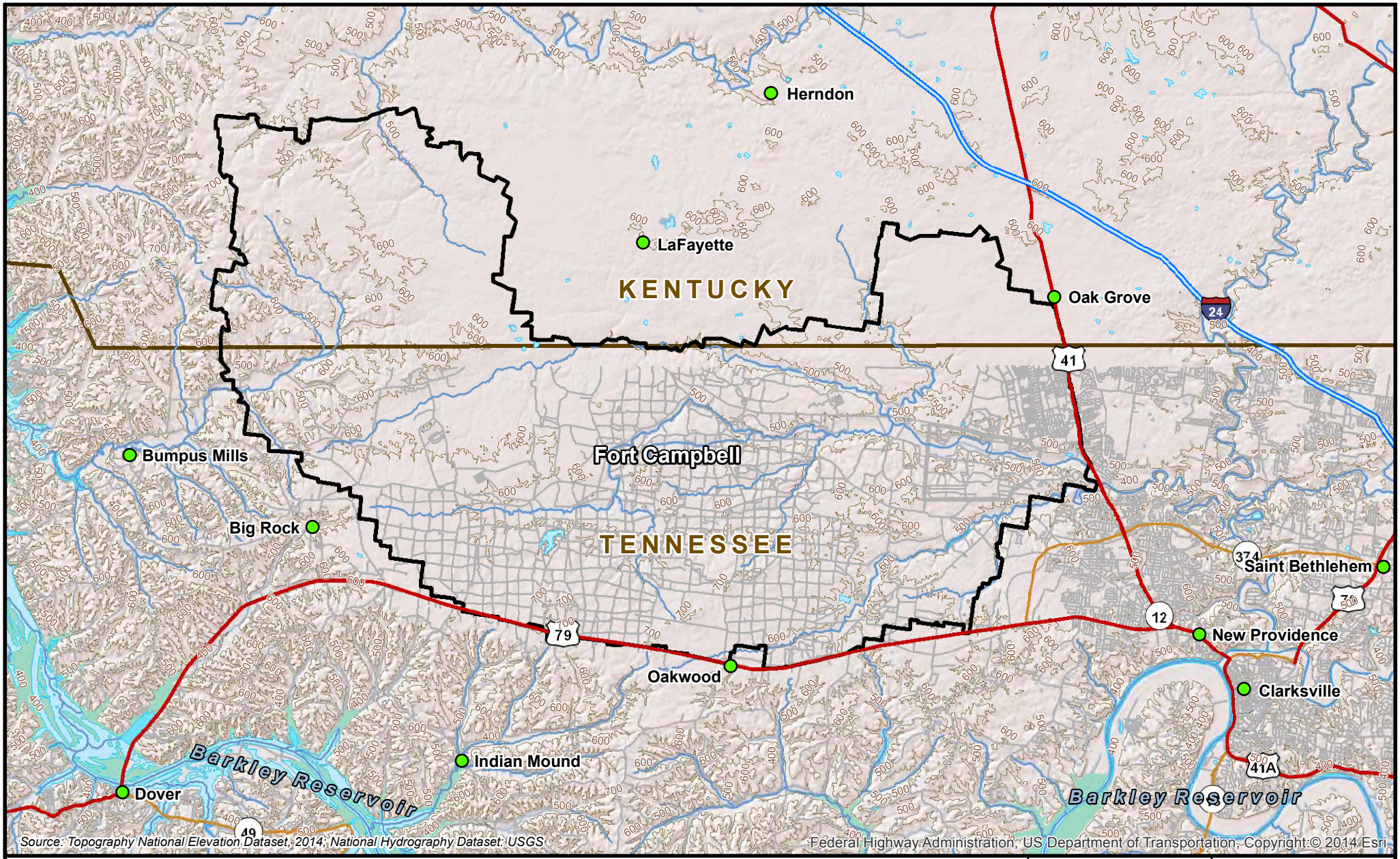
Figure 3.1-7
Fort Campbell Location Map

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	4/23/2015	Figure 3.1-7

Path: L:\Projects\60279942\9.0 CADD\GIS MXDs\60279942_013 Fort Campbell_Location Map.mxd



Legend

- City
- Contour Interval - 100 ft.
- Candidate Area Boundary
- State Line

0 8,250 16,500 33,000 Feet

N W E S

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Figure 3.1-8
Fort Campbell Topographic Map

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	6/10/2015	Figure 3.1-8

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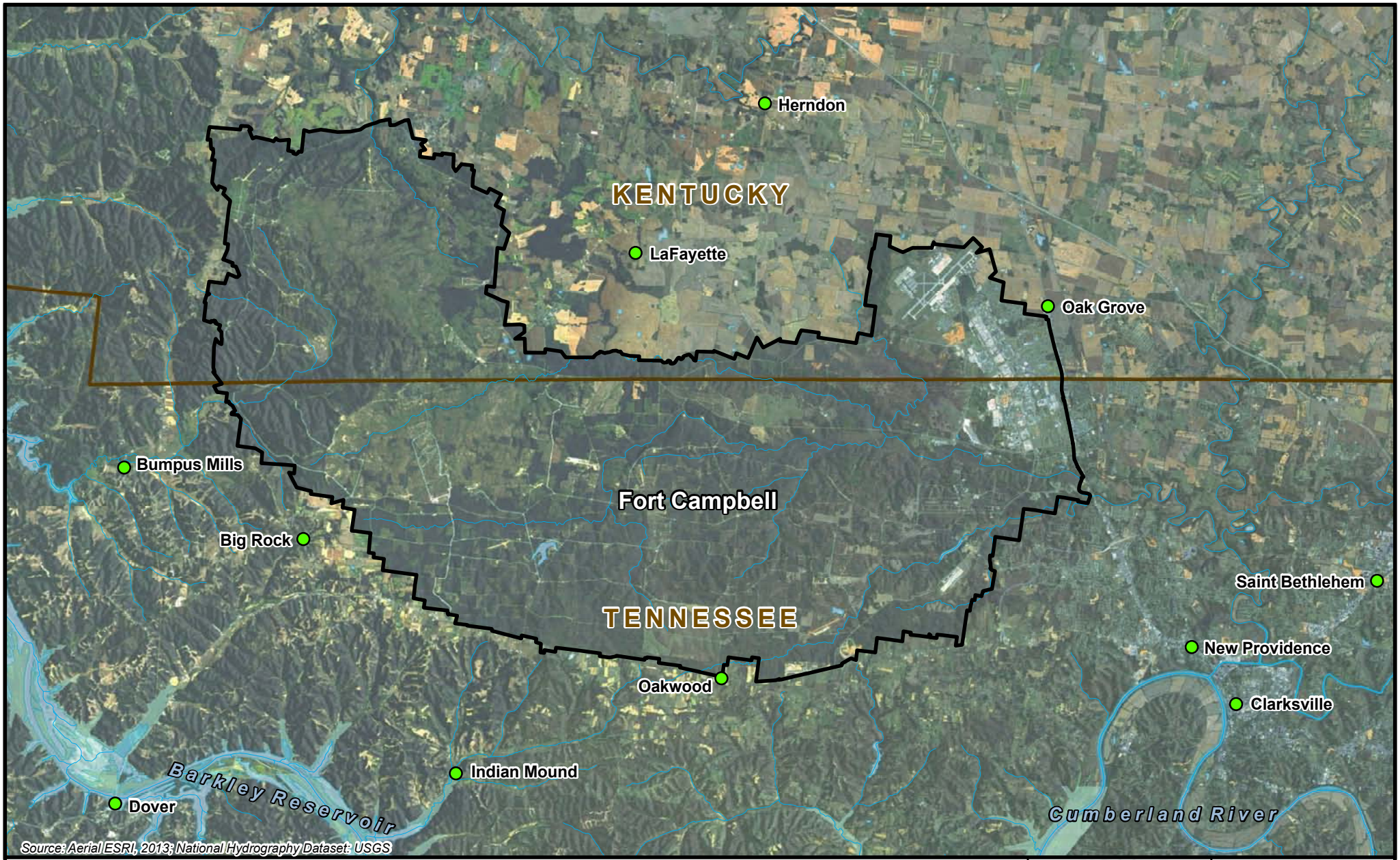

Legend

- Candidate Area Boundary
- City
- State Line

0 8,250 16,500 33,000 49,500 Feet

N W E S

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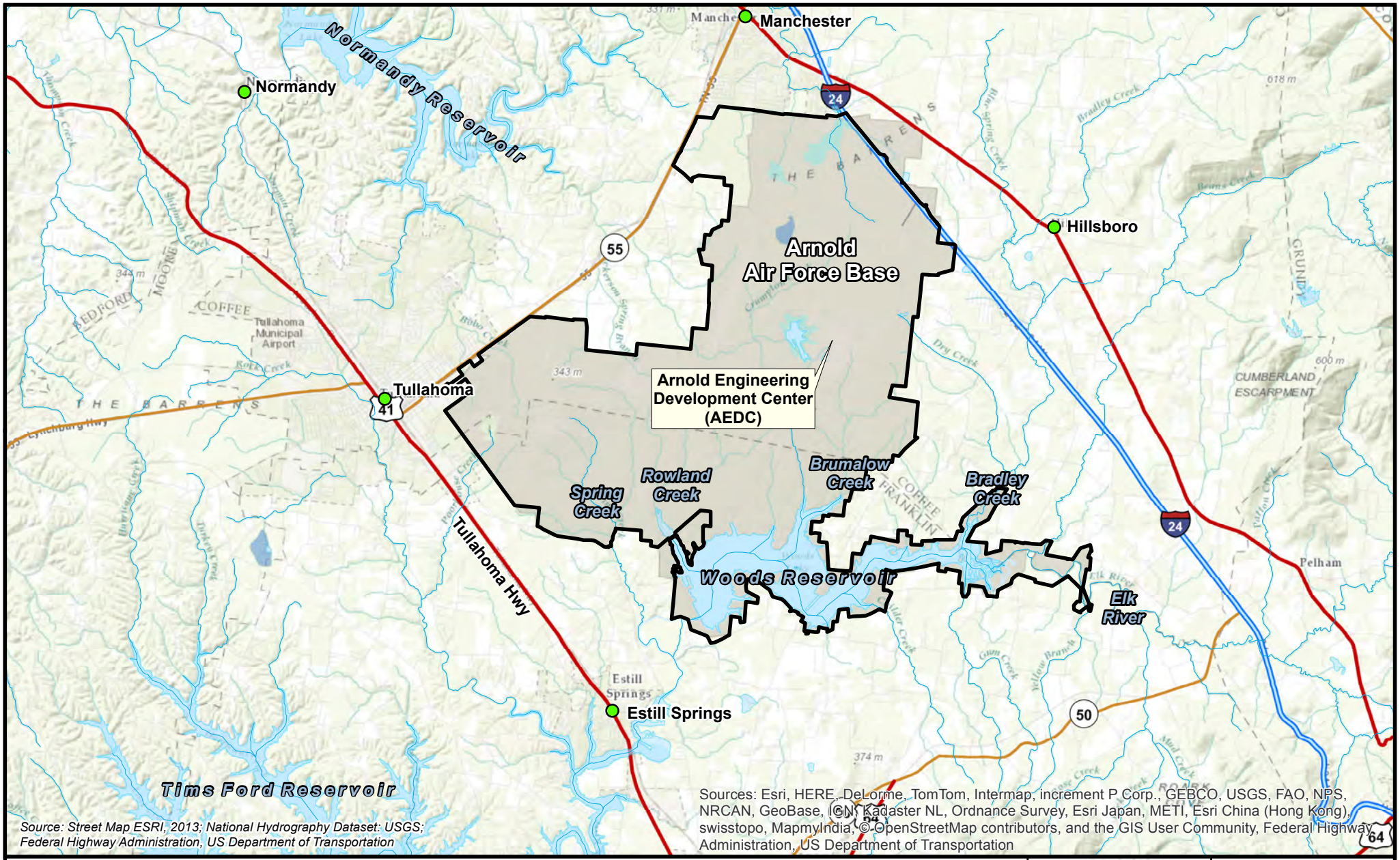
Figure 3.1-9
Fort Campbell Aerial

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	6/17/2014	**Figure 3.1-9**

Path: L:\Projects\60279942\9.0 CADD\GIS MXDs\60279942_014 Fort Campbell_Aerial.mxd



Legend

- Candidate Area Boundary
- City
- County Line

0 7,000 14,000 28,000 Feet

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Figure 3.1-10
Arnold Air Force Base
Location Map

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	4/23/2015	**Figure 3.1-10**

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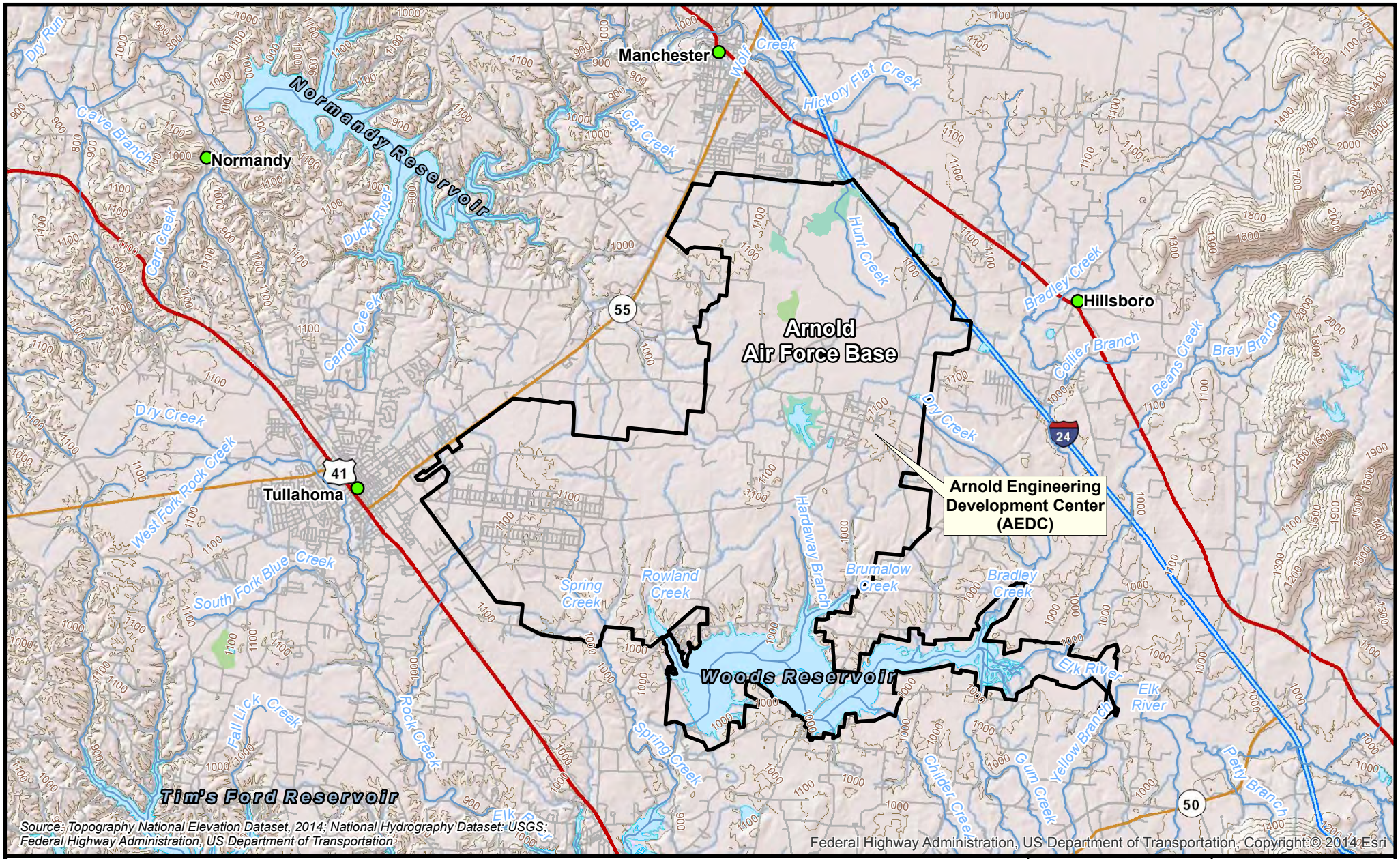

Legend

- City
- Contour Interval - 100 ft.
- Candidate Area Boundary

0 5,500 11,000 22,000 Feet

N W E S

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Figure 3.1-11
Arnold Air Force Base
Topographic Map
SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	6/11/2015	Figure 3.1-11

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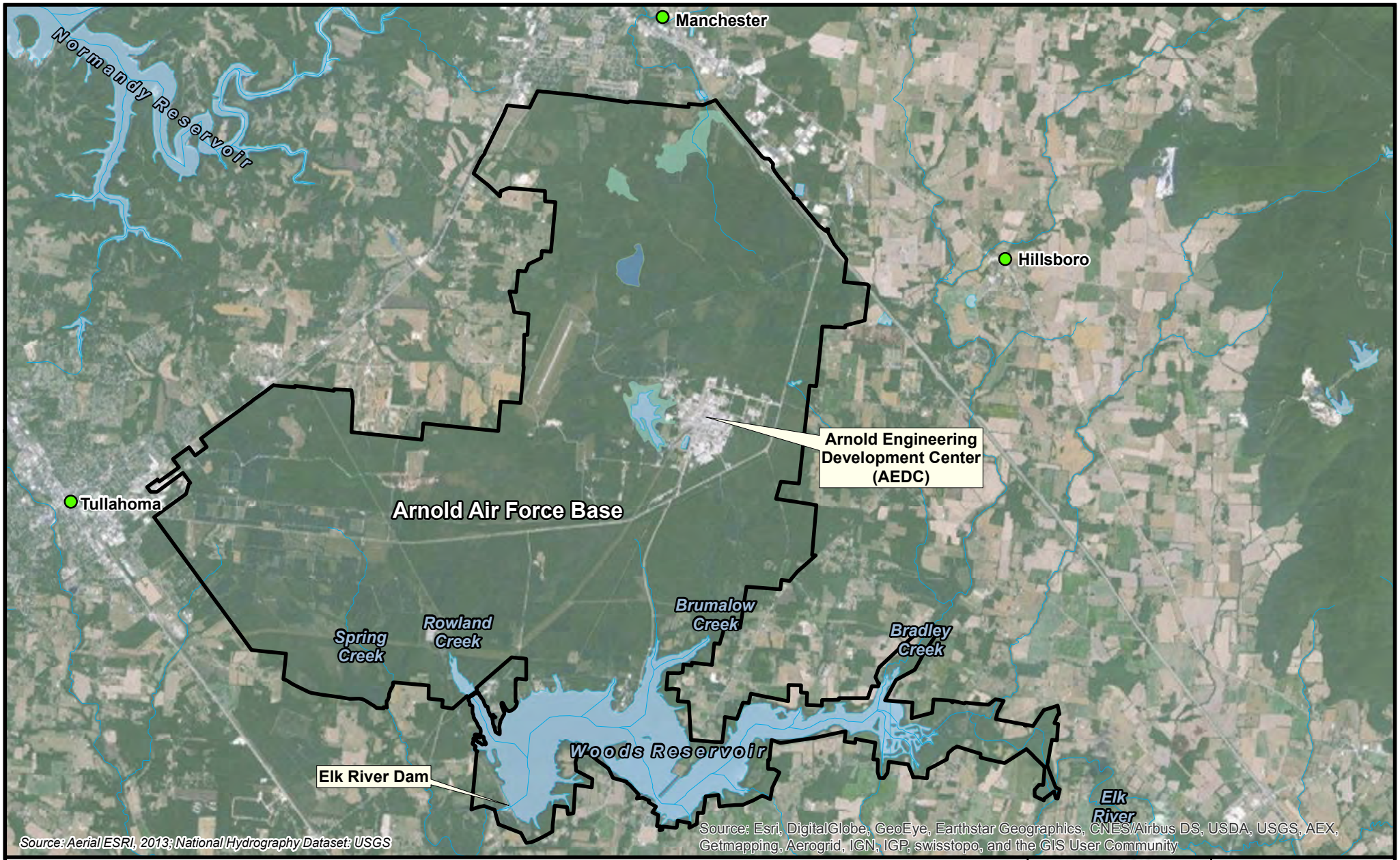

Legend

- Candidate Area Boundary
- City

0 5,000 10,000 20,000 Feet

N W E S

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Figure 3.1-12
Arnold Air Force Base
Aerial

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	4/23/2015	**Figure 3.1-12**

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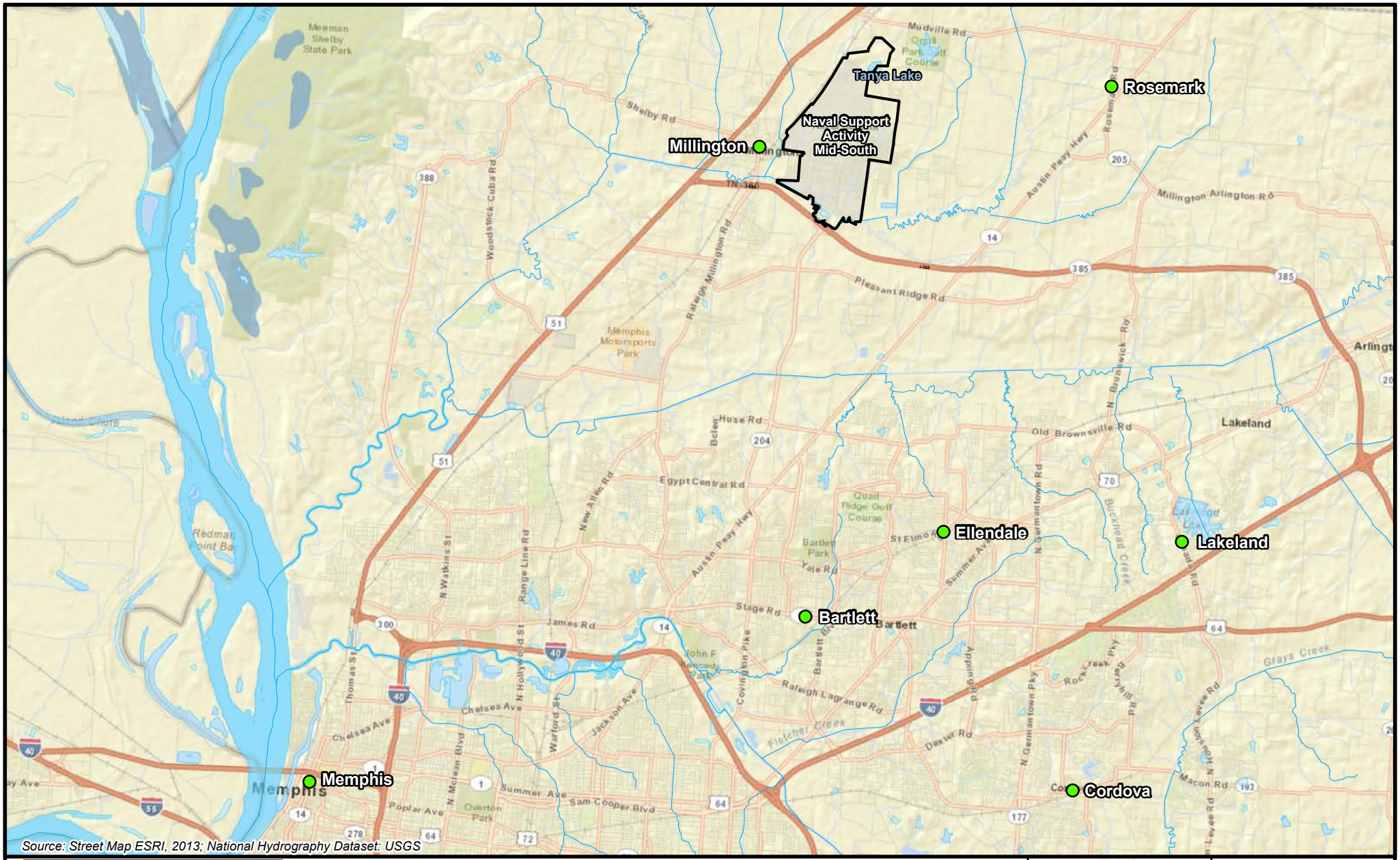

Legend

- Candidate Area Boundary
- City

0 7,000 14,000 28,000 Feet

N W E S

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Figure 3.1-13
Naval Support Activity Mid-South
Location Map

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	6/17/2014	**Figure 3.1-13**

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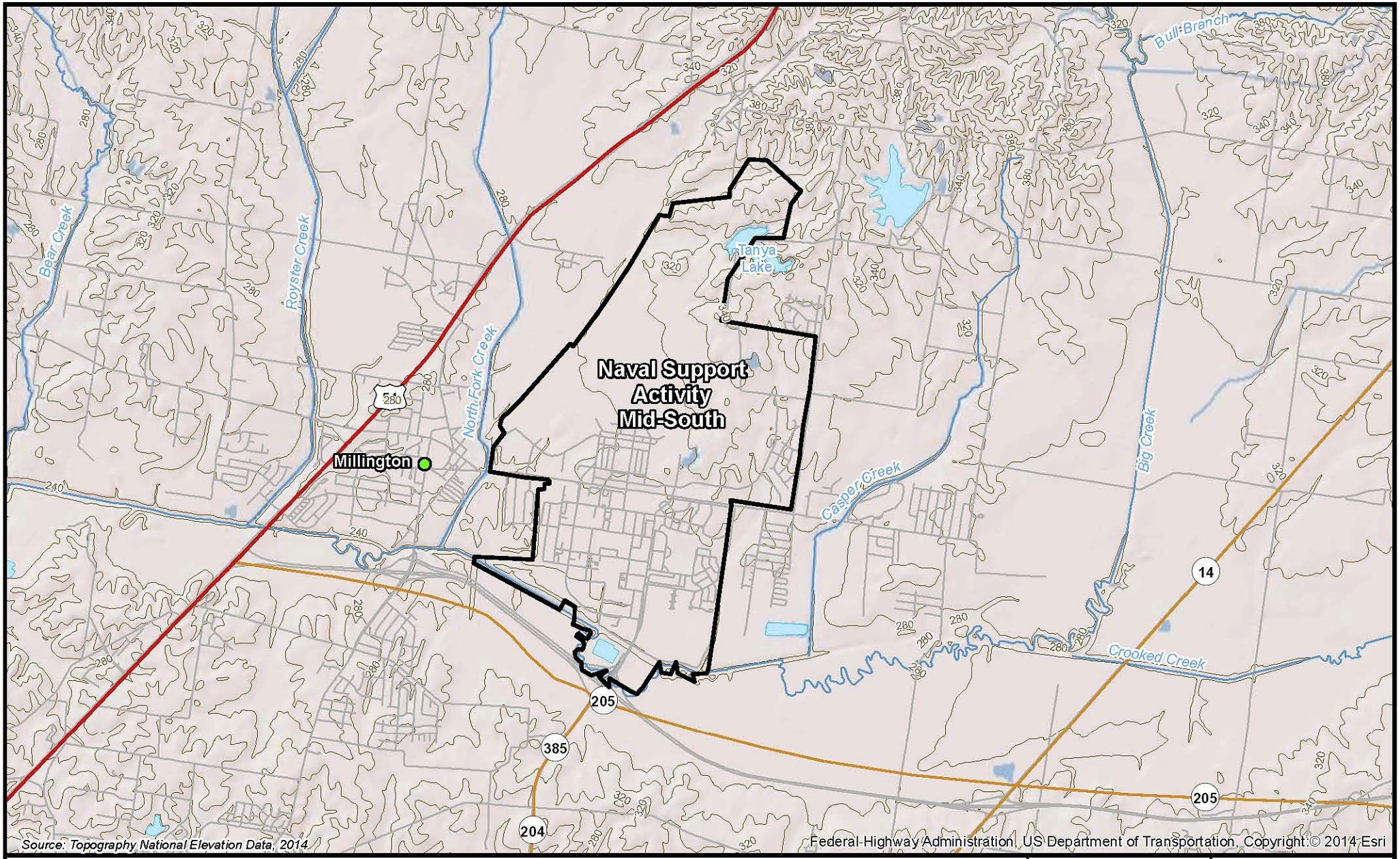

Legend

- City
- Contour Interval - 20 ft.
- Candidate Area Boundary

0 2,500 5,000 10,000 Feet

N W E S

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Figure 3.1-14
Naval Support Activity Mid-South
Topographic Map
SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	6/10/2015	Figure 3.1-14

Path: X:\Admin\BD_Projects\TVA\TVA Figures March 2015\Task 15 Siting Study\60279942_066 NSAMS TopographicMap_Rev1.mxd

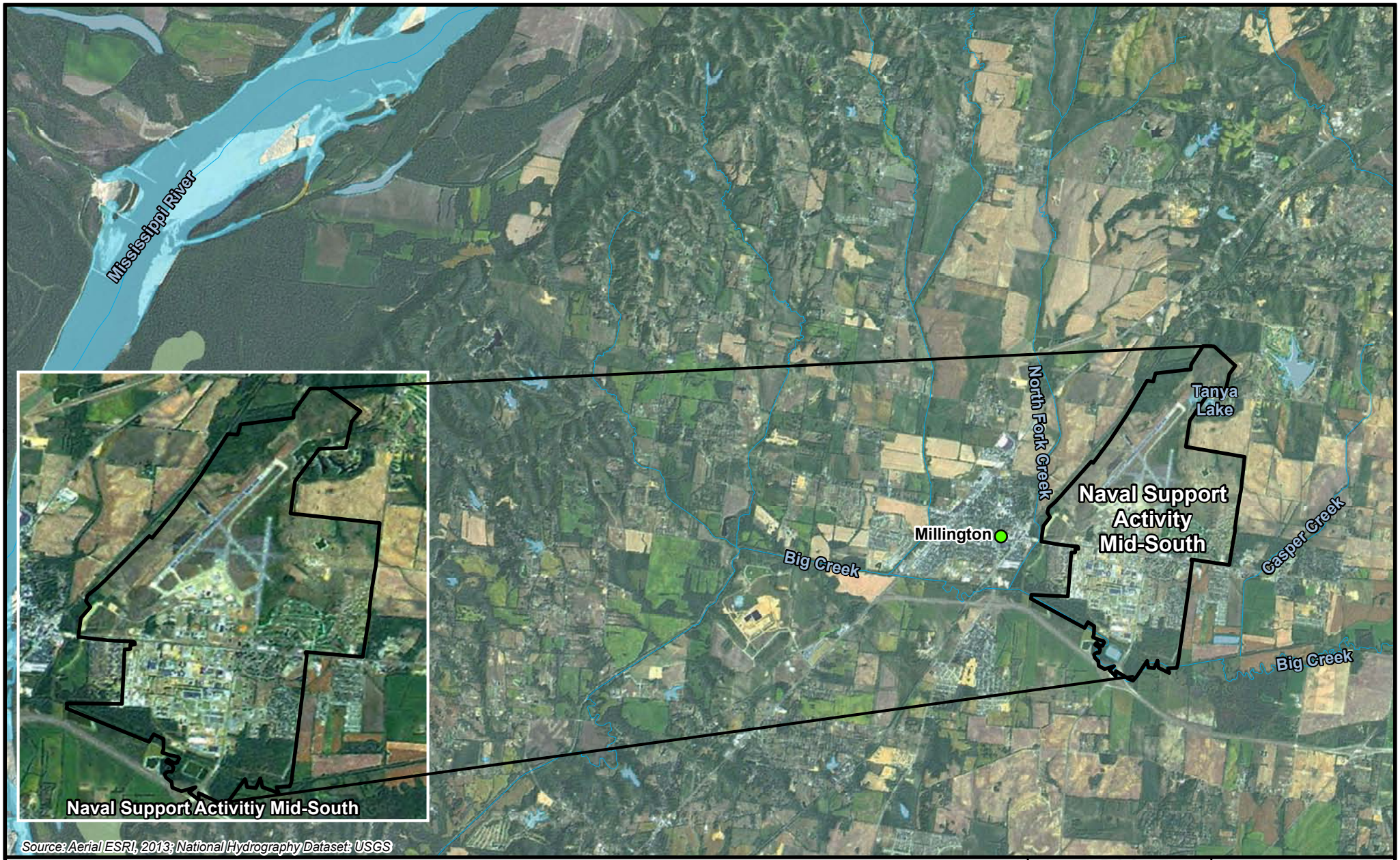

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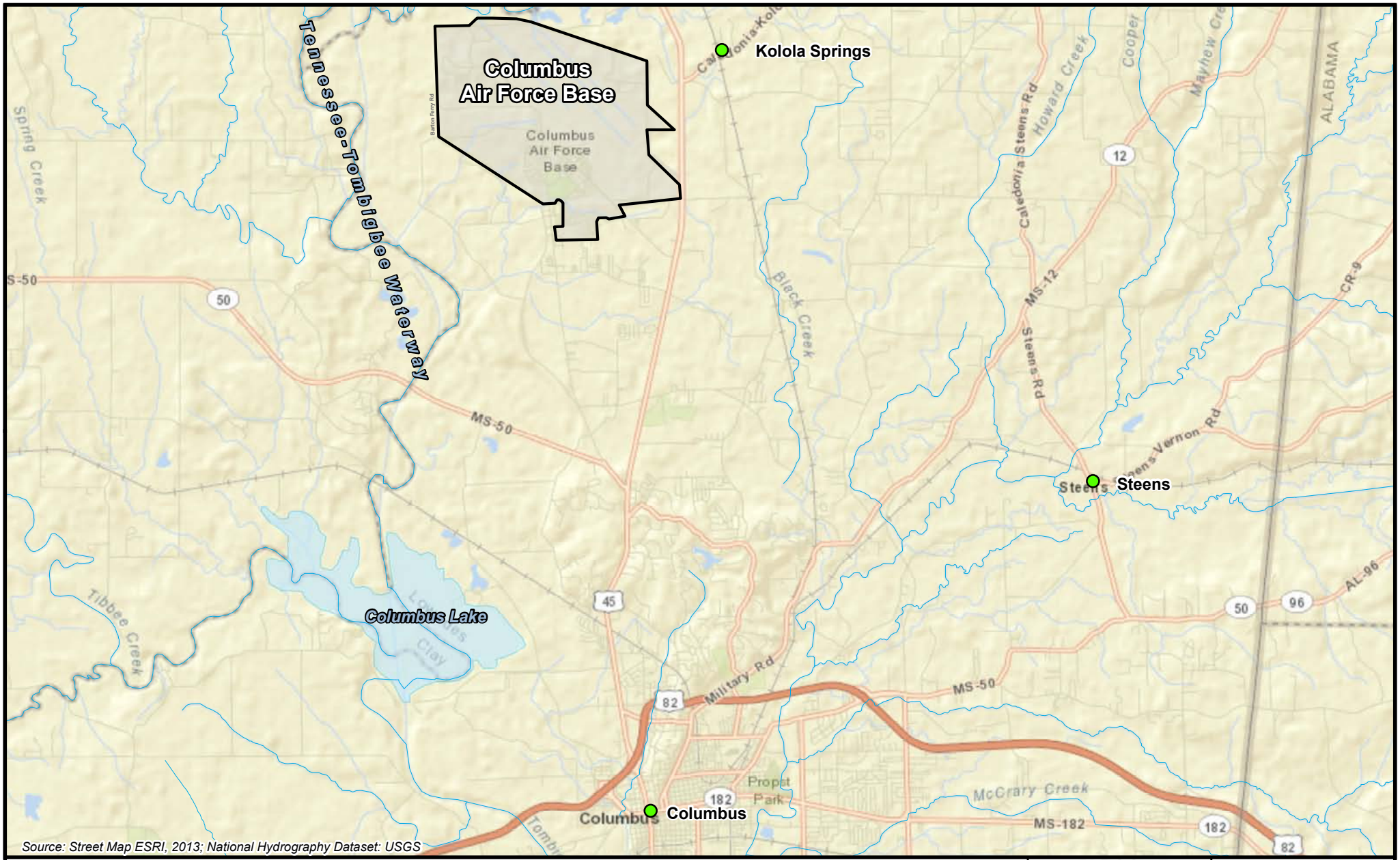
Figure 3.1-15
Naval Support Activity Mid-South Aerial

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	6/17/2014	Figure 3.1-15

Path: L:\Projects\60279942\9.0 CADD\GIS MXDs\60279942_056 NSAMS Aerial.mxd



Source: Street Map ESRI, 2013; National Hydrography Dataset: USGS

Legend

Candidate Area Boundary

City

0 5,000 10,000 20,000 Feet

N W E S

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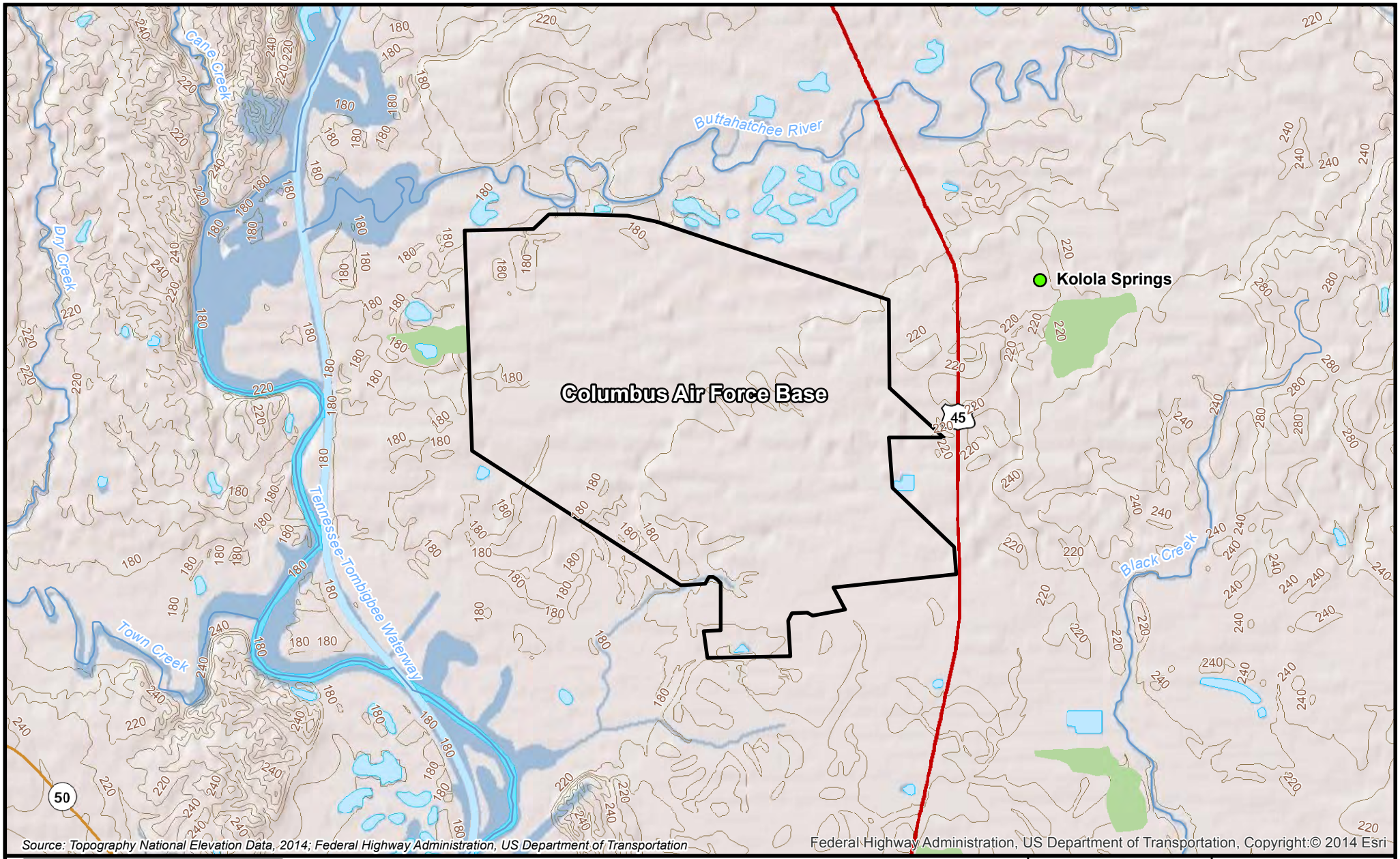
Figure 3.1-16
Columbus Air Force Base
Location Map

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	6/17/2014	**Figure 3.1-16**

Path: L:\Projects\60279942\9.0 CADD\GIS MXDs\60279942_067 Columbus RoadMap.mxd



Legend

- City
- Candidate Area Boundary
- Contour Interval - 20 ft.

0 2,500 5,000 10,000 Feet

N W E S

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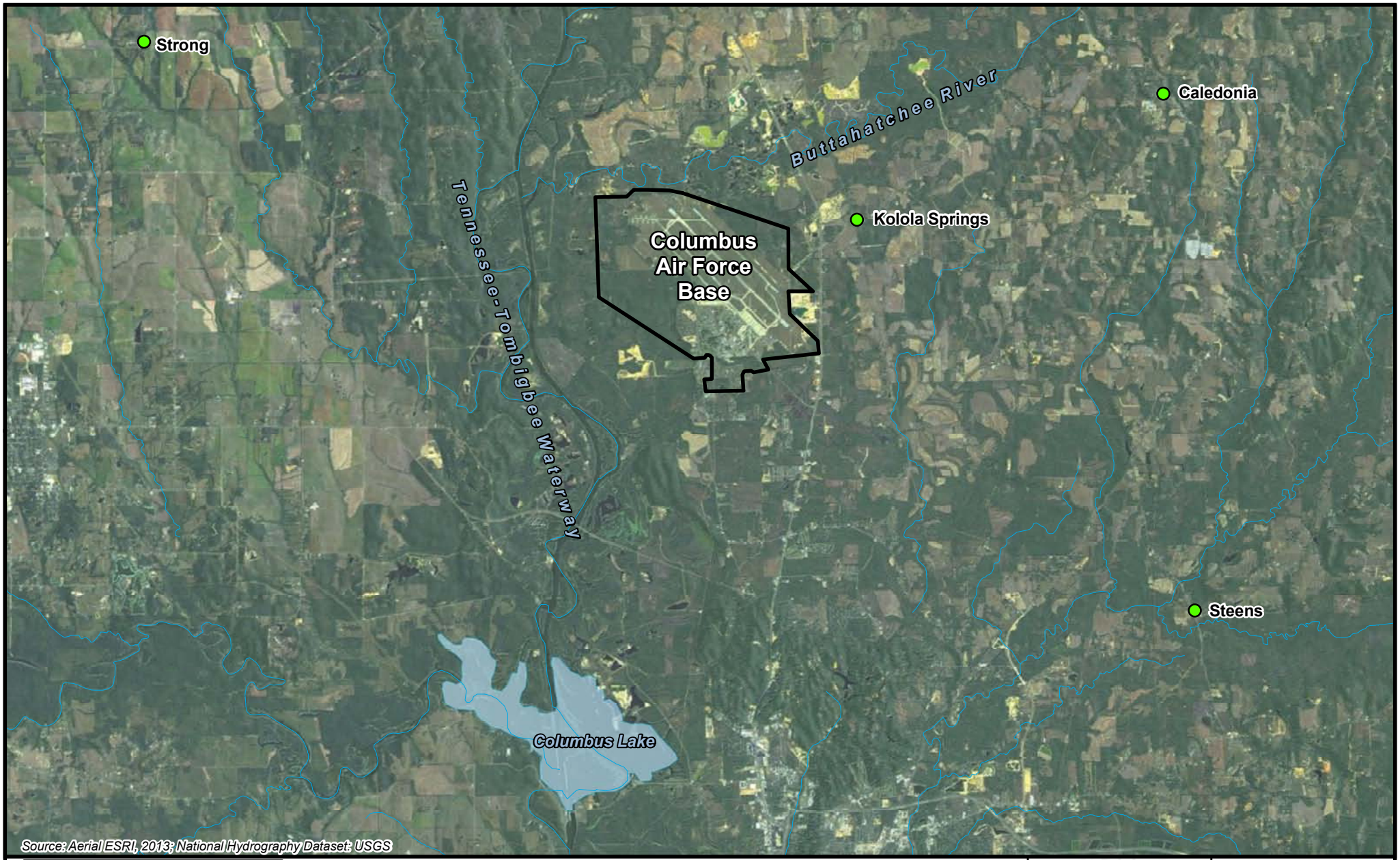
Figure 3.1-17
Columbus Air Force Base
Topographic Map
SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	6/10/2015	**Figure 3.1-17**

Path: X:\Admin\BD_Projects\TVA\TVA Figures March 2015\Task 15 Siting Study\60279942_068 Columbus TopographicMap_Rev1.mxd



Legend

- Candidate Area Boundary
- City

0 5,500 11,000 22,000 Feet

N W E S

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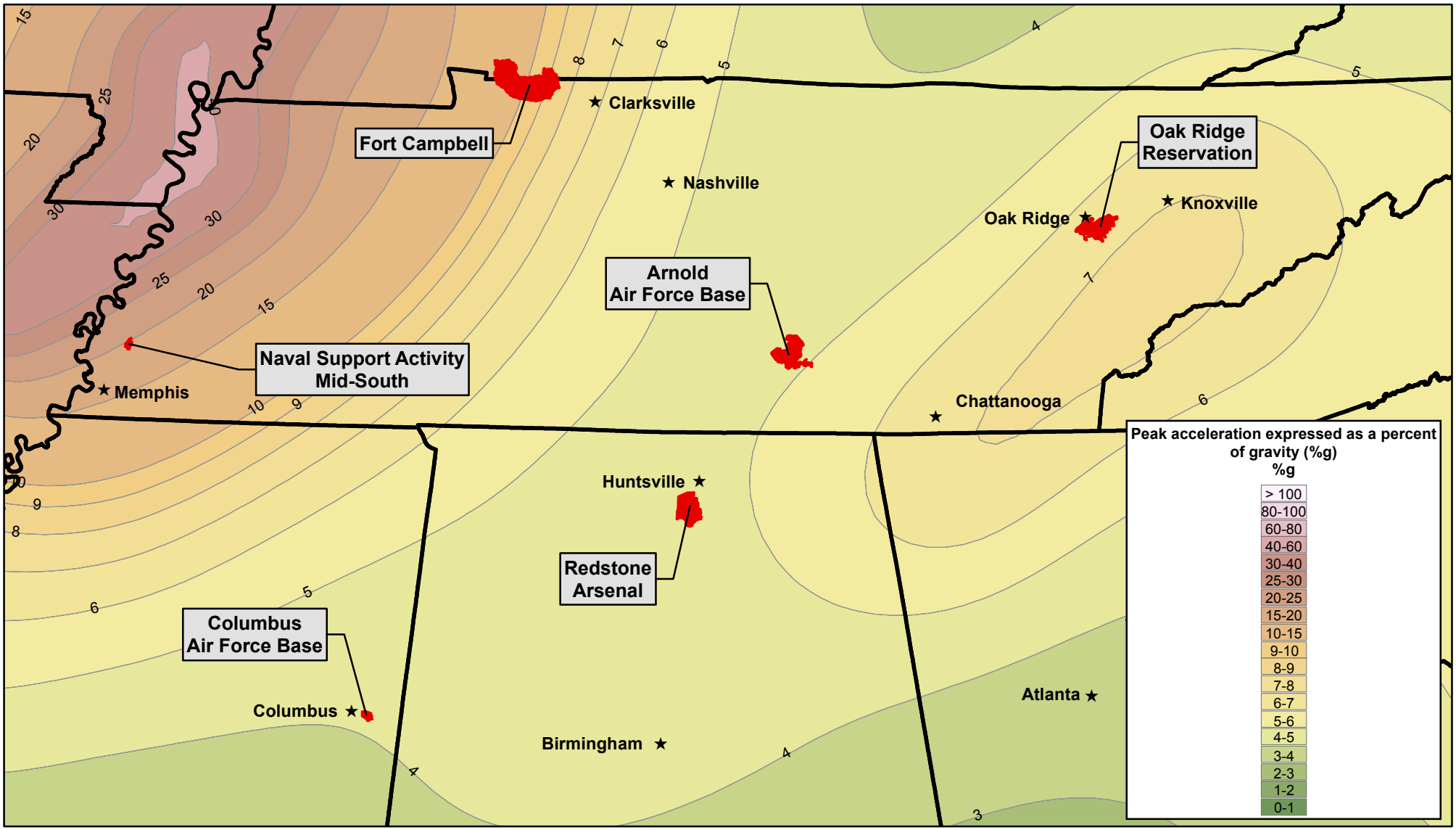
Figure 3.1-18
Columbus Air Force Base Aerial

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	6/17/2014	Figure 3.1-18

Path: L:\Projects\60279942\9.0 CADD\GIS MXDs\60279942_057 Columbus Aerial.mxd



Legend

- TVA SMR Candidate Areas
- Major Cities

0 22.5 45 90 Miles

N W E S

Source: U.S. Geological Survey Seismic-Hazard Maps for the Conterminous United States, 2008, Scientific Investigations Map 3195; State Boundaries ESRI, 2013

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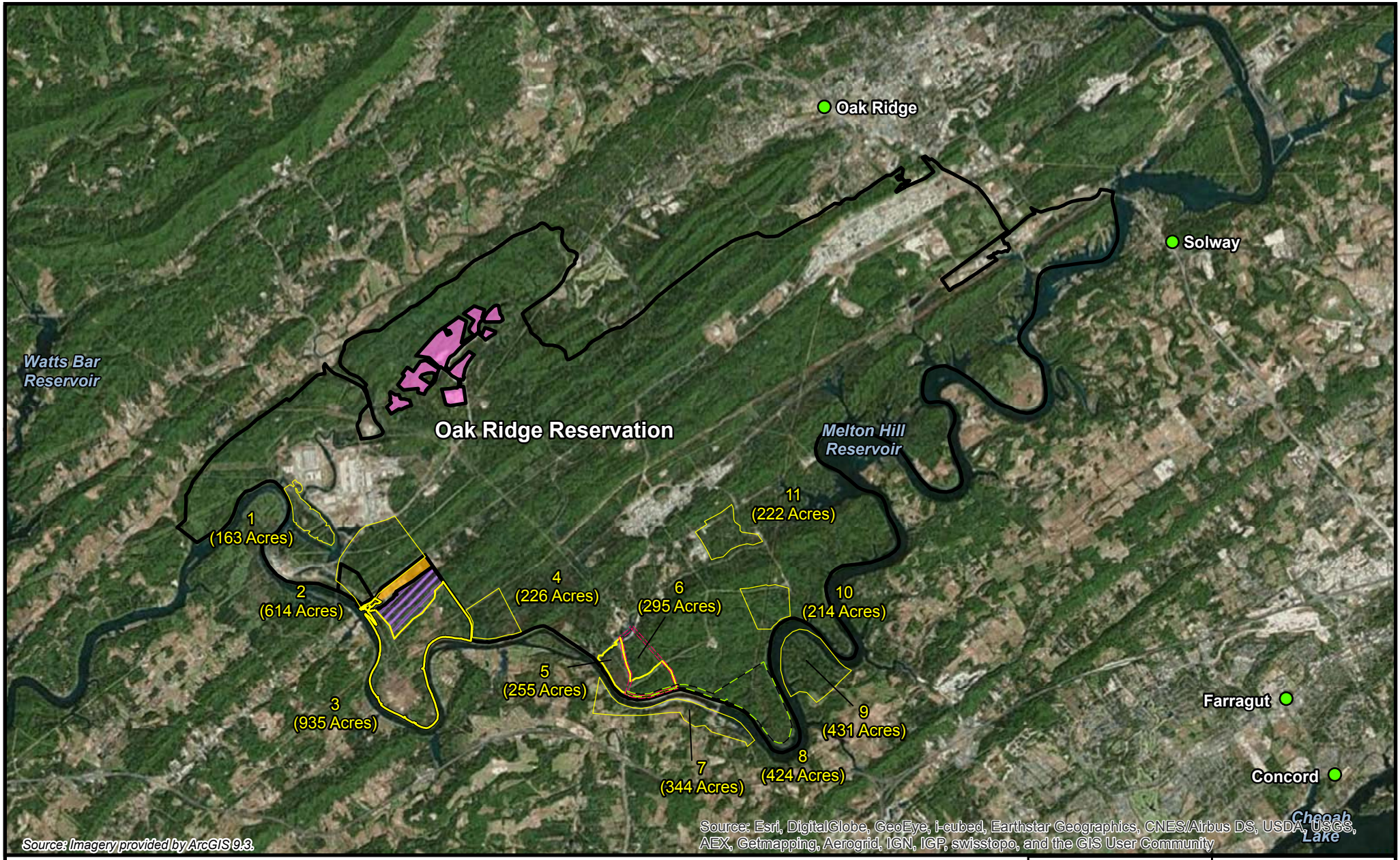
Figure 3.2-1
Peak Horizontal Acceleration with 10 Percent Probability of Exceedance in 50 Years

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	12/23/2013	Figure 3.2-1

Path: L:\Projects\60279942\9.0 CADD\GIS MXDs\60279942_069 Peak Horizontal Acceleration with 10 Percent Probability of Exceedance in 50 Years.mxd



Legend

- Candidate Area Boundary
- Potential Candidate Sites
- City
- ORR Leased Land (CROET)
- Clinch River Industrial Area
- Grassy Creek Habitat Protection Area

0 5,000 10,000 20,000 Feet

N W E S

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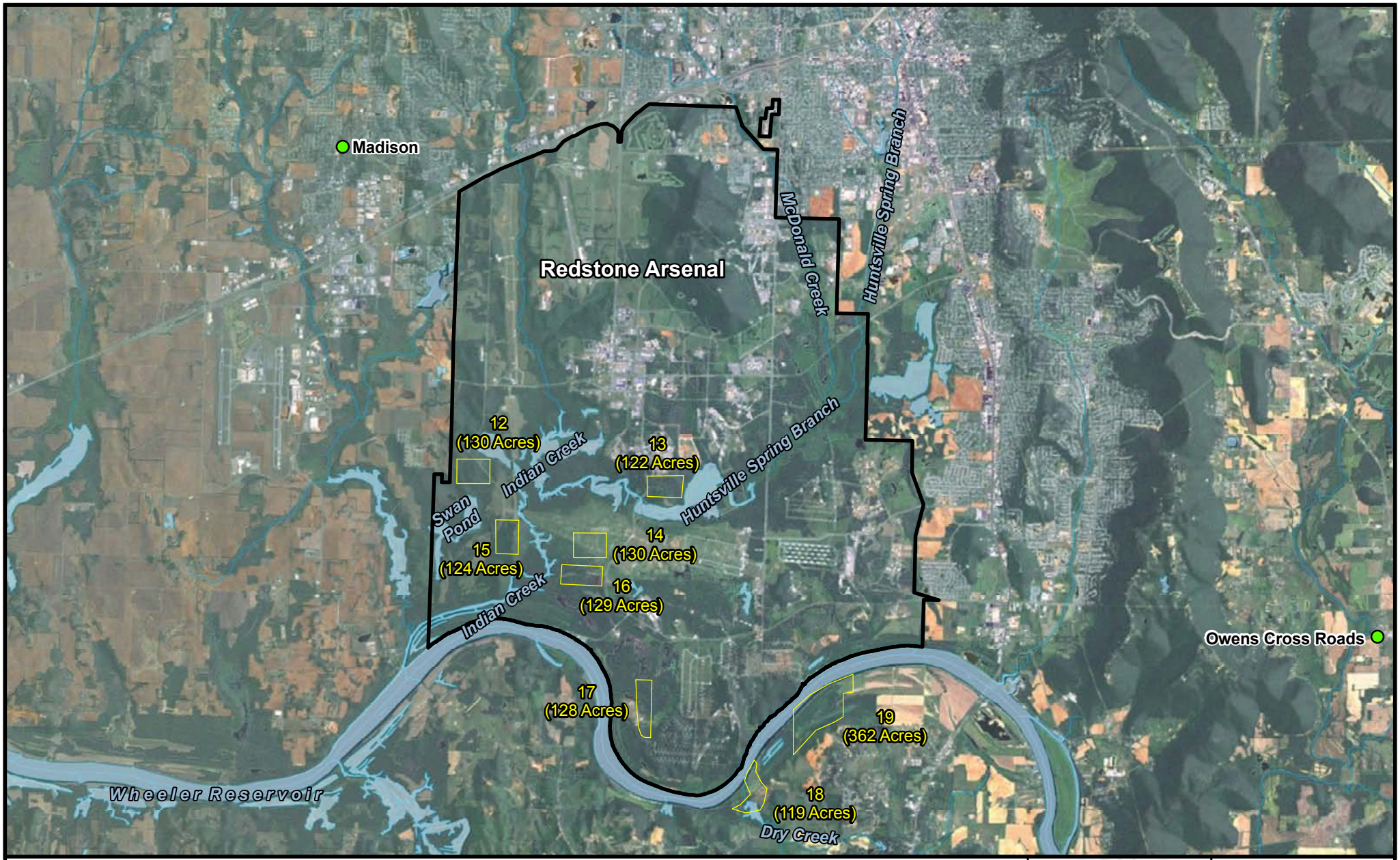
Figure 4.0-1
Oak Ridge Reservation (ORR)
Potential Candidate Sites
SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	8/20/2015	Figure 4.0-1

Path: X:\Admin\BD_Projects\TVA\TVA Figures March 2015\Task 15 Siting Study\60279942_040 ORR Potential Sites_Rev2.mxd



Legend

- Candidate Area Boundary
- Potential Candidate Site
- City

0 5,500 11,000 22,000 Feet

N W E S

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Figure 4.0-2
Redstone Arsenal
Potential Candidate Sites

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60224964	MS	11/21/2014	Figure 4.0-2

Path: L:\Projects\60279942\9.0 CADD\GIS MXDs\60279942_041 Redstone Potential Sites.mxd

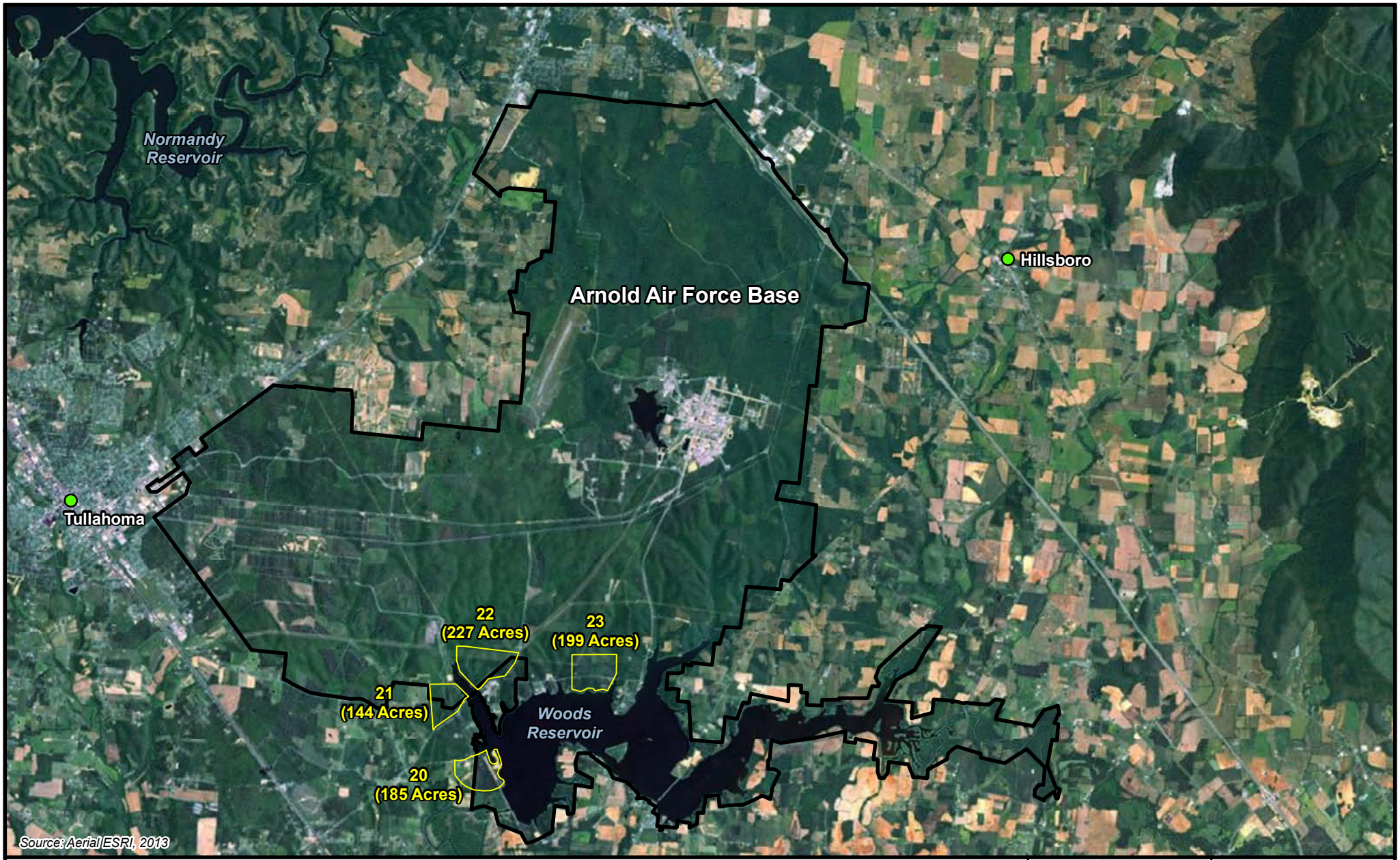

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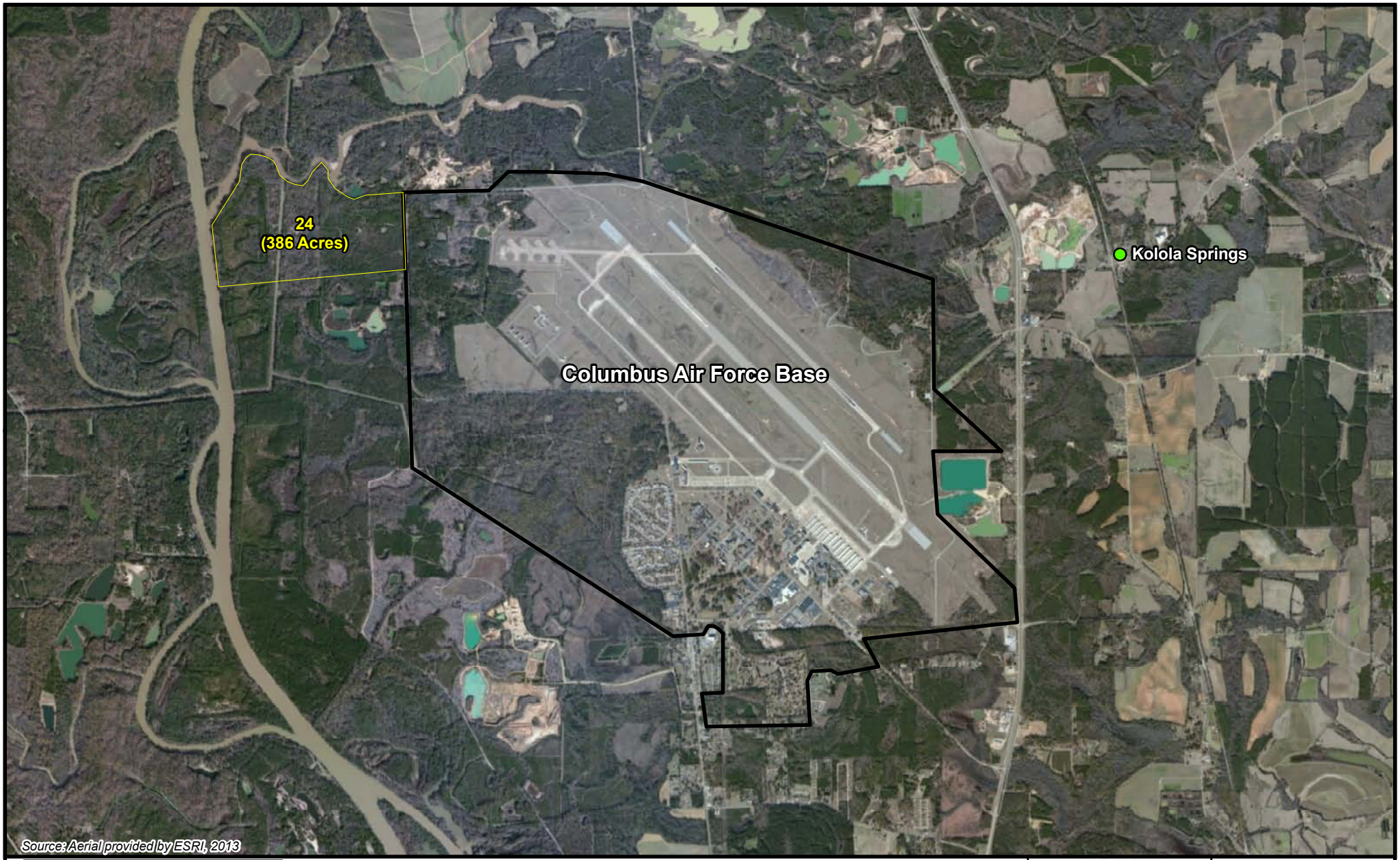
Figure 4.0-3
Arnold Air Force Base
Potential Candidates Sites

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	11/21/2014	Figure 4.0-3

Path: L:\Projects\60279942\9.0 CADD\GIS MXDs\60279942_043 AEDC Potential Sites.mxd



Legend

- Candidate Area Boundary
- Potential Candidate Site
- City

0 2,000 4,000 8,000 Feet

N W E S

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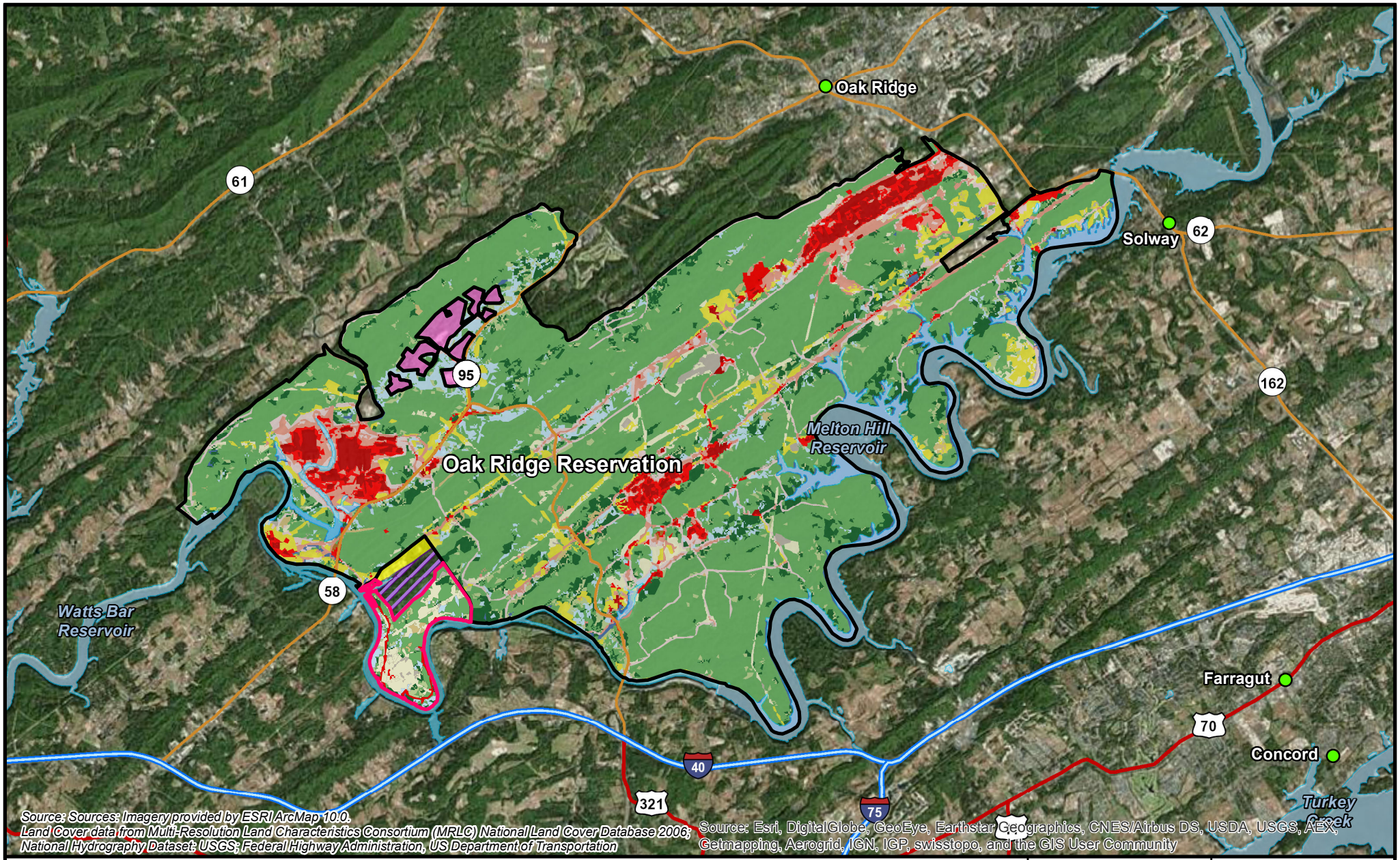
Figure 4.0-4
Columbus Air Force Base
Potential Candidates Sites

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	11/21/2014	Figure 4.0-4

Path: L:\Projects\60279942\9.0 CADD\GIS MXDs\60279942_044 Columbus Potential Sites.mxd



0 5,000 10,000 20,000 Feet

Legend

- Candidate Area Boundary
- Barren Land (Rock/Sand/Clay)
- Cultivated Crops
- Deciduous Forest
- Developed, High Intensity
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, Open Space
- Emergent Herbaceous Wetlands
- Evergreen Forest
- Grassland/Herbaceous
- Mixed Forest
- Open Water
- Pasture/Hay
- Shrub/Scrub
- Woody Wetlands
- City
- ORR Leased Land (CROET)
- Clinch River Industrial Area
- Grassy Creek Habitat Protection Area

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Figure 5.1-1
Oak Ridge Reservation (ORR)
Land Use Land Cover

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	8/20/2015	Figure 5.1-1

Path: X:\Admin\BD_Projects\TVA\TVA Figures March 2015\Task 15 Siting Study\60279942_100 ORR_LULC.mxd

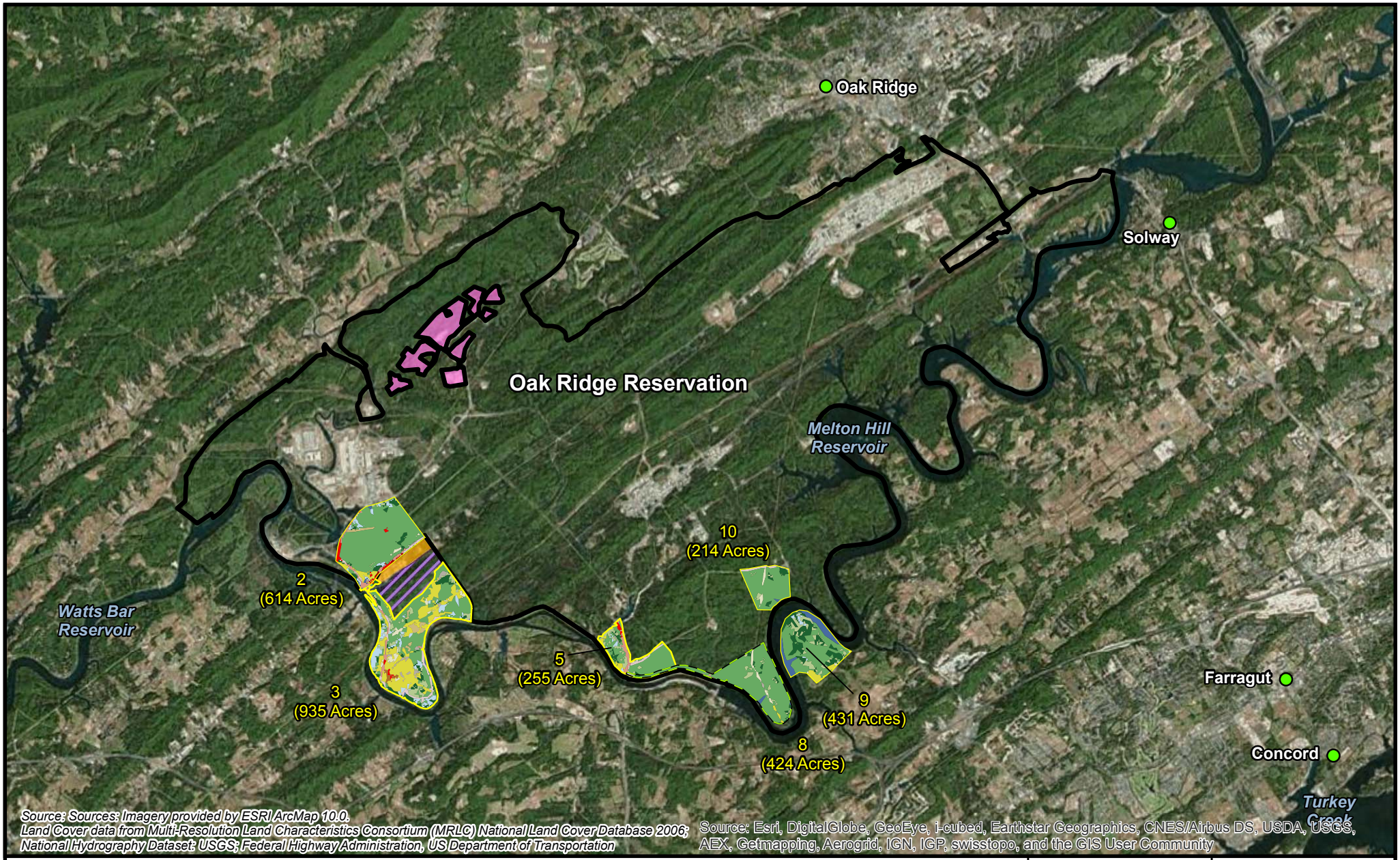

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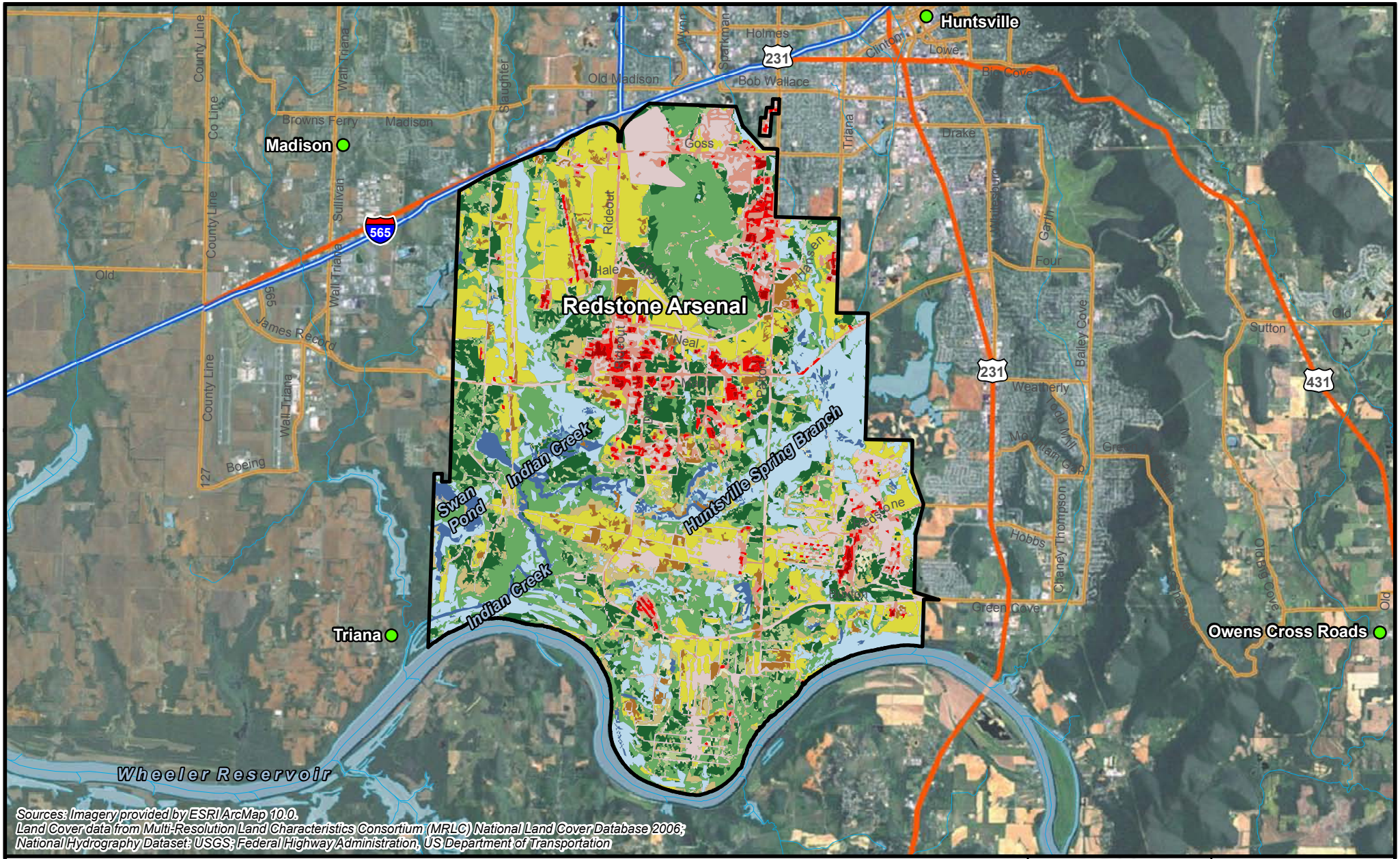
Figure 5.1-2
Oak Ridge Reservation (ORR)
Potential Candidate Sites
Land Use Land Cover
SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	8/20/2015	Figure 5.1-2

Path: X:\Admin\BD_Projects\TVA\TVA Figures March 2015\Task 15 Siting Study\60279942_139 ORR Potential Sites_LULC_Jan2015.mxd



Sources: Imagery provided by ESRI ArcMap 10.0.
Land Cover data from Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database 2006;
National Hydrography Dataset: USGS; Federal Highway Administration, US Department of Transportation

Legend

- Candidate Area Boundary
- Barren Land (Rock/Sand/Clay)
- Cultivated Crops
- Deciduous Forest
- Developed, High Intensity
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, Open Space
- Emergent Herbaceous Wetlands
- Evergreen Forest
- Grassland/Herbaceous
- Mixed Forest
- Open Water
- Pasture/Hay
- Shrub/Scrub
- Woody Wetlands
- City

0 5,500 11,000 22,000 Feet

N W E S

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Figure 5.1-3
Redstone Arsenal
Land Use Land Cover

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60224964	MS	9/2/2014	Figure 5.1-3

Path: L:\Projects\60279942\9.0 CADD\GIS MXDs\60279942_102 Redstone_LULC.mxd

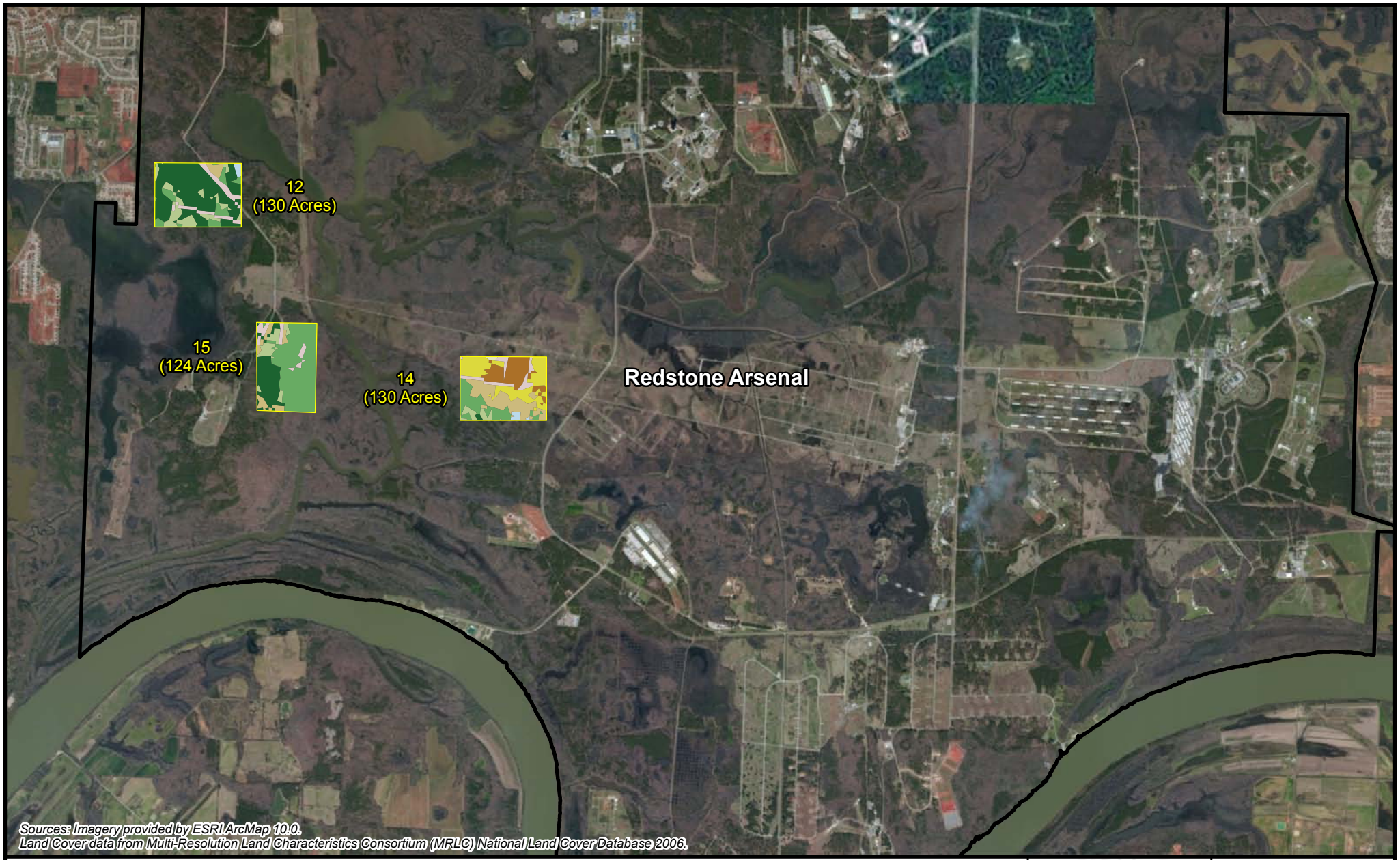

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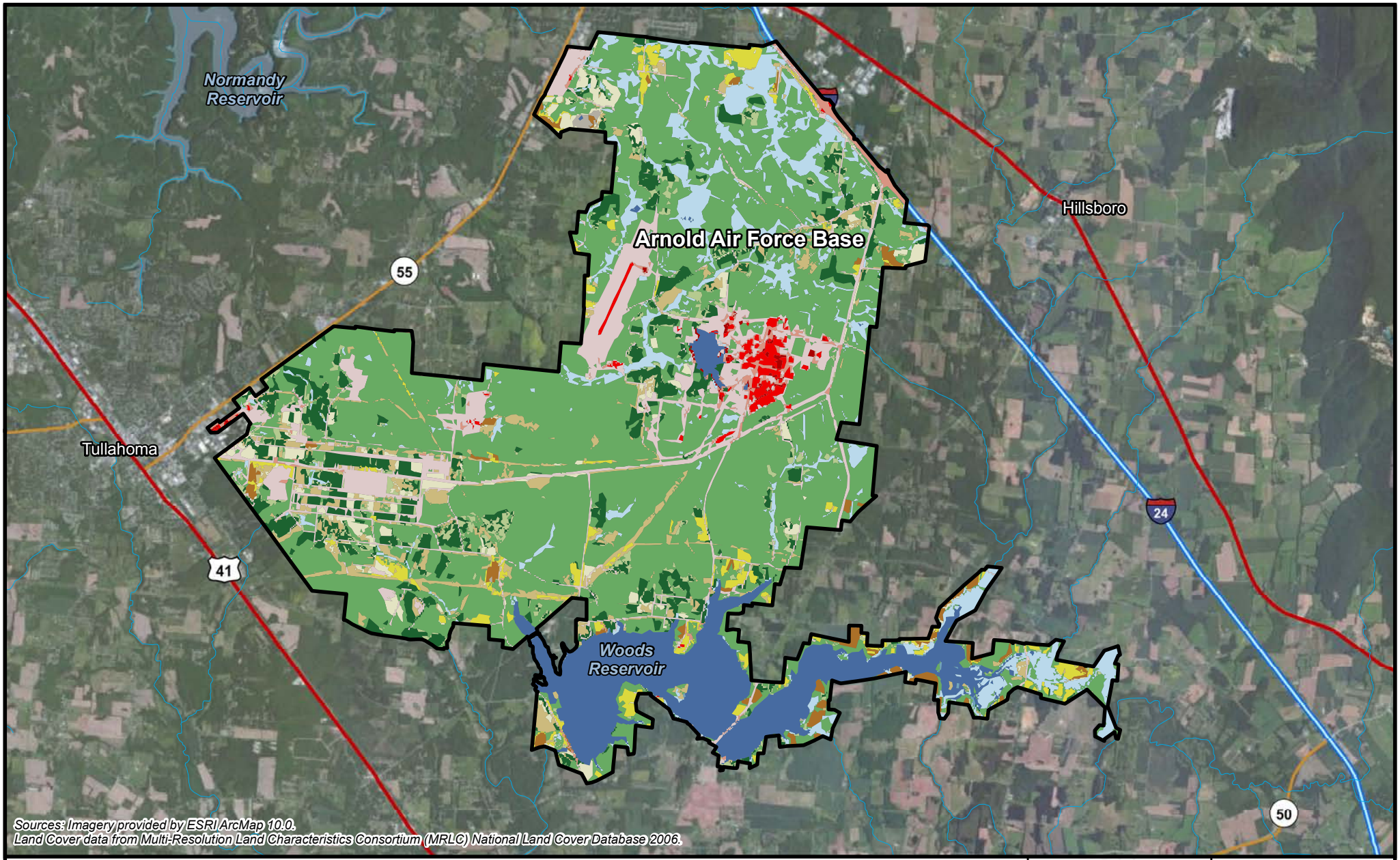
Figure 5.1-4
Redstone Arsenal Potential Candidate Sites Land Use Land Cover

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60224964	MS	12/9/2014	Figure 5.1-4

Path: L:\Projects\60279942\9.0 CADD\GIS MXDs\60279942_140 Redstone_LULC_Dec2014.mxd



Legend

- Candidate Area Boundary
- Barren Land (Rock/Sand/Clay)
- Cultivated Crops
- Deciduous Forest
- Developed, High Intensity
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, Open Space
- Emergent Herbaceous Wetlands
- Evergreen Forest
- Grassland/Herbaceous
- Mixed Forest
- Open Water
- Pasture/Hay
- Shrub/Scrub
- Woody Wetlands

0 5,000 10,000 20,000 Feet

N W E S

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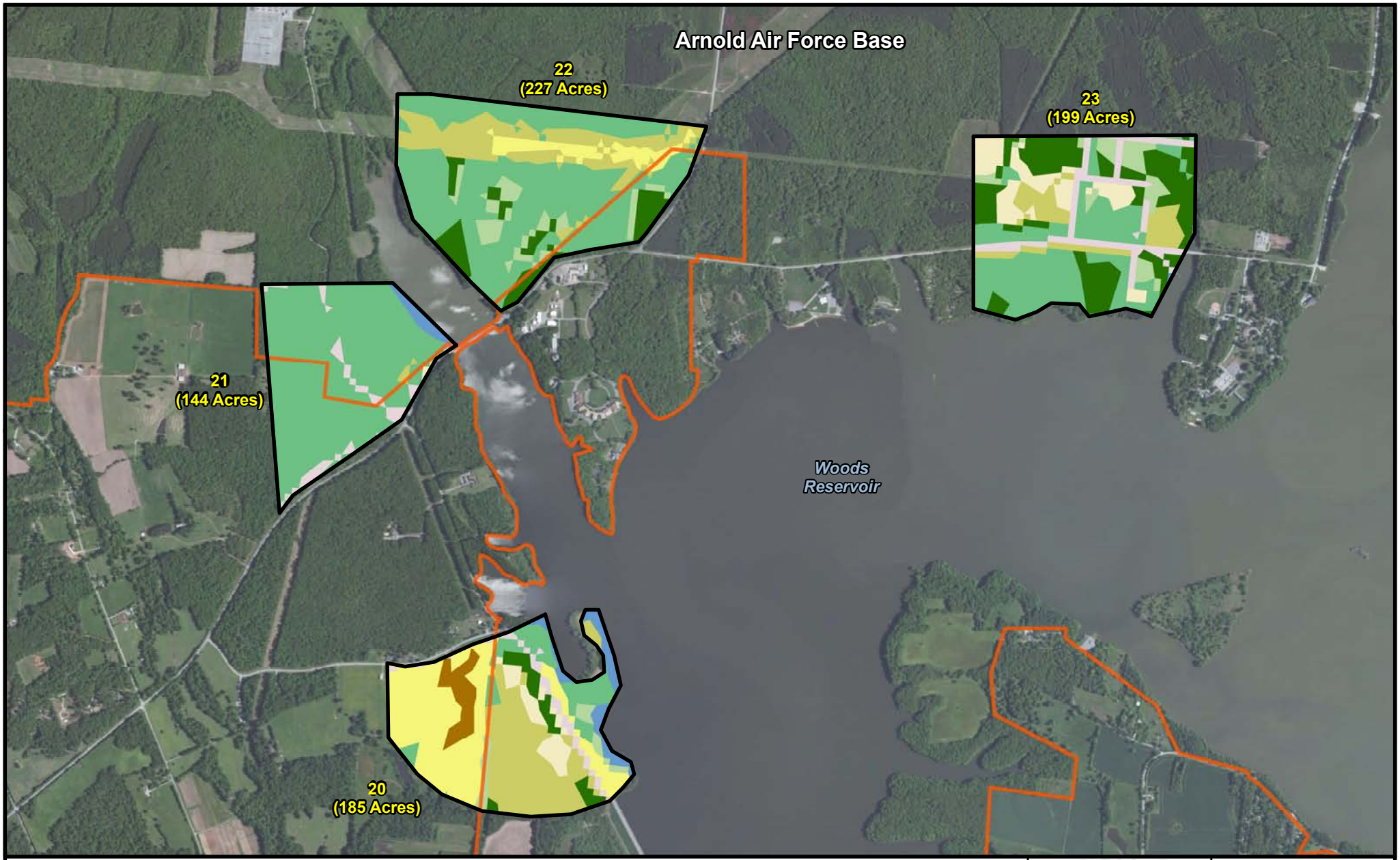
Figure 5.1-5
Arnold Air Force Base
Land Use Land Cover

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	12/23/2013	Figure 5.1-5

Path: L:\Projects\60279942\9.0 CADD\GIS MXDs\60279942_101 AEDC_LULC.mxd



Legend

- Candidate Area Boundary
- Potential Candidate Sites
- Barren Land (Rock/Sand/Clay)
- Cultivated Crops
- Deciduous Forest
- Developed, High Intensity
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, Open Space
- Emergent Herbaceous Wetlands
- Evergreen Forest
- Grassland/Herbaceous
- Mixed Forest
- Open Water
- Pasture/Hay
- Shrub/Scrub
- Woody Wetlands

0 1,000 2,000 4,000 Feet

N W E S

Sources: Imagery provided by ESRI ArcMap 10.0.
Land Cover data from Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database 2006.

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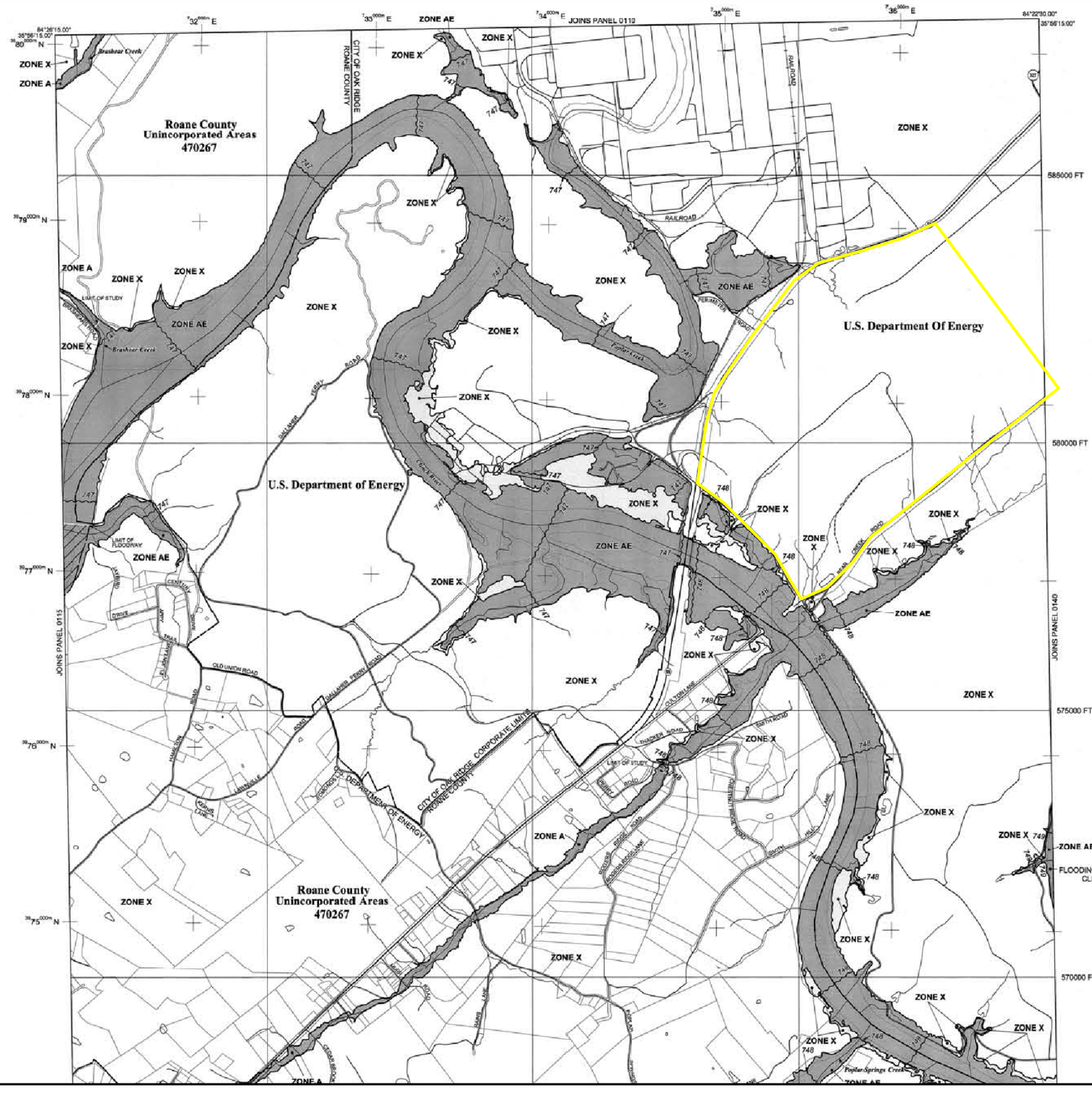
Figure 5.1-6
Arnold Air Force Base Potential Candidate Sites Land Use Land Cover

SMR Project

PROJECT NO.	DRAWN BY:	DATE:	
60279942	MLS	12/23/2013	Figure 5.1-6

Path: L:\Projects\60279942\9.0 CADD\GIS MXDs\60279942_110 AEDC_LULC_w Potential Sites.mxd



N

Legend

Approximate Boundary of Potential Candidate Site

0 1000 2000 4000

SCALE IN FEET

Source: This is an official copy of a portion of the referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been subsequent to August 4, 2008. For the latest product information about National Flood Insurance Program flood maps, check the FEMA Flood Map Store at www.msc.fema.gov

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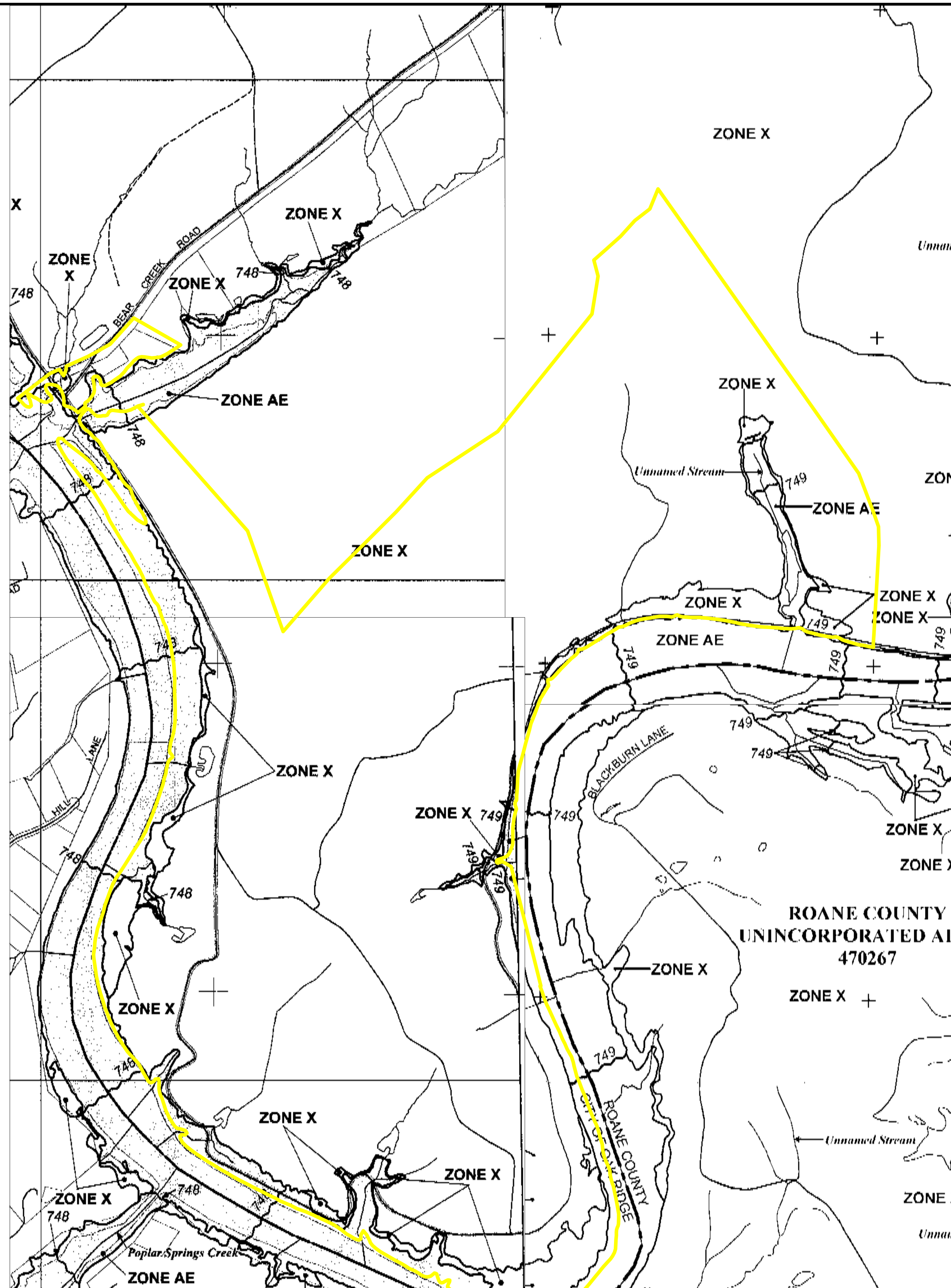
Figure 5.2-1
FIRM - ORR Site 2
Roane County, Tennessee

SMR Project

11/12/2014 60279942



N

Legend

Approximate Boundary of Potential Candidate Site

0 625 1250 2500

SCALE IN FEET

Source: This is an official copy of a portion of the referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been subsequent to September 28, 2007. For the latest product information about National Flood Insurance Program flood maps, check the FEMA Flood Map Store at www.msc.fema.gov

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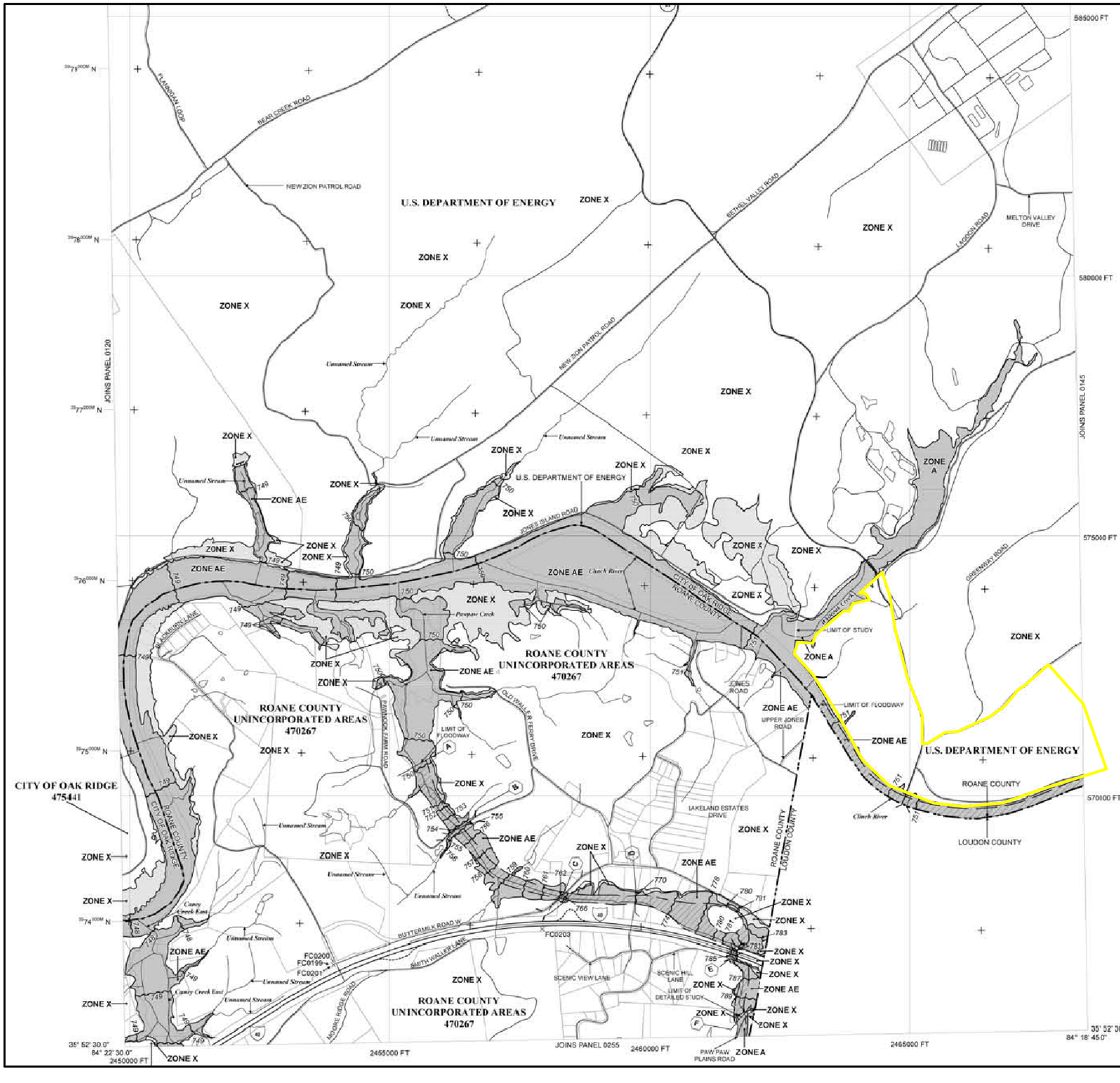
Figure 5.2-2
FIRM - ORR Site 3
Roane County, Tennessee

SMR Project

11/12/2014 60279942



N

Legend

Approximate Boundary of Potential Candidate Site 5

0 1000 2000 4000

SCALE IN FEET

Source: This is an official copy of a portion of the referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been subsequent to August 4, 2008. For the latest product information about National Flood Insurance Program flood maps, check the FEMA Flood Map Store at www.msc.fema.gov

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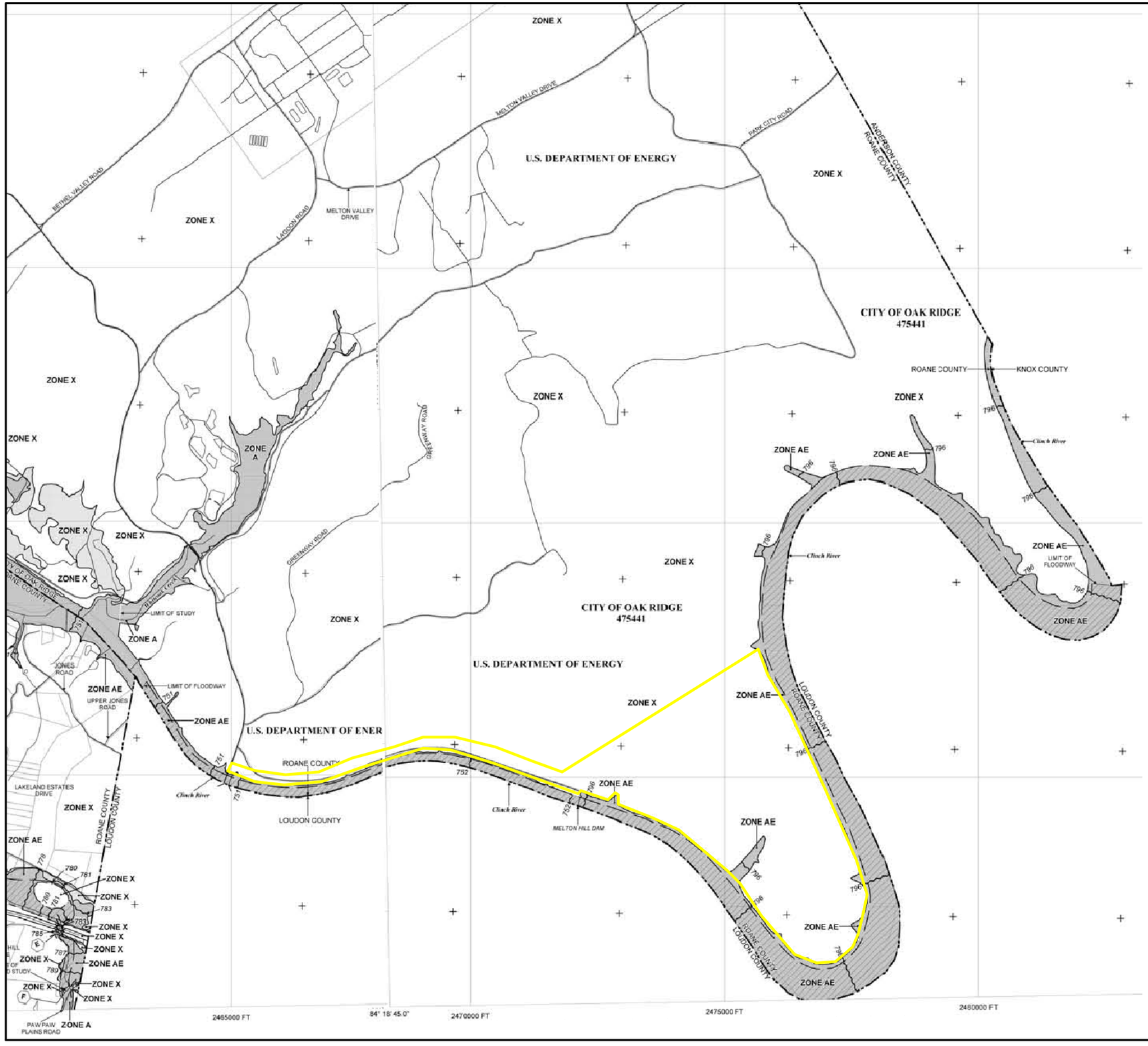
Figure 5.2-3
FIRM - ORR Site 5
Roane County, Tennessee

SMR Project

11/12/2014 60279942

L:\Projects\60279942\9.0 CADD\60279942_017 FIRM_ORR Site 5.dwg, 11/12/2014 3:49:33 PM, splawnm



N

Legend

Approximate Boundary of Potential Candidate Site

0 1000 2000 4000

SCALE IN FEET

Source: This is an official copy of a portion of the referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been subsequent to August 4, 2008. For the latest product information about National Flood Insurance Program flood maps, check the FEMA Flood Map Store at www.msc.fema.gov

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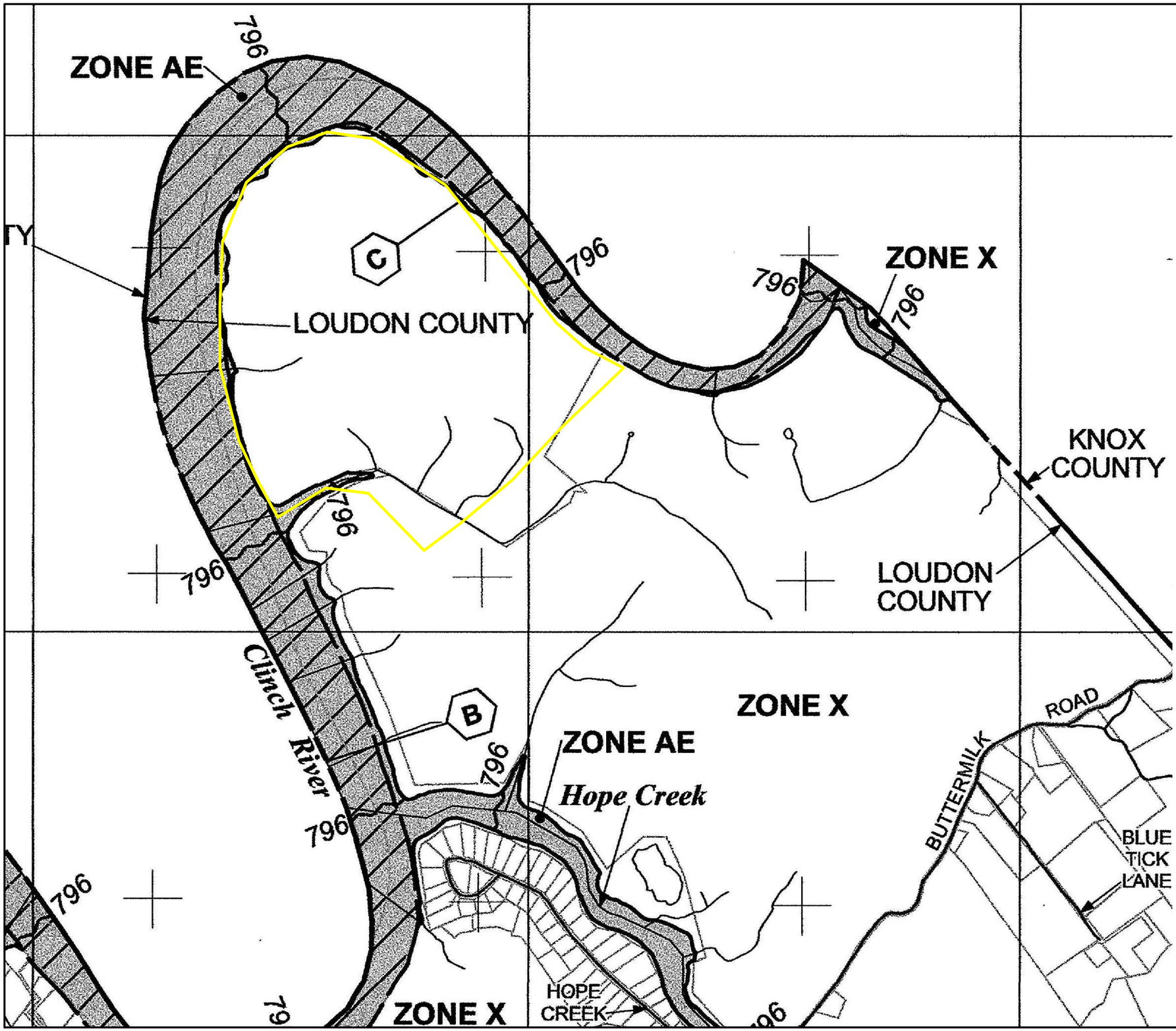
Figure 5.2-4
FIRM - ORR Site 8
Roane County, Tennessee

SMR Project

11/12/2014 60279942

L:\Projects\60279942\9.0 CADD\60279942_018 FIRM_ORR Site 8.dwg, 11/12/2014 3:50:20 PM, splawnm



N

Legend

Approximate Boundary of Potential Candidate Site

0 500 1000 2000

SCALE IN FEET

Source: This is an official copy of a portion of the referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been subsequent to November 18, 2009. For the latest product information about National Flood Insurance Program flood maps, check the FEMA Flood Map Store at www.msc.fema.gov

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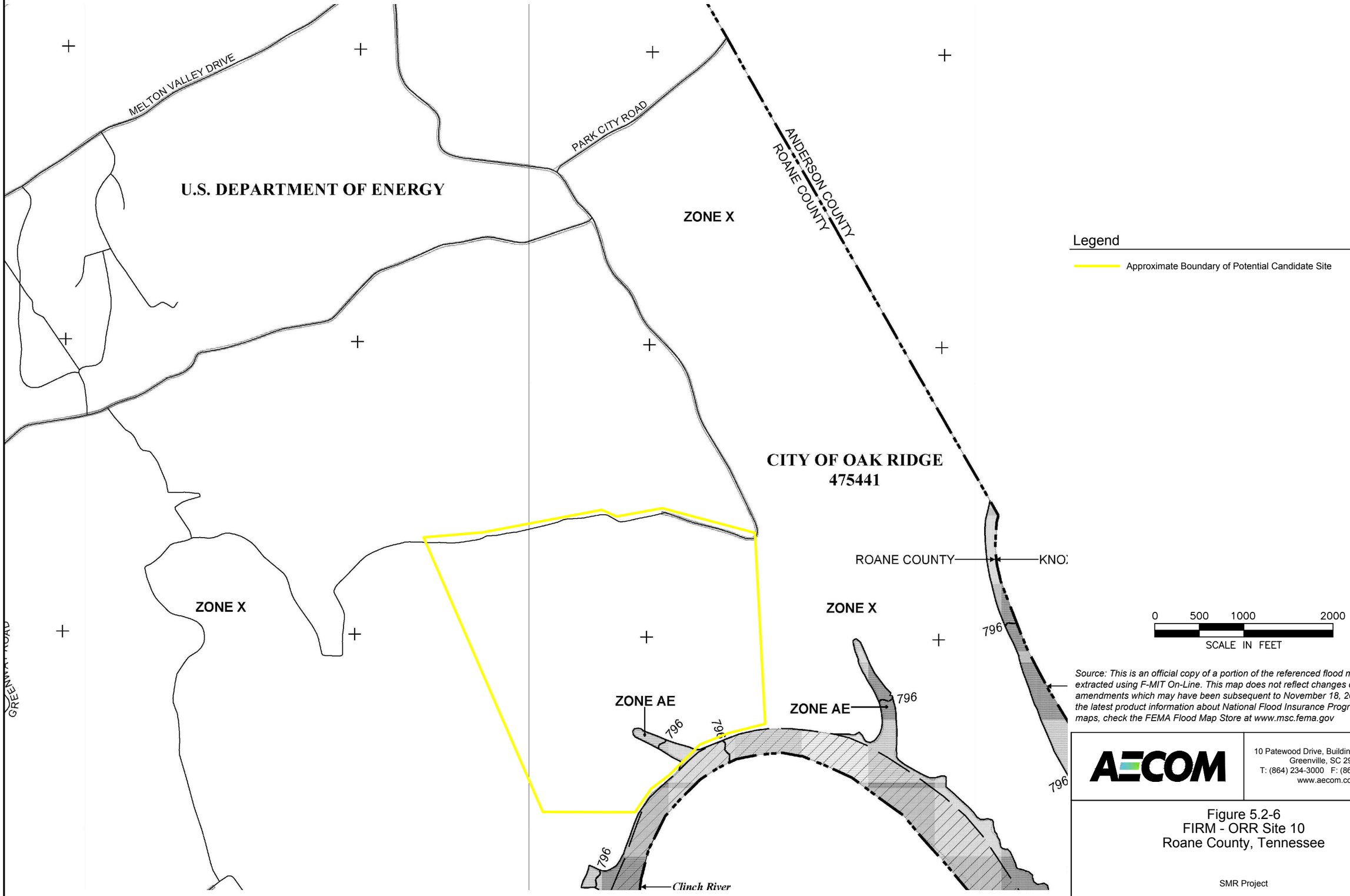
Figure 5.2-5
FIRM - ORR Site 9
Roane County, Tennessee

SMR Project

11/12/2014 60279942



Source: This is an official copy of a portion of the referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been subsequent to November 18, 2009. For the latest product information about National Flood Insurance Program flood maps, check the FEMA Flood Map Store at www.msc.fema.gov

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Figure 5.2-6
FIRM - ORR Site 10
Roane County, Tennessee

SMR Project

11/12/2014 60279942

N

Legend

Approximate Boundary of Potential Candidate Site

0 500 1000 2000

SCALE IN FEET

Source: This is an official copy of a portion of the referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been subsequent to April 20, 1998. For the latest product information about National Flood Insurance Program flood maps, check the FEMA Flood Map Store at www.msc.fema.gov

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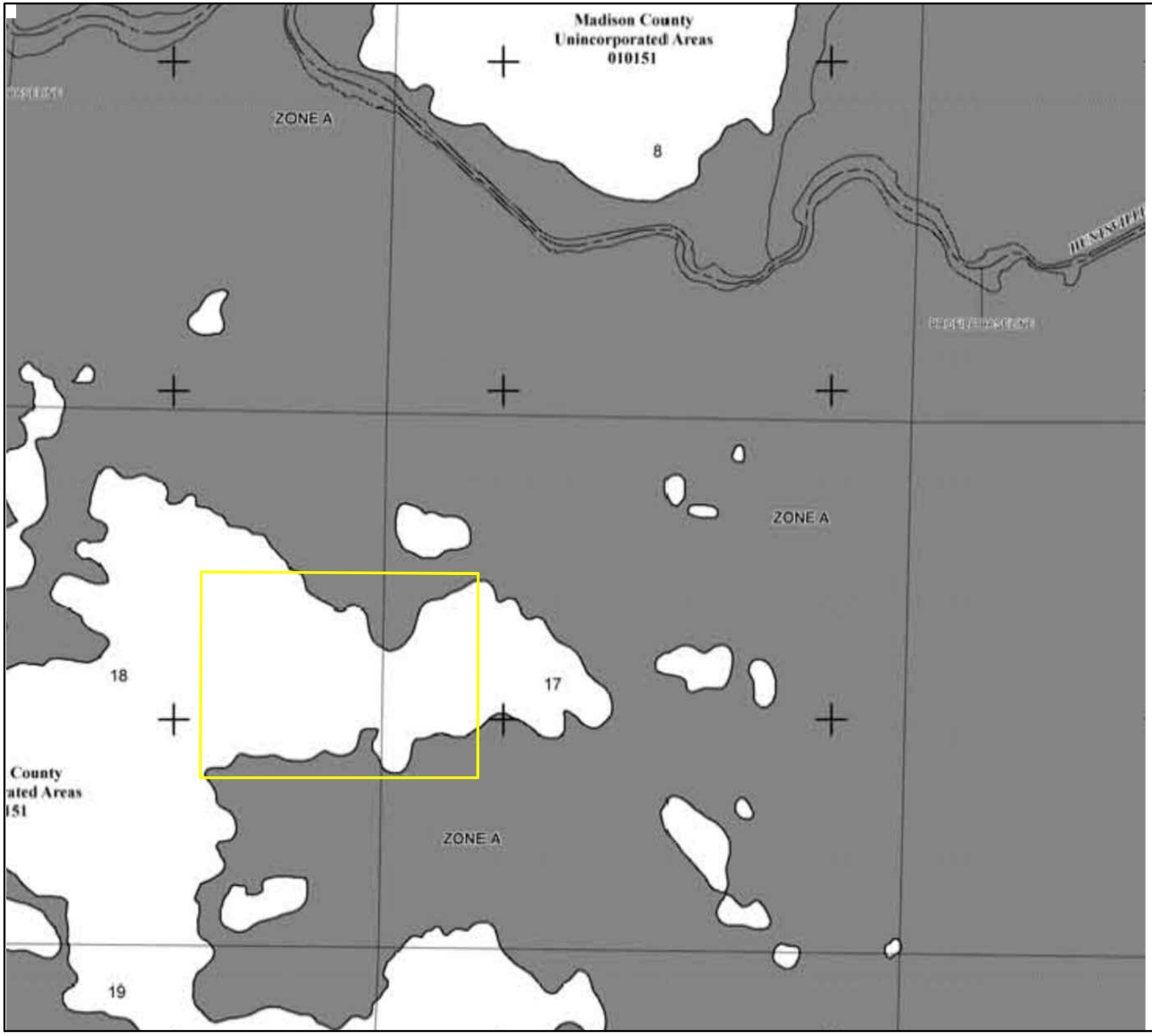
Figure 5.2-7
FIRM - Redstone Arsenal Site 12
Madison County, Alabama

SMR Project

NOVEMBER 2014 60279942



N

Legend

Approximate Boundary of Potential Candidate Site

0 500 1000 2000

SCALE IN FEET

Source: This is an official copy of a portion of the referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been subsequent to April 20, 1998. For the latest product information about National Flood Insurance Program flood maps, check the FEMA Flood Map Store at www.msc.fema.gov

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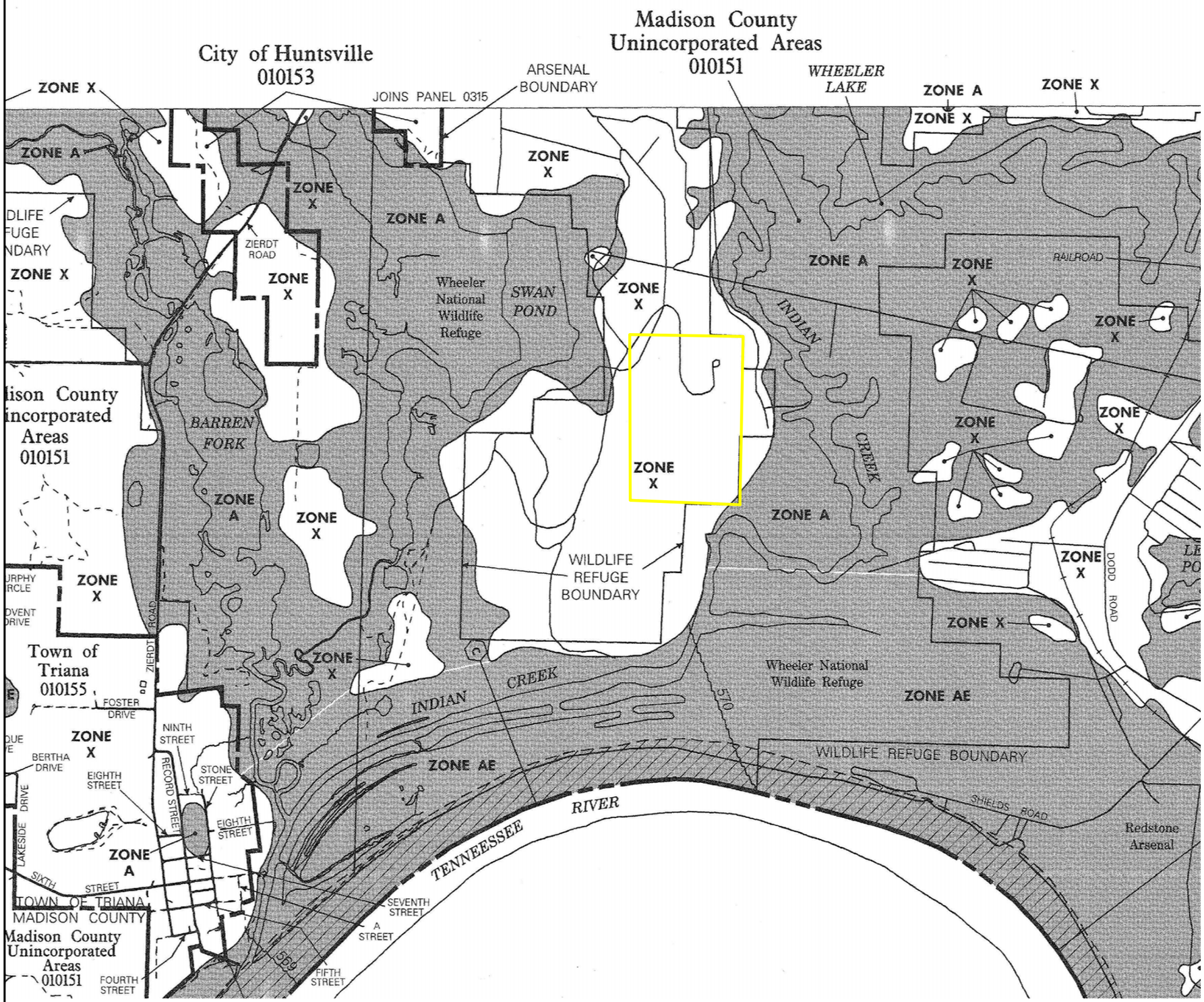
Figure 5.2-8
FIRM - Redstone Arsenal Site 14
Madison County, Alabama

SMR Project

NOVEMBER 2014 60279942



N

Legend

Approximate Boundary of Potential Candidate Site

0 500 1000 2000

SCALE IN FEET

Source: This is an official copy of a portion of the referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been subsequent to April 20, 1998. For the latest product information about National Flood Insurance Program flood maps, check the FEMA Flood Map Store at www.msc.fema.gov

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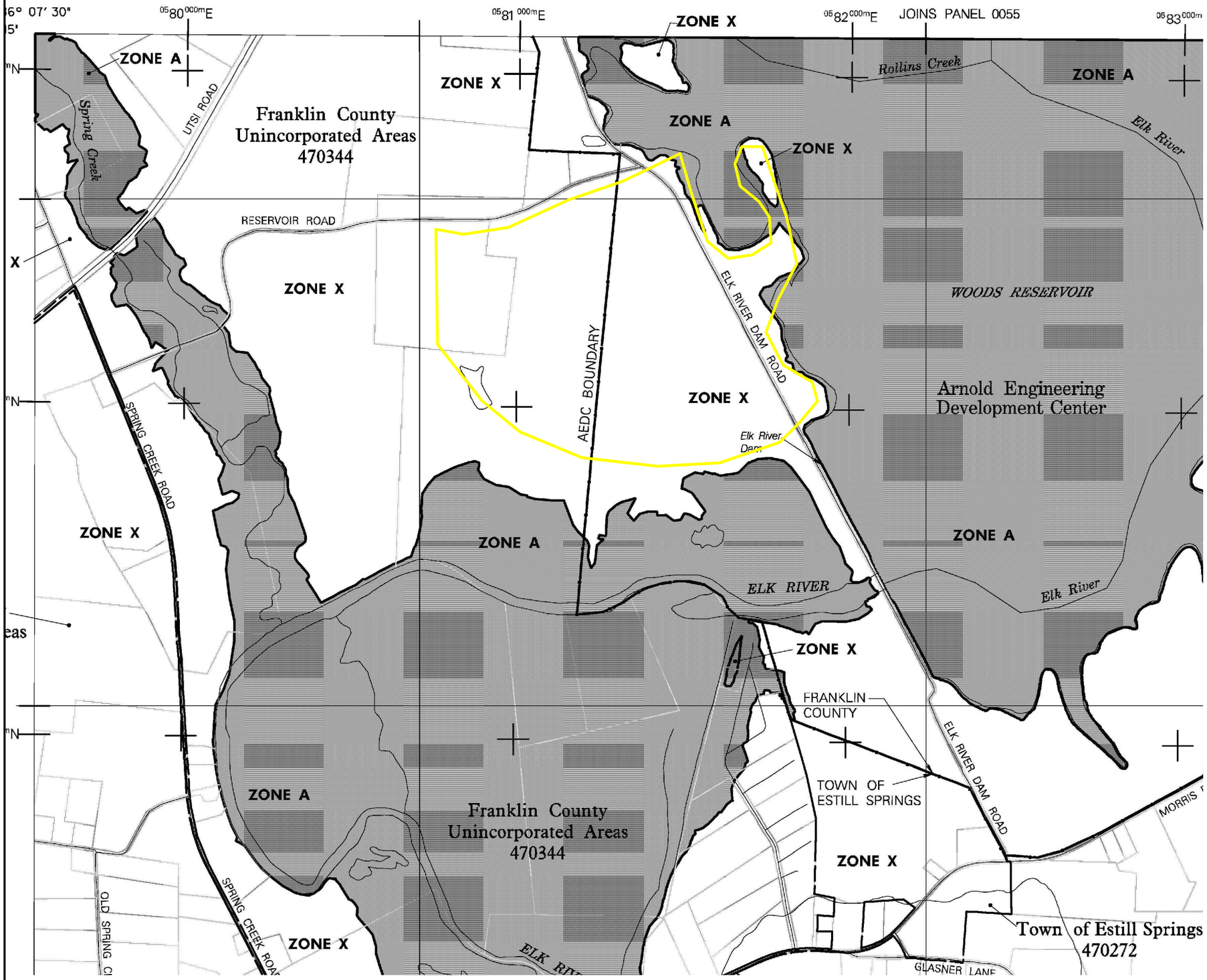
Figure 5.2-9
FIRM - Redstone Arsenal Site 15
Madison County, Alabama

SMR Project

NOVEMBER 2014 60279942



N

Legend

Approximate Boundary of Potential Candidate Site

0 500 1000 2000

SCALE IN FEET

Source: This is an official copy of a portion of the referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been subsequent to August 4, 2008. For the latest product information about National Flood Insurance Program flood maps, check the FEMA Flood Map Store at www.msc.fema.gov

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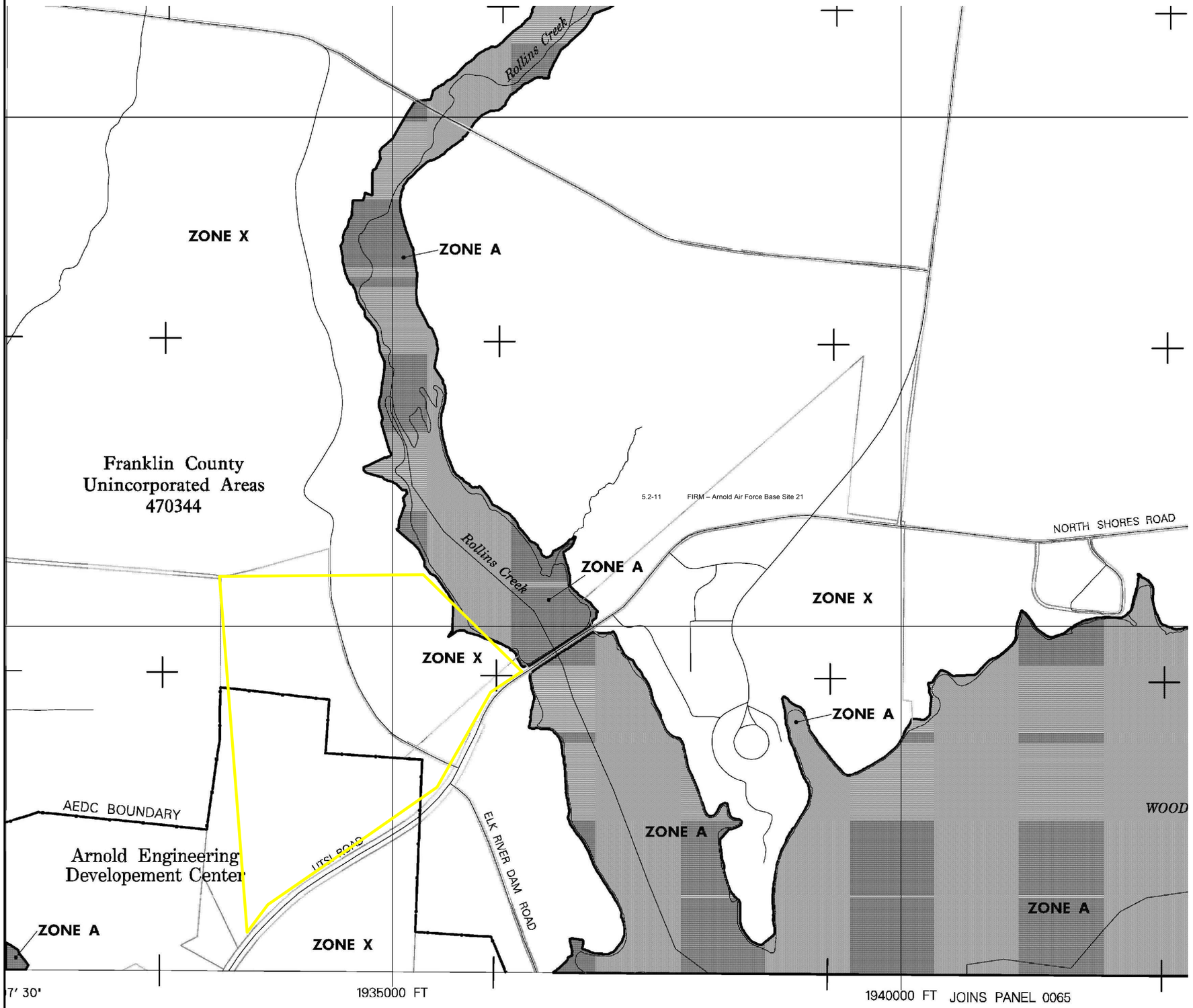
Figure 5.2-10
FIRM - Arnold Air Force Base Site 20
Franklin County, Tennessee

SMR Project

NOVEMBER 2014 60279942



N

Legend

Approximate Boundary of Potential Candidate Site

0 500 1000 2000

SCALE IN FEET

Source: This is an official copy of a portion of the referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been subsequent to August 4, 2008. For the latest product information about National Flood Insurance Program flood maps, check the FEMA Flood Map Store at www.msc.fema.gov

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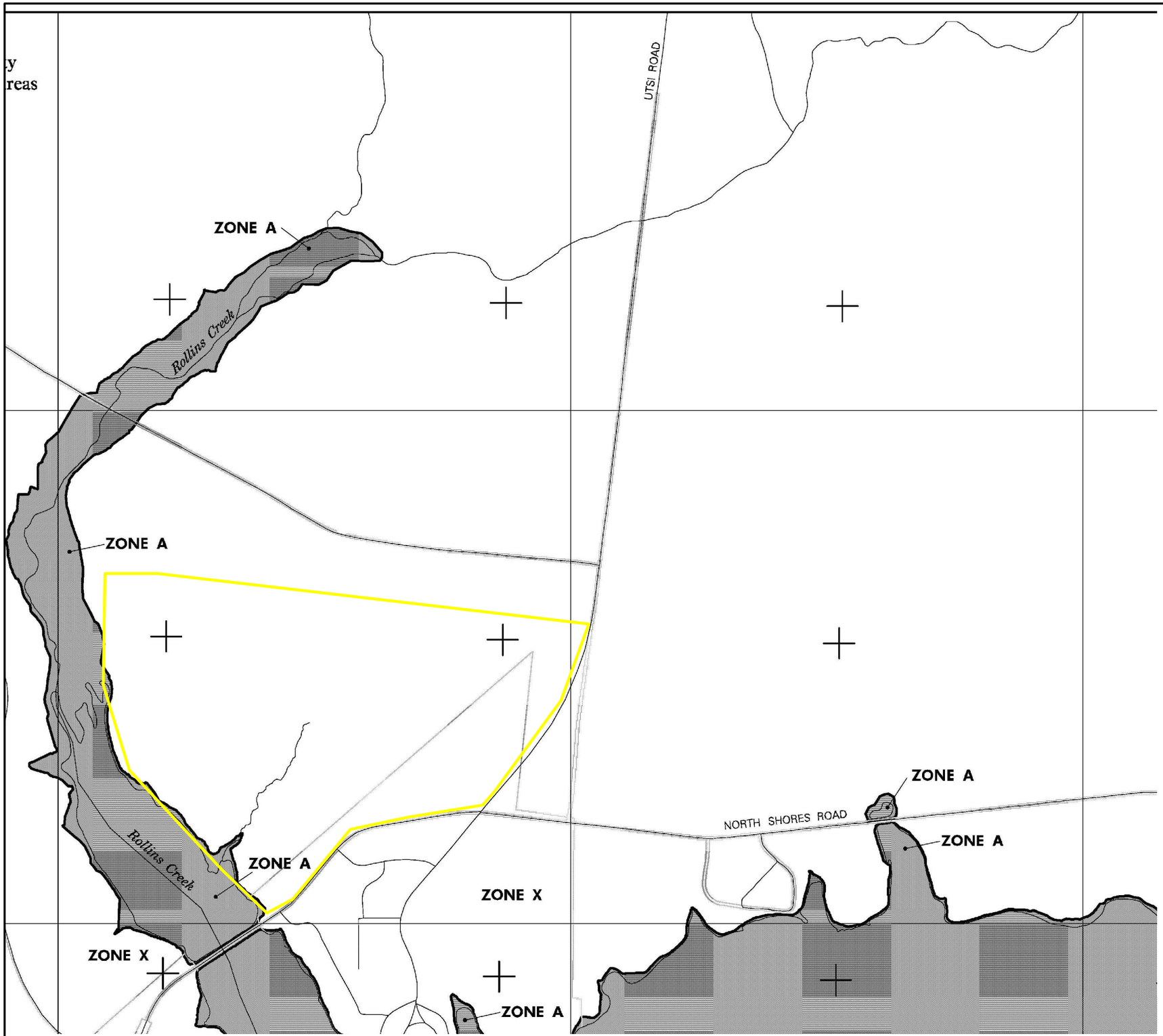
Figure 5.2-11
FIRM - Arnold Air Force Base Site 21
Franklin County, Tennessee

SMR Project

NOVEMBER 2014 60279942

L:\Projects\60279942\9.0 CADD\60279942_012 FIRM_AAFB Site 21.dwg, 11/21/2014 11:41:11 AM, Splawnm



N

Legend

Approximate Boundary of Potential Candidate Site

0 500 1000 2000

SCALE IN FEET

Source: This is an official copy of a portion of the referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been subsequent to August 4, 2008. For the latest product information about National Flood Insurance Program flood maps, check the FEMA Flood Map Store at www.msc.fema.gov

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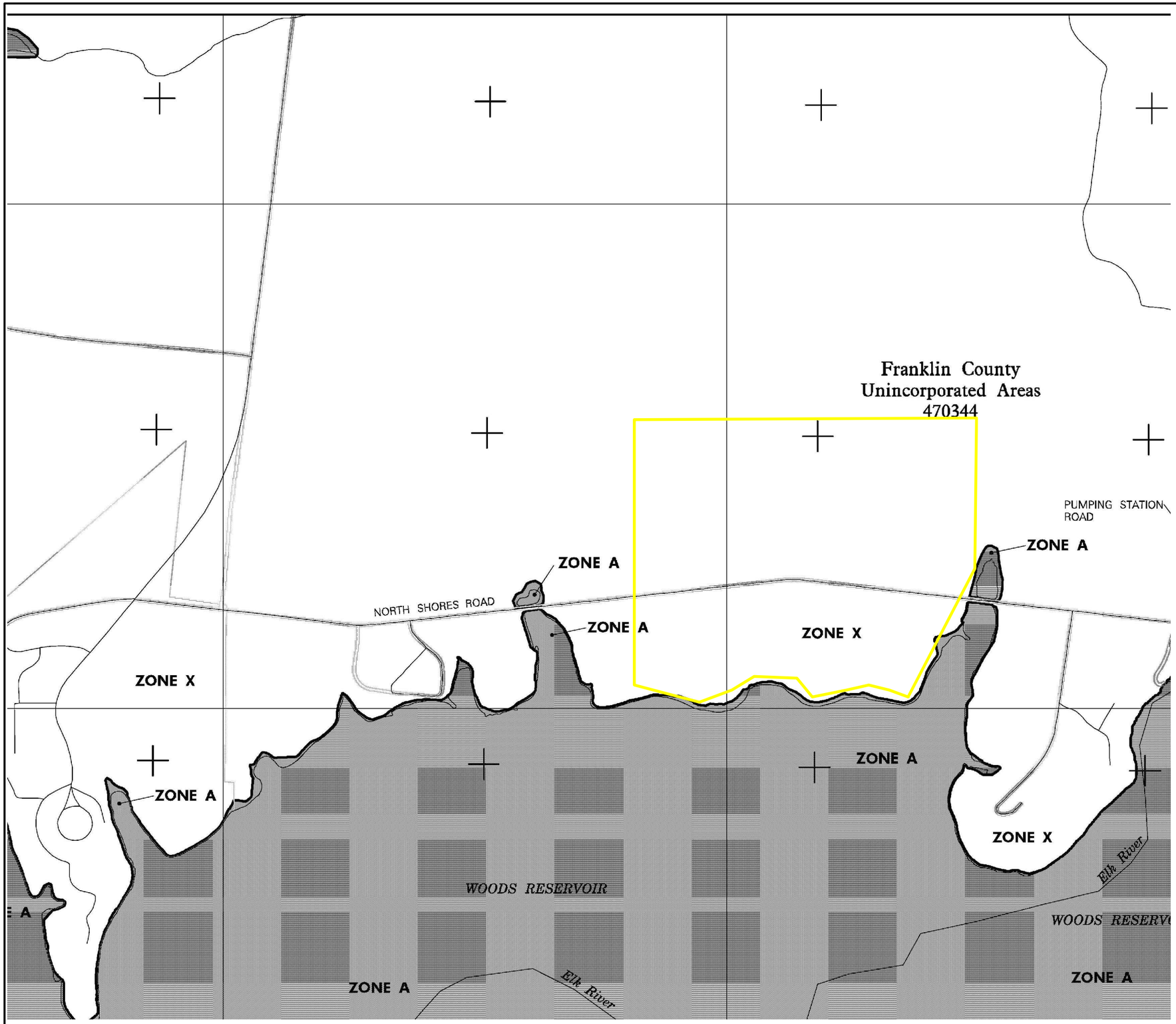
Figure 5.2-12
FIRM - Arnold Air Force Base Site 22
Franklin County, Tennessee

SMR Project

NOVEMBER 2014 60279942



N

Legend

Approximate Boundary of Potential Candidate Site

0 500 1000 2000

SCALE IN FEET

Source: This is an official copy of a portion of the referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been subsequent to August 4, 2008. For the latest product information about National Flood Insurance Program flood maps, check the FEMA Flood Map Store at www.msc.fema.gov

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Figure 5.2-13
FIRM - Arnold Air Force Base Site 23
Franklin County, Tennessee

SMR Project

NOVEMBER 2014 60279942

APPENDIX A

SMALL MODULAR REACTOR
WEIGHTING FACTOR SURVEY SUMMARY

SMALL MODULAR REACTOR WEIGHTING FACTOR SURVEY SUMMARY

REVISION 1

Prepared For:

Tennessee Valley Authority
1101 Market Street, LP 5A-C
Chattanooga, TN 30736

Prepared By:

AECOM
10 Patewood Drive
Building VI, Suite 500
Greenville, SC 29615

JUNE 2016

SMALL MODULAR REACTOR WEIGHTING FACTOR SURVEY SUMMARY

A survey for development of weighting factors associated with resource areas considered in the Siting Study was conducted between January 8 and February 5, 2014. Using the basic Delphi Method approach, nine (9) key members of the technical team associated with preparation of the Environmental Report (ER) for the SMR Construction Permit Application (Table 1) were selected to independently weight the importance of each of the criteria specified in NUREG-1555, Section 9.3, Site Selection Process.

Table 1. Survey Participants

Name	Company Affiliation	Role on the ER for the SMR Construction Permit Application
Jeff Perry	TVA	ER Project Manager
Bobbie Hurley	AECOM	SMR Program Manager
Kevin Taylor, PE, CHP	AECOM	ER Project Manager
Charles Nicholson	TVA	NEPA Principal Program Manager
Ruth Horton	TVA	Project Manager, Environmental Projects
Charles Wilson	TVA	Environmental Licensing Engineer
Anita Masters	TVA	SMR NEPA Program Manager
Robert Dover, PG	AECOM	EIS Project Manager
Evelyn Rogers, PE	AECOM	Senior Technical Reviewer

1.0 SURVEY - ROUND 1

The Round 1 Surveys were distributed via email to the team of participants (Table 1) on January 8, 2014. The survey participants were asked to rate the importance of each criterion (resource area) independently of one another using a standard weighting scale of “1“ to “10” with “1” meaning “not at all important” and “10” meaning “extremely important”. The participants were instructed to weight the importance of each criterion by assigning each resource area a weighting factor (1 through 10). The purpose of the 1 through 10 weighting factor scale was not to *rank* the criteria in order of importance, but to assess the degree of importance for each. For example, a “6” may have been assigned to both Land Use and Air Quality if the participant considered those criteria to be of equal importance. It was not necessary to assign a “1” or a “10” to any criteria if the evaluator did not consider that any criteria met the definitions of “not at all important” or “extremely important”. Participants were also instructed to include rationales for each weighting factor they assigned.

The Round 1 Survey form is presented in Figure 1.

ESTABLISHING WEIGHTING FACTORS FOR SUBJECT AREAS FOR POTENTIAL SITE EVALUATION

Participant Name: _____

Role of SMR Project: _____

Company Affiliation: _____

SUBJECT AREA FOR POTENTIAL SITE EVALUATION	WEIGHTING FACTOR	RATIONALE
Land Use, including availability, and areas requiring special consideration		
Hydrology, Water Quality, and Water Availability		
Terrestrial biological resources (including endangered species)		
Aquatic biological resources (including endangered species)		
Socioeconomics (including population, employment, and transportation)		
Population distribution and density		
Historic and Cultural Resources		
Air Quality		
Human Health		
Postulated Accidents		
Fuel Cycle Impacts		
Facility Costs		
Transmission Corridors		
Institutional Constraints		

Figure 1. Round 1 Survey Form

Once the participants had independently completed their surveys, making sure to not discuss their assigned weighting factors with any of the other participants, they submitted their forms to be tallied and compiled by AECOM staff.

2.0 SURVEY – ROUND 2

Results from Round 1 of the Weighting Factor Survey were compiled into Table 2, which was then distributed back to the participants for their Round 2 input on January 21, 2014.

Participants were provided the following instructions for Round 2:

> "When you open the Excel file, you will see 1) the individual criteria; 2) the average Round 1 score; 3) the lowest Round 1 score; 4) the highest Round 1 score; 5) the rationales; and 6) a column for you to enter your Round 2 weighting factors and any comments you have. Only the red Round 2 columns are editable.
>
> For the next step, you all must decide for each criterion if you want your Round 2 score to 1) agree with the Round 1 average; or 2) provide a new Round 2 weighting factor and a new rationale to try and convince the group that the Round 1 average is not acceptable.
>
> <u>When reviewing the results please keep the following in mind:</u>
>
> · *If you weighted a criteria a "10" but its average score is an 8.6 – do not automatically conclude that the weighting factor is not high enough – because 8.6 may be "the new 10" in the overall scheme of things.*
>
> · *When you are assigning a weight to each criterion – the question you should be asking yourself is "how important is this criterion in allowing us to discriminate between alternative sites?" You may consider a resource to be very important, but in the context of the Siting Study, it could be completely independent of the site and should therefore receive a lower weight.*
>
> · *Each participant applied the 1 to 10 scale in their own way; meaning some of you may have chosen to weight some resources a 10, and others a 5 (i.e. you started by weighting what you viewed as most important by assigning those criteria a "10" and then worked your way down). Others of you may have weighted some resources a 1 and others a 5 (i.e. you started by weighting the least important by assigning a "1" and then worked your way up). Or you could have started out by assigning all criteria that you viewed as equal a "5".*
>
> · *Focus on relationship of the weighting factors between resources (i.e., do the average Round 1 scores reflect the weight or importance that you assigned to each criteria when you compare the individual resources against one another? For example: if you gave Water a "10" and Air Quality a "7", but the averages show that Water is a "8" and Air Quality is a "5" – then those are essentially the same when compared to one another.*
>
> Remember that this process works in such a way that as the group moves through each round, the range of the answers will decrease and the group will converge towards the "correct" answer. The process is considered complete after a pre-defined stop criterion, which in this case is 'stability of results,' and the average scores of the final rounds determine the final weighting factors."

1

Table 2. SMR Weighting Factor Survey - Round 2 Input
January 2014

SUBJECT AREA FOR POTENTIAL SITE EVALUATION	ROUND 1 Average Score	Lowest Weight (Round 1)	Highest Weight (Round 1)	Round 1 Rationale	Round 2 Weighting Factor	Round 2 Comments *(optional)*
Hydrology, Water Quality, and Water Availability	**8.6**	6	10	· Necessary for operation. · Closed cycle cooling limits water use, but any contamination can become an issue. · Site-specific engineering can mitigate most water-related problems, including by use of dry or hybrid wet-dry cooling · Hydrology is important primarily because the reactor units will be underground and subject to potential corrosive action of groundwater. Also, with karst terrain and a plant located so close to the river, any leak or spill to groundwater can quickly reach protected waters. For the Clinch R. site, there is also the potential for legacy ground water contamination. Water quality and availability can be important from two aspects—the plant needs a source of process water and the receiving water body needs to be able to absorb the thermal and chemical impacts of plant operations. For water cooled plants, water is a key factor. For the air cooled option, water becomes less critical. · Access to a near-by cooling water source is a significant factor in cost. The Purpose & Need does not address air cooled, so water is required. · Hydrology and water quality impacts are important, but water availability for cooling may be a deal breaker. I understand that an air cooled option is available on mPower? If that is correct, then water availability becomes slightly less critical, but only slightly. · Plant cannot operate if a suitable water source is not available or is located in inappropriate hydrologic conditions.		
Land Use, including availability, and areas requiring special consideration	**7.9**	4	10	· Necessary to accommodate project. · Normally not a major concern. · A very basic factor for which there are likely few or no engineering or mitigation solutions · Surrounding land use can be a “go / no” issue for siting a nuclear plant. Density of adjacent development, proximity to current or historic hazards (e.g. ground water contamination), and accessibility are among the key factors. Management of owner control issues could be a consideration for sites located on other federal installations. · Land availability: The plant cannot be built without the required land area and security/safety perimeters. · Land use impacts are relatively minor. But land availability is a complete deal breaker, so is probably the most important factor. · Plant cannot be built if land is not available or suitable for construction		
Institutional Constraints	**7.6**	5	10	· Since TVA would own the site, I don’t know if it would be a major factor · Can result in delays. · Institutional constraints could eliminate a site. The plant has to be located in an area allowed by zoning and not in conflict with the federal installations’ charter and mission. · Ties closely with land availability. But since Purpose & Need ties the project to Federal facilities, it must be compatible with the mission of those facilities. · Based on how it is used in the siting study, this criterion appears to focus on compatibility with surrounding land uses. This may be a deal-breaker at some sites, and therefore this should have a high weight. · Project would be a non-starter if it doesn’t fit with mission of installation		

Table 2. SMR Weighting Factor Survey - Round 2 Input
January 2014

SUBJECT AREA FOR POTENTIAL SITE EVALUATION	ROUND 1 Average Score	Lowest Weight (Round 1)	Highest Weight (Round 1)	Round 1 Rationale	Round 2 Weighting Factor	Round 2 Comments *(optional)*
Transmission Corridors	**7.0**	4	9	· Transmission improvements needed to construct and operate an SMR are a significant cost and time consideration. A site that requires no new transmission lines and line improvements/uprates should be rated higher than sites that require new lines and many upgrades. Siting a new line in a suburban or urban area can be difficult. · Availability of adequate transmission capacity desirable; could be differences between sites in cost of providing transmission but these likely to be small proportion of overall project costs. · Problems can take years to resolve. · New lines are a major cost factor. · This is actually a mix of several of the other factors. It combines issues of land availability, resource impacts, and cost. The most important of these are land availability and cost, so I gave it a high number. · All sites currently receive power from TVA grid or have access to grid. Information on upgrades to transmission lines and/or re-routing of transmission lines will not be available at this phase of the project.		
Facility Costs	**6.8**	4	10	· This is hard to judge since I don't know how much TVA is willing to spend above the original budget. · Less important than technical feasibility constraints (land and water availability), but more important than impact constraints. · Once environmental considerations are taken into account, final decision on construction will likely be decided based on cost models. · Feasibility. · Usually an important single issue. · Land acquisition and site-specific development costs will be small proportion of overall project costs. · Although the basic cost of an SMR would be similar on any of the potential sites, the cost of construction could vary greatly from a TVA owned-managed property to a site owned-managed by another federal agency. Also, construction on a site with existing facilities and infrastructure that may have to be altered or relocated could result in increased project costs (likewise, presence of infrastructure could reduce some costs).		
Population distribution and density	**6.4**	4	10	· Politically, easier if avoided. · Moderate importance for emergency management. · Public concern. · Both categories are important, but population distribution and density is also covered in socioeconomics, so it is in essence double counted. · The site must meet NRC's minimum distribution and distribution characteristics to be viable. · This is a safety-related function and deserves a higher than average rating. · A safety issue, at some points it can become a deal breaker, based on NRC regulations. I believe we screened out preliminary sites based on this already, so, by definition the sites we are ranking have already passed the "deal breaker" part. But for distinguishing between our remaining sites, it would still be preferable to put in a less populated area.		
Aquatic biological resources (including endangered species)	**5.8**	4	9	· Likelihood of truly unique site-specific resources of concern is low, engineering fixes can minimize/avoid impacts. · Possible to work around or mitigate. · Important, more difficult to avoid or mitigate. · Standard middle of the road environmental concern. No proposed sites are in very sensitive environments. · The weighting factor for terrestrial and aquatic should, by definition, be the same. I cannot think of a reason why one type of T&E would be a more important discriminator than another. · Can become site selection issue. · The presence of T&E species in the plant's primary water source (river or lake) that could be impacted by plant operations could present challenges (time and money) to the project, since one of the primary operational impacts from a water cooled nuclear plant will be to the receiving water body.		

Table 2. SMR Weighting Factor Survey - Round 2 Input
January 2014

SUBJECT AREA FOR POTENTIAL SITE EVALUATION	ROUND 1 Average Score	Lowest Weight (Round 1)	Highest Weight (Round 1)	Round 1 Rationale	Round 2 Weighting Factor	Round 2 Comments *(optional)*
Terrestrial biological resources (including endangered species)	**5.7**	4	8	· Important, but can usually be avoided or mitigated. · You want to avoid impacts, but impacts can be mitigated and compensated, so while T&E species are an important factor, they should not be a deal breaker. · Standard middle of the road environmental concern. No proposed sites are in very sensitive environments. · Identification of T&E species and other biological resources are rarely a show stoppers—the issue is more the cost of mitigation. Since all sites being considered are at least somewhat previously disturbed, biological resources have less weight than they might at a greenfield site. · Potential for irrevocable loss of site-specific features, difficult to adequately mitigate. · Can become site selection issue. · Possible to work around or mitigate.		
Historic and Cultural Resources	**5.2**	3	8	· Should probably be about the same weight as T&E species. Similar issue – they can usually be avoided or mitigated. · Normally not a major concern but can escalate rapidly. · If NHPA eligible archaeological resources are present and cannot be avoided, the primary issue will be the cost and time of resource recovery. Impacts to federally listed historic structures/features can be more politically charged. For example, impacts to the viewshed of the Natchez Trace Trail was a major issue for the Red Hills Lignite Mine and Coal plant project in Mississippi due to NPS regulations protecting the viewshed of the Trail. · Standard middle of the road concern. No proposed sites are in very sensitive locations. · Potential for irrevocable loss of site-specific features, accepted mitigation measures do not necessarily preserve the resources. · Important, but can usually be avoided or mitigated. · Possible to work around or mitigate.		
Socioeconomics (including population, employment, and transportation)	**4.8**	3	8	· Most socioeconomic factors can be mitigated. The main issue may be that the cost of building a nuclear plant may vary with different socioeconomic settings. · Normally not a major concern. · Ability to transport modular components of high importance; other socioeconomic factors of low to moderate importance and not likely to be major distinguishing factor. · Construction impacts are short-term and small plants are expected to have less impact. · These impacts are almost always beneficial, and are unlikely to be different among various sites. Transportation impacts may be adverse, but are usually temporary during construction, and can almost always be mitigated, so these should not be a major factor in discriminating between sites. · Both Socioeconomics and Population are important, but population distribution and density is also covered in socioeconomics, so it is in essence double counted. · Public concern.		

Table 2. SMR Weighting Factor Survey - Round 2 Input
January 2014

SUBJECT AREA FOR POTENTIAL SITE EVALUATION	ROUND 1 Average Score	Lowest Weight (Round 1)	Highest Weight (Round 1)	Round 1 Rationale	Round 2 Weighting Factor	Round 2 Comments *(optional)*
Air Quality	**4.8**	2	8	· Since air emissions from normal nuclear plant operations are low, the status of air quality is not a key issue in siting a nuclear plant. Use of back up/emergency diesels may raise some issues in a non-attainments area, but this wouldn't be a show stopper. · Normally not a major concern for Nuclear. · Plant contribution to air impacts would be similar for all locations, differentiation would be current air quality at location. · Very low operational emissions, so effects on local air quality attainment status minimal. · Impacts are not very site-specific. Therefore a less than neutral rating. · Should probably be about the same weight as T&E species. Similar issue – they can usually be avoided or mitigated.		
Human Health	**4.8**	1	7	· Normally not a major concern for Nuclear. · Little potential for distinguishable differences between sites. · Human health issues associated with plant construction and operation are manageable with use of Best Management Practices (BMPs), and adherence to state and federal regulations and TVA procedures. Also, the issues would be the same at any site. · Impacts are not very site-specific. Therefore a less than neutral rating. · This should be about the same as population density. Both are a human health and safety issue. Again, there is a point at which it becomes a deal breaker by not complying with NRC regulations, and those sites would be screened out by that. For distinguishing among remaining sites, its importance is the same as, and linked to, population density. · Will be similar for all locations, with population density begin accounted for under separate category. · Public concern.		
Postulated Accidents	**4.7**	1	8	· I need to understand more about this factor. Is it probability of postulated accidents, or effects? If it is probability, then I do not understand how this can be a discriminator between sites – this is not a facility design issue? The probability should be the same for all sites. If it is effects, then this is simply population density and human health again, isn't it? · Impacts are not very site-specific. Therefore a less than neutral rating. · As the siting study points out, postulated accidents for all sites considered would be similar. Meteorological difference could be a factor, but climate conditions at sites within the Valley would be similar. Military operations and aircraft traffic could be a factor. · Moderate to low potential for distinguishable differences between sites, engineering solutions. · Can easily become major issue. · Will be similar for all locations. · Public concern.		
Fuel Cycle Impacts	**3.3**	1	6	· Will be similar for all locations. · I do not see how the fuel cycle is a discriminator between sites, unless this is a transportation safety issue. All sites would obtain fuel from the same source, and treat spent fuel in the same manner, right? The only difference is the transportation route to and away from the site. There may be differences in on-site spent fuel storage – does that fall under fuel cycle impacts? If so, would not impacts from fuel storage be covered under the other resources (T&E, water quality, accidents?). · Impacts are not at all site-specific. Therefore the lowest rating. · Any site within the Tennessee Valley would have similar impacts from the fuel cycle. · Moderate to low potential for distinguishable differences between sites, engineering solutions. · Sites usually similar for nuclear.		

3.0 RESULTS

All nine (9) Round 2 surveys were returned to the independent AECOM staff member responsible for compiling and tabulating the results by January 28, 2014. The results were formatted into a summary table (Table 3) and re-distributed to the participants with the following instructions:

> "I've attached the results of the Weighting Factor Survey – Round 2. The following information is presented in the spreadsheet: Round 1 Average, Round 2 Average, lowest Round 2 score, highest Round 2 score, and Round 2 comments.
>
> Note that the relative ranking of resources (ranked highest to lowest after Round 1) remained the same, with the exception of Terrestrial Resources, which moved above Aquatic Resources in Round 2. The majority of your scorings did not change much from Round 1, and are therefore unlikely to change in future rounds. Given the stability of the averages between the two rounds, we are proposing to incorporate the Round 2 average values into the Siting Study site calculations.
>
> **If you concur with this decision, please reply to this email**
>
> If anyone has a strong objection to the ranking of a specific factor, please provide a written reason for your objection. That reasoning will then be distributed to the group, who will then submit Round 3 surveys."

4.0 CONCLUSIONS

By February 5, 2014, all participants had responded to the AECOM staff member responsible for scoring the surveys that they concurred with the Round 2 results and generally had no objections to the ranking or weighting of any of the factors.

Table 3. SMR Weighting Factor Survey - Round 2 Results
January 2014

SUBJECT AREA FOR POTENTIAL SITE EVALUATION	ROUND 1 Average Score	ROUND 2 Average Score	Lowest Weight (Round 2)	Highest Weight (Round 2)	Round 2 Comments
Hydrology, Water Quality, and Water Availability	8.6	**8.7**	7	10	Site-specific engineering can mitigate most hydrology problems, unlikely to result in orders-of-magnitude cost differences between sites, and low water use cooling systems available. Flooding/Hydro-thermal issues will be a key factor in determining site suitability.
Land Use, including availability, and areas requiring special consideration	7.9	**8.1**	6	10	Agree that land availability can be a go/no-go criteria. Minimum land needs are already built into the process in Phase 1 of the siting study. At this stage, it is important but the primary aspect has already been addressed.
Institutional Constraints	7.6	**7.6**	7.5	9	Need for compatibility with mission of federal facility, whether on or adjacent (as at Clinch River) to the federal facility. Agree that the Institutional Constraints can be restrictive. However, if a site wants to make it happen, the executive management can resolve the institutional constraints.
Transmission Corridors	7	**7.4**	6	9	Site-specific cost differences likely to be small proportion of overall project costs. Also, TVA has ability to build necessary transmission within overall project schedule (our transmission planners, etc. could do it faster…) Going to be a primary cost driver and thus a major contributor to site suitability.
Facility Costs	6.8	**7.0**	6	9	Site-specific engineering and related cost differences; still unlikely to be orders-of-magnitude cost differences. While this can be an issue, in our case, I don't think it is a major contribution to the decision.
Population distribution and density	6.4	**6.9**	6	8	Should be ranked since this is one of the primary NRC criteria for siting new reactors.
Aquatic biological resources (including endangered species)	5.8	**5.5**	5	6	NONE
Terrestrial biological resources (including endangered species)	5.7	**5.7**	5	8	Greater likelihood of truly unique site-specific features that cannot be fully mitigated than several other environmental resources.
Historic and Cultural Resources	5.2	**5.4**	4	8	I don't agree that Cultural Resources are not normally a major concern. They aren't a show stopper, but they can be on the critical path of a project and can garner a lot of public attention. That said, it's not a big issue for this site if we can avoid major sites.
Socioeconomics (including population, employment, and transportation)	4.8	**4.5**	3	6	Impacts will be beneficial, and should not be substantially different between sites, except possibly transportation. Therefore, I repeat the low rating I gave in Round 1. Major differentiating factor is transportation
Air Quality	4.8	**4.5**	2	6	NONE
Human Health	4.8	**4.4**	1	7	Surprised at some comments. Human health is not normally a concern for nuclear? For the public, it is the #1 concern. Little potential to distinguish between sites? Several commenters noted that it will be highly related to population density, which will vary between sites.
Postulated Accidents	4.7	**4.0**	1	6	Don't see potential for much differences between sites.
Fuel Cycle Impacts	3.3	**2.7**	1	4	Don't see potential for much differences between sites.