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Evaluation of Proposed Hampton Roads Area Sites for Using Small Modular Reactors to Support Federal Clean Energy Goals

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ACRONYMS

B&W	Babcock and Wilcox
DOE	US Department of Energy
Dominion	Virginia Electric and Power Company
GIS	geographic information systems
iPWR	integral pressurized-water reactor
MW(e)	megawatt electrical
NE	(DOE) Office of Nuclear Energy
NRC	US Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
OR-SAGE	Oak Ridge Siting Analysis for Power Generation Expansion
PWR	pressurized-water reactor
SSEC	site selection and evaluation criteria
SMR	small modular reactor
USGS	US Geological Survey
VSEC	Virginia-Hampton Roads SMR Energy Development Council

1. BACKGROUND, INTRODUCTION, AND METHODOLOGY

1.1 Background

The U.S. Department of Energy (DOE) Office of Nuclear Energy (NE) has previously tasked Oak Ridge National Laboratory (ORNL) to support identification of candidate sites for new small modular reactor (SMR) power plants using an ORNL geographic information system (GIS)–based tool.[1,2] The tool, Oak Ridge Siting Analysis for power Generation Expansion (OR-SAGE), is a flexible system being used to evaluate power plant siting options and considerations for a variety of power sources. The objective in developing OR-SAGE was to merge industry-accepted approaches for screening sites with the array of GIS data sources at ORNL to identify candidate areas for a particular application.

Recently, DOE-NE staff met with members of the Virginia-Hampton Roads SMR Energy Development Council (VSEC) to understand how nuclear energy in general, and SMRs in particular, fit into future plans for secure and reliable energy for the Hampton Roads, Virginia, metro area. This partnership has been promoting the use of SMRs as a means of meeting federal clean energy goals.

The constituents of VSEC are the Jefferson National Laboratory, Huntington-Ingalls Newport News Shipyard, Virginia Electric and Power Company (Dominion), Babcock and Wilcox (B&W) Generation mPower, and an economic development group called the Hampton Roads Military and Federal Facilities Alliance. VSEC has identified a number of potential locations for siting SMRs on or near federal government property. Dominion Energy has performed an initial but limited desktop siting review. The current federal electricity use in this area is estimated by Dominion Energy at over 500 megawatts with potential for significant growth based on expansion of the Jefferson Laboratory National Accelerator Facility and other economic growth in the area.

ORNL staff previously evaluated screening criteria for large and small nuclear power plants, advanced coal plants with carbon sequestration, wet and dry solar power technologies (excluding photovoltaic cells), and compressed air energy storage for the Electric Power Research Institute.[3] ORNL staff also evaluated repowering select coal plants with an SMR[4] and powering select military and DOE facilities with a dedicated SMR.[5]

1.2 Introduction

The overall objective of this research project is to support DOE-NE in evaluating future electrical generation deployment options for SMRs in areas with significant energy demand from the federal sector. Deployment of SMRs in zones with high federal energy use can provide a means of meeting federal clean energy goals. A report documenting the initial evaluation of energy demand in the federal sector (Task 1 of this project) has been submitted to DOE-NE.[6] The Task 1 report documents additional federal agency energy clusters that may subsequently warrant additional analysis in support of meeting federal clean energy goals. These federal power clusters were identified based upon power usage data, geographical concentration (collocation) of federal agencies, or operation of large federal data centers. The Hampton Roads, Virginia area was verified as a potential federal energy cluster by the Task 1 study.

This letter report provides the results of evaluations of eleven potential sites in the Hampton Roads, Virginia area (Task 2 of this project). The sites were identified for evaluation by VSEC. The site evaluations are based on previously developed screening criteria and the application of spatial modeling and GIS. For reference purposes, a generalized SMR plant parameter envelope for the B&W Generation mPower SMR integral technology is used for all site evaluations. The B&W technology is based on existing pressurized-water reactor (PWR) technology. The mPower design is characterized as an

"integral" PWR (iPWR) since these plants will have major equipment such as pumps, steam generators, and pressurizers all located within the pressure vessel in an integrated, compact design.

1.3 Approach and Methodology

The approach for this study is to use the OR-SAGE tool configured to screen for a 2-unit installation of the B&W Generation mPower iPWR. This power generation installation would nominally provide 360 MW(e) to a utility grid or to a micro-grid. The ten OR-SAGE tool screening criteria for SMRs are as follows:

- Land with a population density greater than 500 people per square mile (including a 10 mile buffer) is excluded
- Wetlands and open water are excluded
- Protected lands (e.g., national parks, historic areas, wildlife refuges) are excluded
- Land with moderate or high landslide hazard susceptibility is excluded
- Land that lies within a 100-year floodplain is excluded
- Land with a slope of greater than 18% (~10°) is excluded
- Land areas that are more than 20 miles from sufficient cooling water makeup sources (at least 30,000 gpm), based on a 360 MW(e) modular iPWR installation, are excluded for nominal SMR plant applications
- Land too close to identified fault lines is excluded (the length of the fault line determines the standoff distance)
- Land located in proximity to hazardous facilities (airports and oil refineries) is avoided
- Land with safe-shutdown earthquake peak ground acceleration (2% chance in a 50 year return period) greater than 0.5 g is excluded

Sensitivity to population density is a factor of interest in this study and will be evaluated in detail for the top two sites selected based on this initial analysis of all the proposed sites. The population density analysis will be conducted as part of Task 3 of this project. Therefore, population density is eliminated as a screening layer for the initial analysis of the eleven candidate sites provided by VSEC. The remaining nine SMR screening criteria listed above are applied to each of the eleven sites. However, a regional map of population density is available for reference (Fig. 4, Fig. 5) in the body of the report, and satellite views indicating nearby residences to the sites of interest are noted in the individual site evaluations in Appendix A.

2. EVALUATION OF SELECTED HAMPTON ROADS AREA SITES

The initial phase of this project characterized all land in the contiguous United States to possibly site new SMR nuclear power plants in areas where the concentration and electricity use by federal government agencies is high and forecasted to grow in the next 10 years. "Federal agencies" include military and other agencies (e.g., Homeland Security, DOE, FBI, and Social Security Administration) that have missions of national critical importance.

This second phase of the project focuses on 11 potential sites in the Hampton Roads area of Virginia as shown by the red dots in the large regional map in Fig. 1. All the sites in Fig. 1 are clustered near the entrance to the Chesapeake Bay. According to Dominion Resources records, the power demand for federal facilities in the area is more than 500 MW(e). Therefore, this area is highly suitable for investigation to use an SMR to help meet federal clean energy goals. Areas depicted in green in Fig. 1 meet the nine applied criteria at the selected screening value. Nine of 10 OR-SAGE site selection and evaluation criteria (SSEC) for SMRs are applied to each site to scope each site for further review. The intent is to select two sites for further population density studies (Task 3) and other parameter sensitivities as identified by DOE-NE and VSEC (Task 4).

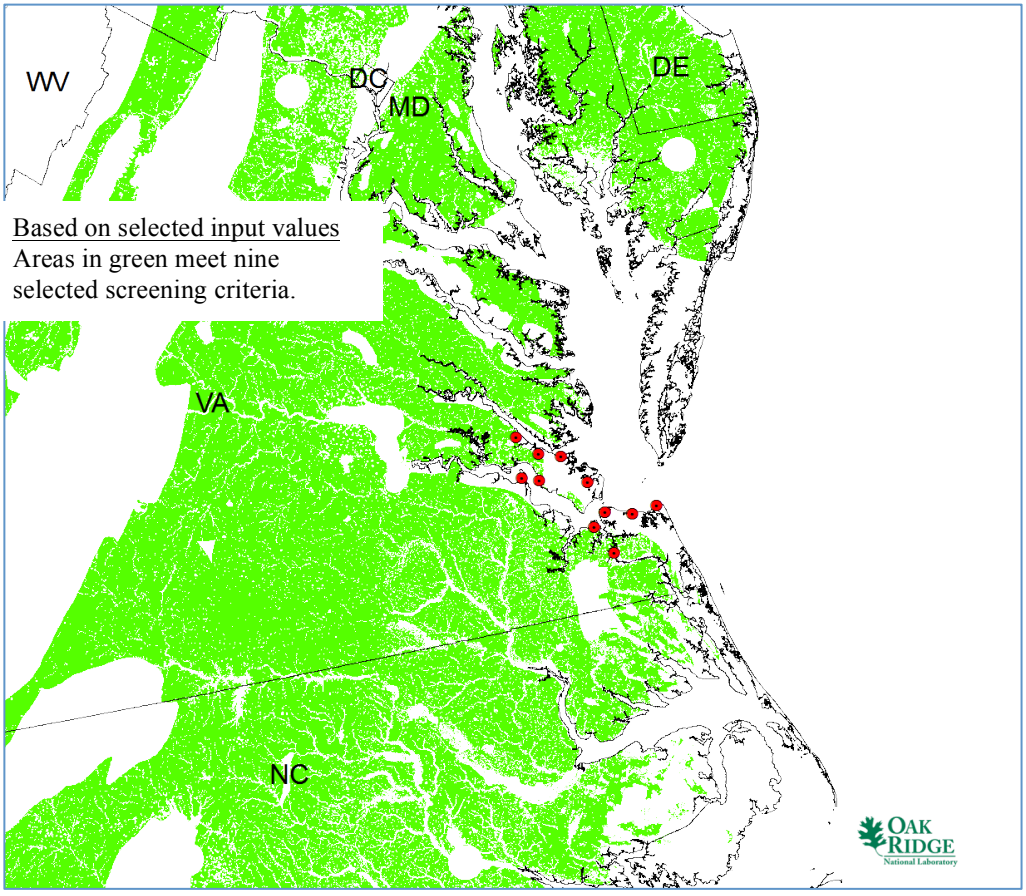


Fig. 1. Broad area view of proposed sites.

2.1 Review of Nominal SMR Site Selection and Evaluation Criteria

A summary of the SSEC selected for site evaluation are provided below. These parameters are tracked on a cell-by-cell basis for the entire contiguous United States. A more detailed discussion of each individual SMR SSEC is available in the general SMR siting report[2] provided to DOE-NE in September 2012.

- Wetlands and open water are excluded
- Protected lands (e.g., national parks, historic areas, wildlife refuges) are excluded
- Land with moderate or high landslide hazard susceptibility is excluded
- Land that lies within a 100-year floodplain is excluded
- Land with a slope of greater than 18% (~10°) is excluded
- Land areas that are more than 20 miles from sufficient cooling water makeup sources (at least 30,000 gpm), based on a 360 MW(e) modular iPWR installation, are excluded for nominal SMR plant applications
- Land too close to identified fault lines is excluded (the length of the fault line determines the standoff distance)
- Land located in proximity to hazardous facilities (airports and oil refineries) is avoided
- Land with safe-shutdown earthquake peak ground acceleration (2% chance in a 50 year return period) greater than 0.5 g is excluded

Based on preliminary design information and expert judgment, it is assumed that an SMR iPWR base design package can be accommodated on a 50-acre footprint. In general, more than 50 acres is available at each of the evaluated sites.

The OR-SAGE tool tracks the SSEC parameters for each 100 by 100 m cell. As a result, not only can the cells that are clear of all the SSEC layer exclusions be displayed visually, but also cells that are tripped by one, two, or three or more exclusions can be tracked and displayed. This is known as a “composite map” (small scale example shown in Fig. 2). This is a powerful aspect to the OR-SAGE tool, because it allows areas with a limited number of siting challenges to also be identified. Engineering solutions may be available for areas with just one or two siting challenges.

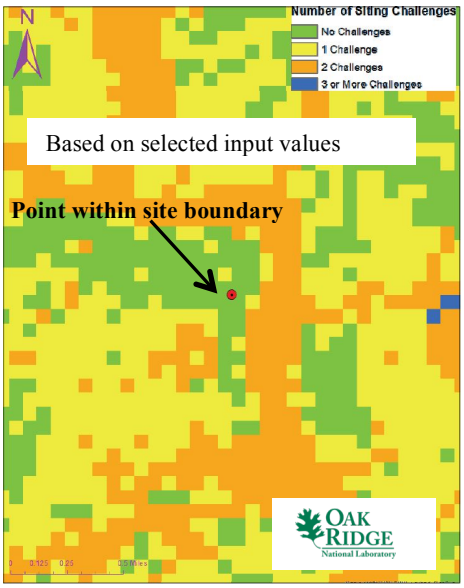


Fig. 2. Nominal, bounding SMR composite map detailing siting challenges for Chesapeake Power Station.

2.2 Selection of Hampton Roads Area Sites for Characterization

Based on internal preliminary analysis, VSEC proposed eleven sites in the Hampton Roads area for evaluation. The sites are listed in Table 1 at the end of this subsection. The proposed sites, represented as red dots, are also identified in the regional map (Fig. 3) below. Areas depicted in green in Fig. 3 meet the nine applied criteria at the selected screening value.

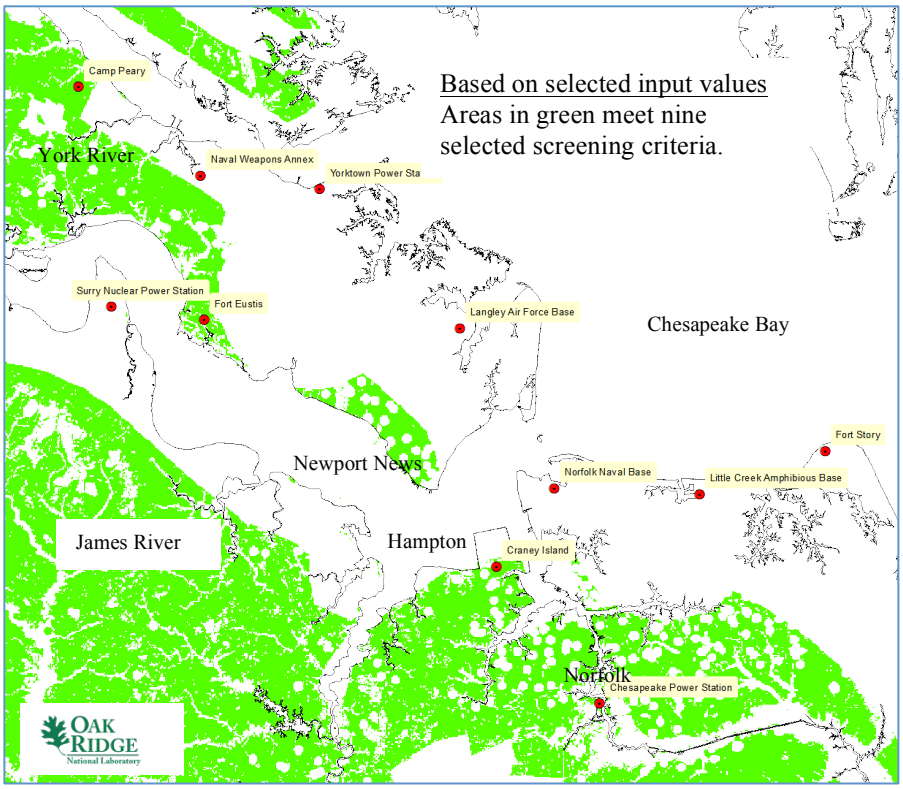


Fig. 3. Regional view of proposed sites.

NRC siting guidance[7] recommends calculating the population density within 20 miles of the site and excluding population densities of greater than 500 people per square mile. Current SMR vendors identify the ability to replace smaller, aging coal plants with an SMR having a similar capacity and footprint as an advantage of SMR iPWR designs. In order to realize this advantage, SMRs will need to be located closer to population centers where many of these coal plants already exist. SMRs will have a smaller source terms than large reactors, and the appropriate evacuation zone is an issue still under discussion with the NRC staff. For the purposes of this study, a 10-mile buffer was deemed appropriate for initial SMR siting evaluations. This value is variable within the database and will be evaluated further for two selected sites in Task 3 of the project.

To meet the guidance, each cell in the database is queried for ambient population, which considers the weighted transient population. If a cell population is greater than 500 people per square mile, it is immediately excluded. If a cell population is less than 500 people per square mile, the surrounding area is evaluated by calculating the population density in an expanding set of rings out to a maximum of 10 miles (in simple terms, a buffer zone). If any ring is calculated to have a population density above 500 people per square mile, then the center cell is excluded. If no ring around the central cell exceeds a population density of 500 people per square mile, then the cell remains viable with regard to population. Though population density is not included in the initial site evaluations, Fig. 4 shows a regional result of a population dataset query with a 10-mile buffer distance considered. This provides some added insight on the viability of the proposed sites, represented as blue dots on the map. The maximum search radii can be set to any value to create alternate buffer distances.

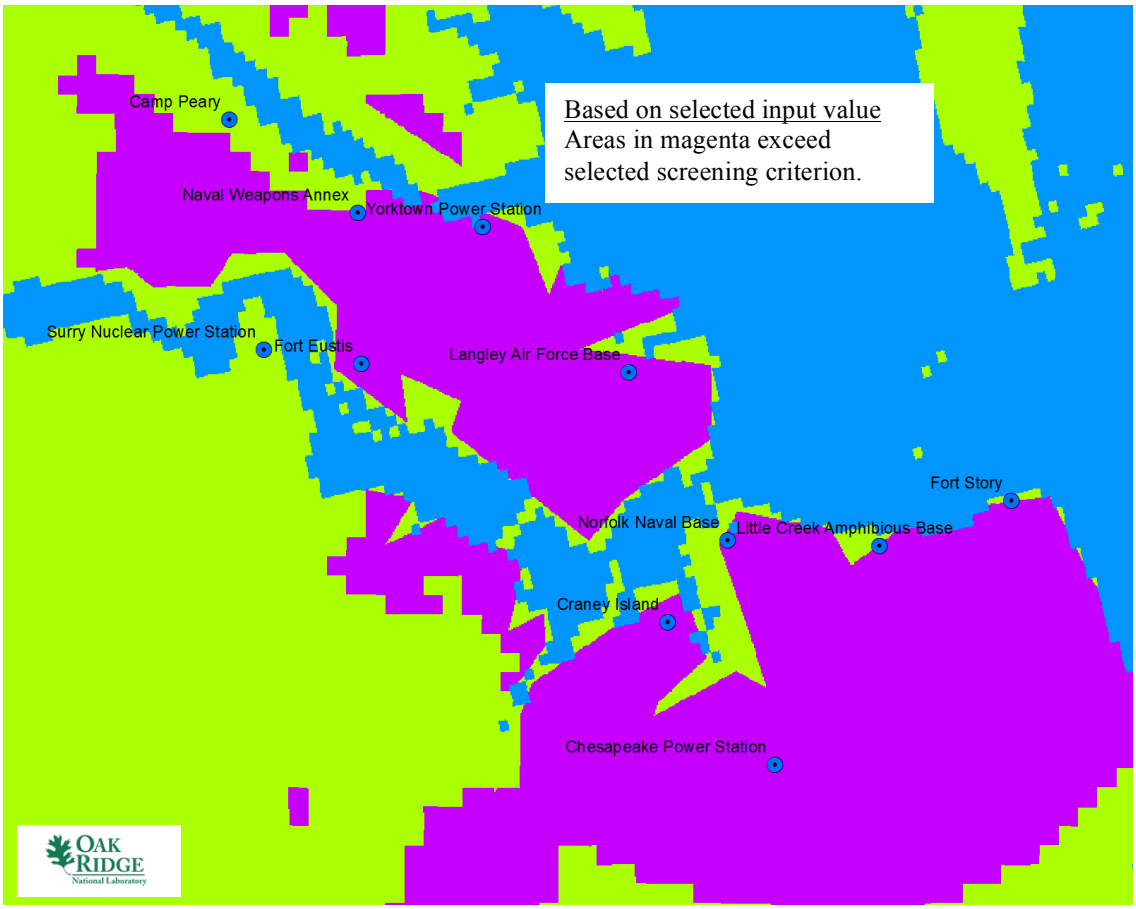


Fig. 4. Regional population density GIS layer (500 people per square mile within 10 miles)

ORNL uses a highly sophisticated population database known as LandScan™ that provides high-resolution global population distribution data representing an ambient population (averaged over 24 hours). The LandScan™ algorithm uses spatial data and imagery analysis technologies and a multi-variable dasymetric modeling approach to disaggregate census counts within an administrative boundary. LandScan™ is readily adaptable to various socio-environmental studies, including exposure/heath risk assessment, urban sprawl estimation, and estimating population at risk from natural and anthropogenic disasters. It uses an innovative approach with GIS and remote sensing technologies with various spatial information sources to reconstruct synthetic population distribution databases. LandScan™ has two databases, the LandScan Global and LandScan USA. The LandScan USA has a spatial resolution of 3 arc seconds (~90 m) that covers the continental United States, Alaska, and Hawaii. Each database has two layers, a nighttime and a daytime population distribution. A sample output from LandScan™ for the Hampton Roads region is shown in Fig. 5. Areas in orange and dark red in Fig. 5 have higher population density. This figure provides some directionality of the population density relative to the proposed sites, identified as blue dots. This figure provides some added insight on the viability of the proposed sites, represented as blue dots on the map below.

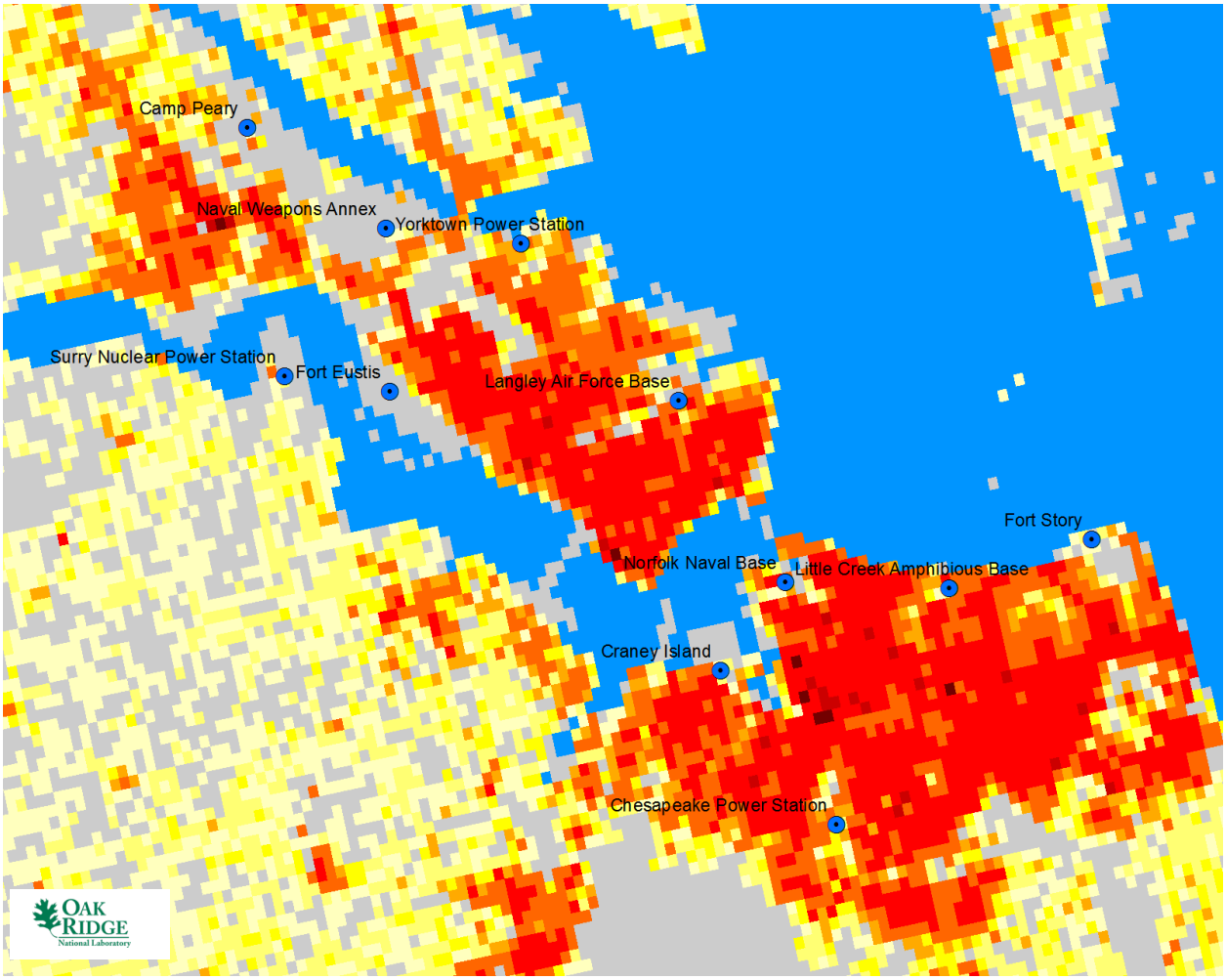


Fig. 5. Regional population density by cell (orange and red indicate higher population density).

The list of proposed sites for evaluation is provided in Table 1. The sites are listed in alphabetical order. Overall, there are 3 utility sites owned by Dominion Resources. The remaining sites are owned by the Department of Defense. The results of the initial OR-SAGE screen for each site are also listed in Table 1.

However, these issues need to be seen in the context of the individual site evaluations in Appendix A and the list is not intended to score the proposed sites. For example, for cell locations bordering on water, false indication of a hazard often appears based on the way the data is parsed into the grid cell system (a false positive). The only identified hazardous areas in the region are two commercial airports (military bases are screened separately) and a shutdown oil refinery. Airports are depicted with a 5-mile buffer and other hazards receive a 1-mile buffer. In addition, schools and hospitals are depicted with a 1-mile buffer as protected land.

Table 1. List of 11 proposed sites

Proposed Site	Owner	Initial GIS evaluation
Camp Peary	Department of Defense	2 partial siting issues
Chesapeake Power Station	Dominion Resources	2 partial siting issues
Craney Lsland	Department of Defense	3 partial siting issues
Fort Eustis	US Army	3 partial siting issues
Fort Story	US Army	2 partial siting issues*
Langley Air Force Base	US Air Force	1 full, 2 partial siting issues*
Little Creek Amphibious Base	US Navy	1 full, 4 partial siting issues
Norfolk Naval Base	US Navy	2 partial siting issues*
Surry Nuclear Power Station	Dominion Resources	1 full, 4 partial siting issues*
Yorktown Naval Weapons Station	US Navy	3 partial siting issues
Yorktown Power Station	Dominion Resources	1 full, 2 partial siting issues

* Erroneous hazards siting issue shown based on map edge effects

2.3 Nominal Site Evaluation Process

A data package and analysis for each site in the sample set was prepared. These site summaries are available in Appendix A. Each site summary in Appendix A includes specific detail regarding the site location similar to the example shown in Fig. 6. In addition, a table of statistics similar to the example shown in Table 2 supports a description of the site. Table 2 includes:

- Population within 0.5, 1, 5, and 10 miles, which allows a population density calculation
- Distance to 400, 800, 1600, and 3200 MW(e) grid capacity[1]
- Nearest cities with populations greater than 10,000, 50,000, 100,000, and 500,000
    - Calculated from site center to nearest city center with population between above values (10,000 to 50,000, 50,000 to 100,000, etc.)
    - If a site resides within a large city, algorithm will still identify nearest population centers meeting each set of ranges
- Distance to cooling water makeup source greater than 50,000, 100,000, 200,000, and 500,000 gpm stream flow
    - Note that a 360 MW(e) modular iPWR installation requires approximately 30,000 gpm stream flow, assuming no more than 10% of the available stream flow is used for power production

[1] Grid capacity data are based on 2004 data.

- Available cooling water makeup is based on current consumption. The cooling water already used by a given coal station may be sufficient for a replacement iPWR SMR

- Geotechnical information, including
  - Maximum earthquake acceleration
  - Maximum slope
  - Nearest fault line
  - Nearest hazardous site
- Accessibility by road, water, rail, and air

Fig. 6. Sample site location map.

Table 2. Sample site statistical summary

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi	< 500	> 400 MWe	~ 10 mi
1 mi	~ 650	> 800 MWe	~ 63 mi
5 mi	~ 46,300	> 1600 MWe	~ 78 mi
10 mi	~ 206,100	> 3200 MWe	~ 129 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Corning, NY	> 50,000 gpm	~ 3.1 mi (Chemung River)
> 50,000	Irondequoit, NY	> 100,000 gpm	~ 3.1 mi (Chemung River)
> 100,000	Rochester, NY	> 200,000 gpm	~ 3.1 mi (Chemung River)
> 500,000	Philadelphia, PA	> 500,000 gpm	~ 3.1 mi (Chemung River)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.3g	Distance to Major Roadway	~ 0.3 mi (Interstate 86)
Max Slope	~ 67%	Distance to Water Transport	~ 16 mi (Seneca Canal)
Nearest Fault Line	~ 1,190 mi (Oklahoma)	Distance to Rail Transport	~ 0.2 mi (NS)
Nearest Hazard Site	~ 5 mi (Airport—Corning Regional)	Distance to Airport	~ 5 mi (Corning Regional)

In each site evaluation summary, a satellite aerial view of each site is provided. This provides a convenient look at the area topography, including major nearby roads, rivers, and population activity such as towns and subdivisions. An example of an aerial image for a proposed site is provided in Fig. 7.

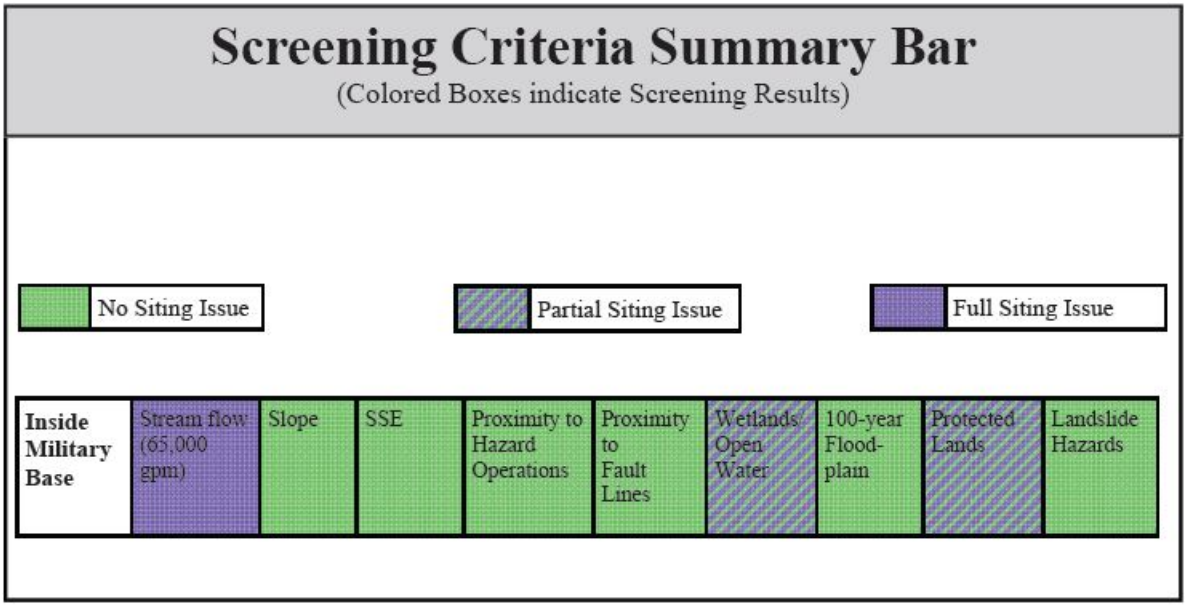
Following the satellite view of the site, a screening criteria summary bar, or "dashboard" chart, for the site provides a quick look at what siting issues may exist for the site. The SMR SSEC that are not met at the screened values are indicated. If an SMR siting criterion box is green, there is no potential siting issue. Hatched purple and green indicates that only a portion of the area does not meet that criterion and is termed a "partial" siting issue for the site. Solid purple indicates that the particular SMR criterion is an issue for a significant portion of the site. The SMR SSEC are listed; their respective values appear below the summary bar for reference. A sample site screening criteria dashboard is provided in Table 3.

Following the site screening criteria dashboard in each evaluation summary is a localized composite map similar to that shown in Fig. 2. At the local level, individual 100 by 100 m cells can be identified. The cells are color-coded, as in Fig. 2, to quickly gain insight to multiple SMR siting criteria that are not met. A green square has no siting issues relative to the selected SMR SSEC values; a yellow square has a single siting issue; an orange square has two siting issues; and a blue square has three or more siting issues.

Following the composite map, nine smaller individual siting criterion maps are provided to identify the locations where the selected individual parameter values may not be met within the proposed site boundary. Any areas shown in a magenta color do not meet the individual siting criterion at the value selected for SMR screening. A sample individual SSEC map is shown in Fig. 8.

Fig. 7. Sample satellite view of a site proximity.

Table 3. Sample siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

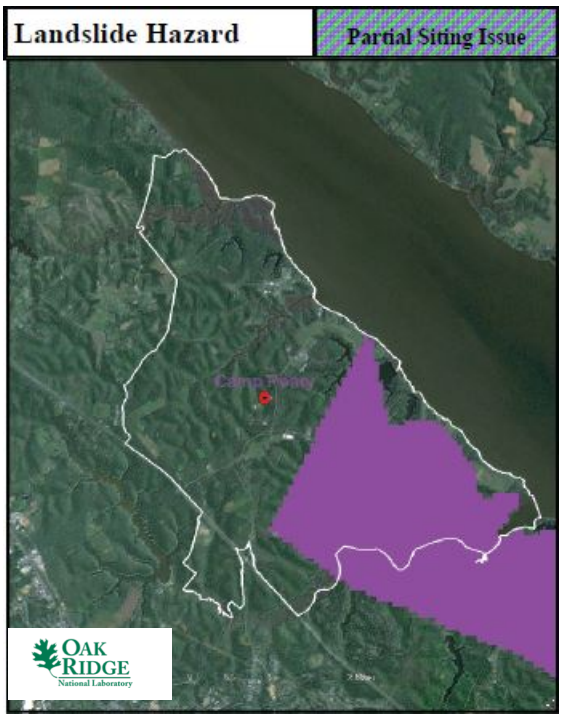


Fig. 8. Sample individual siting criterion map (magenta areas do not meet criterion).

Based on the detail provided in each site summary package, an evaluation of the site is offered. Detail about the site owner is provided and any partial or full siting issues are addressed. Other imagery details are also explained. Based on the analysis, the individual site is binned into one of three categories based on the review:

1. Exclusive of population, the site meets multiple conventional standards for consideration of siting an SMR at the proposed location. There are no current or near-term foreseeable SMR SSEC siting issues that should preclude this site from further SMR siting consideration.
2. Exclusive of population, the site meets multiple conventional standards in the near term for consideration of siting an SMR at the proposed location, but there may be longer-term issues that could potentially preclude this site from further SMR siting consideration. For example, the site may be heavily developed with little room for expansion necessary to site an iPWR.
3. The site is not a likely candidate for consideration of siting an SMR. Numerous SSEC are not met or other parameters exist that could make it difficult to site an iPWR.

2.4 Summary of Site Evaluations

Each site was evaluated visually using Google Earth to estimate available acreage, identify proximity to nearby dwellings and other industrial uses, and identify any potential hazards. Internet searches were conducted to identify more up-to-date plant status and other conditions that may limit the site for SMR placement.

2.4.1 First Group of Site Evaluations

Of the 11 sites, five are rated as the more favorable for siting an iPWR. These sites have significant space that meets all screening criteria or the issues are well understood and are judged not to impact iPWR siting at that location. These sites are (listed in alphabetical order):

- Camp Peary
- Chesapeake Power Station
- Surry Nuclear Power Station
- Yorktown Naval Weapons Station
- Yorktown Power Station

Not surprisingly, three of these sites are existing power plant sites. The remaining two are owned by the Department of Defense. The Surry Nuclear Power Station stands out based on the existing infrastructure, logistics, available space, and security. Camp Peary stands out based on available space and transportation infrastructure. The Yorktown Naval Weapons Station has similar attributes as Camp Peary. The remaining two sites are retiring coal plants with excellent infrastructure in place. The two coal plants may have more issues with population when that criterion is factored into the analysis.

2.4.2 Second Group of Site Evaluations

Four of the remaining sites are rated in the second category for siting an iPWR. These sites are generally favorable for siting an iPWR, but are identified as having at least one significant issue to overcome. These sites are (listed in alphabetical order):

- Craney Island
- Fort Story
- Langley Air Force Base
- Norfolk Naval Base

All of these sites are owned by the Department of Defense. Fort Story stands out in this group based on available space, and security. Issues for Fort Story include transportation and freshwater cooling availability. Langley Air Force Base also stands out based on general location and available space. Issues for Fort Story include avoiding the base runway and freshwater cooling availability. Siting at Langley is limited to the north of the runway based on site development. Craney Island meets all applied screening criteria. However, there are four schools identified along the site boundary, which could be problematic. In addition, the eastern end of the site is a Navy fueling location. This would require additional risk assessment for siting an iPWR at Craney Island. The eastern section of the Norfolk Naval Station meets all the applied screening criteria. However, the base is heavily developed, including housing, and a runway sits in the middle of the base.

2.4.3 Third Group of Site Evaluations

The final two sites are rated as not likely candidates for siting an iPWR. These sites have identified hazards that will be difficult to overcome. These sites are (listed in alphabetical order):

- Fort Eustis
- Little Creek Amphibious Base

Both of these sites are owned by the Department of Defense. Fort Eustis has runway issues from the nearby Newport News/Williamsburg International Airport and from an onsite airfield. If the onsite airfield is not used, then portions of Mulberry Island on Fort Eustis become more favorable. The Little Creek Amphibious Base is heavily developed. No open space was identified within the base property. In addition, the Norfolk Airport runway is in direct alignment with the base and is well within the recommended 5-mile buffer.

3. SUMMARY

Nine of the eleven sites demonstrate reasonable potential for further consideration for placement of an iPWR. Five of these nine sites were judges to be the more favorable. Of these, the Surry Nuclear Power Station, Camp Peary, and the Yorktown Naval Weapons Station stand out based upon the OR-SAGE screening criteria and apparent space available. Dated evaluation of nearby grid capacity is available with each evaluation. However, an evaluation of current grid infrastructure, potential for micro-grid infrastructure, or other factors of potential interest to VSEC (that are not part of the standard OR-SAGE criteria,) is not part of the proposed site reviews at this point. Therefore, other sites could be judged more favorable based on additional screening parameters.

4. REFERENCES

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3. G. T. Mays, R. J. Belles, O. A. Omitaomu et al., *Application of Spatial Data Modeling and Geographical Information Systems (GIS) for Identification of Potential Siting Options for Various Electrical Generation Sources*, ORNL/TM-2011/157/R1, May 2012.
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5. W. P. Poore, R. J. Belles, G. T. Mays, and O. A. Omitaomu, *Evaluation of Suitability of Selected Set of Department of Defense Military Bases and Department of Energy Facilities for Siting a Small Modular Reactor*, ORNL/TM-2013/118, March 2013.
6. R. J. Belles, G. T. Mays, O. A. Omitaomu, and W. P. Poore, *Identification of Selected Areas to Support Federal Clean Energy Goals Using Small Modular Reactors*, ORNL/TM-2013/578, December 2013.
7. Regulatory Guide 4.7, *General Site Suitability Criteria for Nuclear Power Stations*, Nuclear Regulatory Commission, April 1998.

APPENDIX A—HAMPTON ROADS EVALUATIONS OF SELECTED SITES

The sites are included in Appendix A in alphabetical order. The sites included are:

- Camp Peary
- Chesapeake Power Station
- Craney Island
- Fort Eustis
- Fort Story
- Langley Air Force Base
- Little Creek Amphibious Base
- Norfolk Naval Base
- Surry Nuclear Power Station
- Yorktown Naval Weapons Station
- Yorktown Power Station

APPENDIX A—EVALUATIONS OF SELECTED SITES

A.1 CAMP PEARY

A.1.1 Location Detail

Camp Peary is located in York County, Virginia. As shown in Fig. A.1, the site is located between the York River and Interstate 64. The camp center is approximately 4 miles north of Colonial Williamsburg. Rail, barge, and interstate access are all readily available to the site. An airstrip is also available on the site.

- Location: Camp Peary
- Owner: Department of Defense
- Coordinates: lat. 37.332292° N, long. 76.671517° W

Fig. A.1. Camp Peary location map.

A.1.2 Site Description and Status

Camp Peary was established during World War II by the Navy as a Seabee training base. It is currently used by various intelligence services for training. The camp consists of more than 9000 acres; most of which is in a natural state. As noted in Table A.1, there are no fault lines in the immediate vicinity and maximum earthquake ground acceleration is minimal. Adequate utility grid capacity for an iPWR facility is available within 2 miles. Sufficient fresh water makeup is available for a closed-cycle cooling system. Once-through cooling may also be available given the proximity to the York River and the Chesapeake Bay and reprocessed (gray) water cooling may be an option given the proximity to population centers.

Camp Peary is roughly 11 miles from the Surry Nuclear Power Station (across the York River) and 32 miles from the Norfolk Naval Base in the central part of the region of interest.

The permanent population within 1 mile of the camp is approximately 1600 people, yielding a population density of approximately 500 people per square mile. The permanent population within 10 miles of the plant is approximately 223,000 people, yielding a population density of about 700 people per square mile. There is some single family housing on the camp property, but otherwise, there appears to be limited housing in the area. There are two schools immediately south of Interstate 64 from the camp property.

Table A.1. Camp Peary site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Boundary	~ 500	> 400 MWe	~ 2 mi
1 mi of Site Boundary	~ 1,600	> 800 MWe	~ 9 mi
5 mi of Site Boundary	~ 62,500	> 1600 MWe	~ 11 mi
10 mi of Site Boundary	~ 223,000	> 3200 MWe	~ 168 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Williamsburg, VA	> 50,000 gpm	~ 2.1 mi (Queen Creek)
> 50,000	Suffolk, VA	> 100,000 gpm	~ 2.1 mi (Queen Creek)
> 100,000	Hampton, VA	> 200,000 gpm	~ 2.1 mi (Queen Creek)
> 500,000	Washington, DC	> 500,000 gpm	~ 2.1 mi (Queen Creek)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.2 g	Distance to Major Roadway	~ 1.5 mi (I-64)
Max Slope	~ 11%	Distance to Water Transport	~ 2.1 mi (Queen Creek)
Nearest Fault Line	~ 1150 mi	Distance to Rail Transport	~ 3.4 mi (CSXT)
Nearest Hazard Site	~ 14 mi (Refinery—Giant Yorktown Refining)	Distance to Airport	~ 16 mi (Williamsburg Int'l)

A.1.3 Aerial Imagery

The aerial imagery in Fig. A.2 indicates abundant open space near and within the Camp Peary boundary.

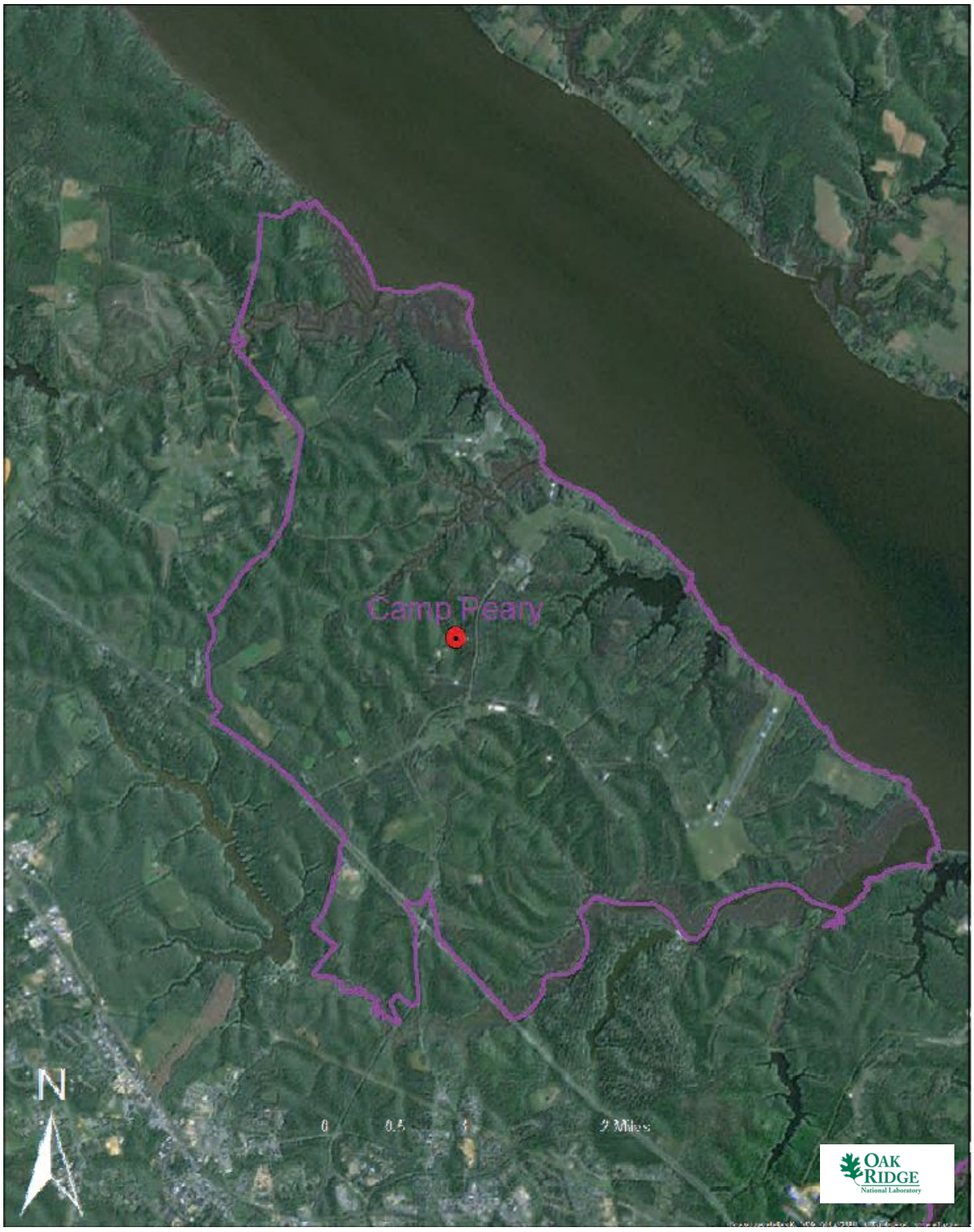
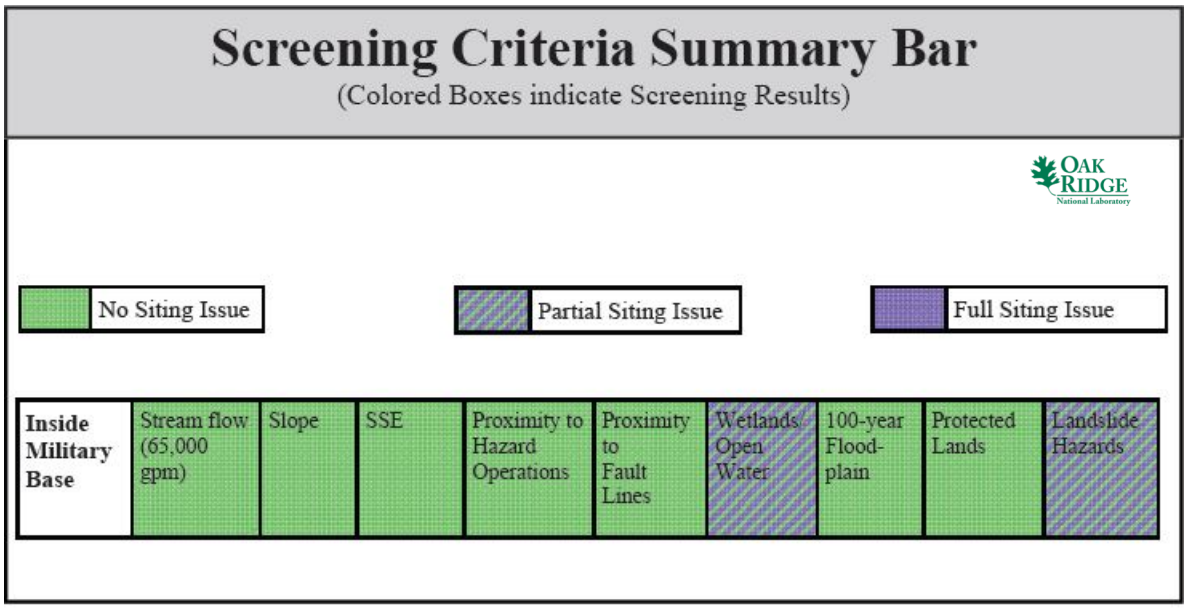


Fig. A.2. Satellite view of Camp Peary proximity.

A.1.4 Screening Criteria Overview

Table A.2. Camp Peary siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports—5 miles and oil refineries—1 mile)

A.1.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to Camp Peary is shown in Fig. A.3. As shown, (independent of population) half of the property outlined is immediately favorable for siting an iPWR. Following this map are maps of the individual SMR siting criteria based on selected input values.

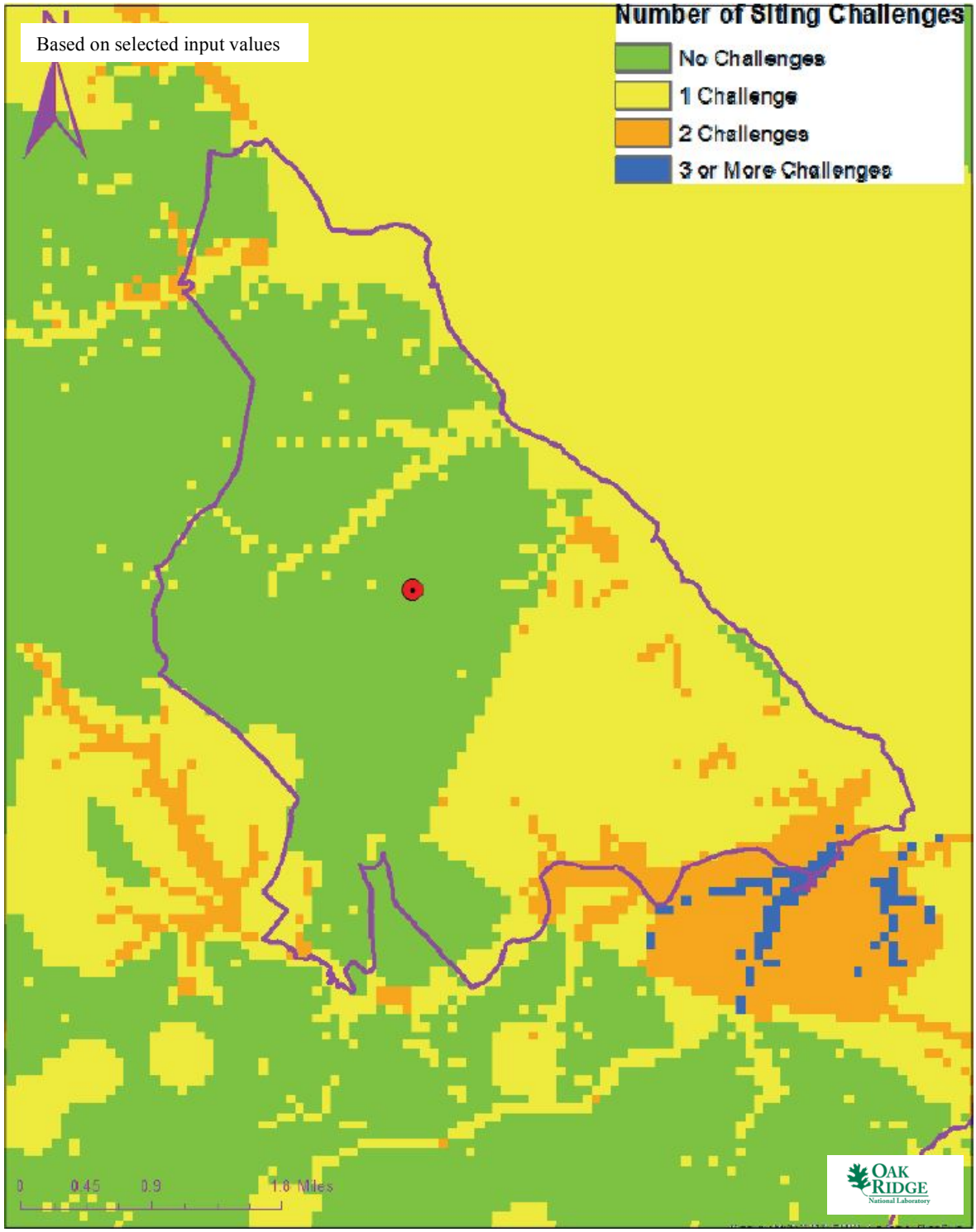
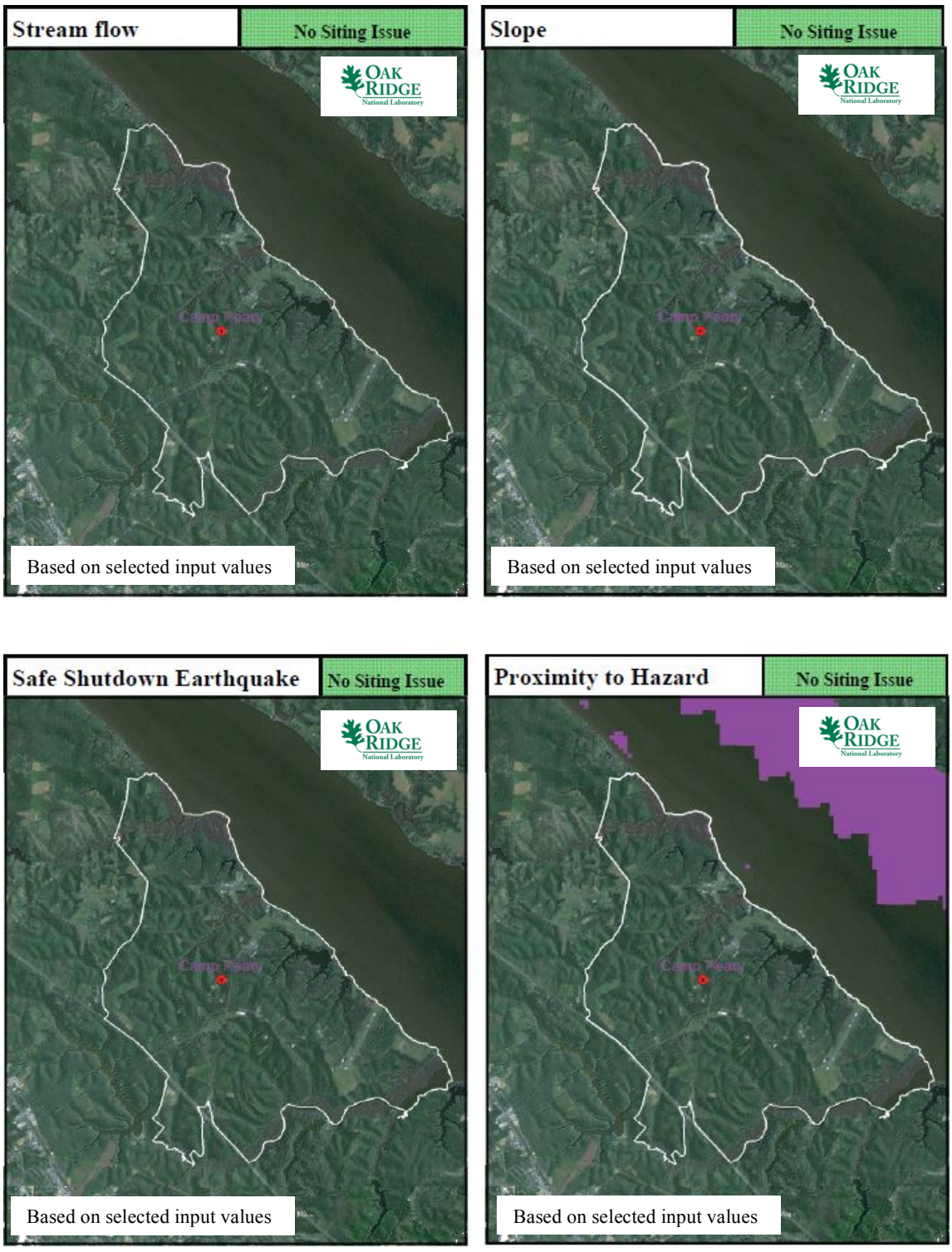


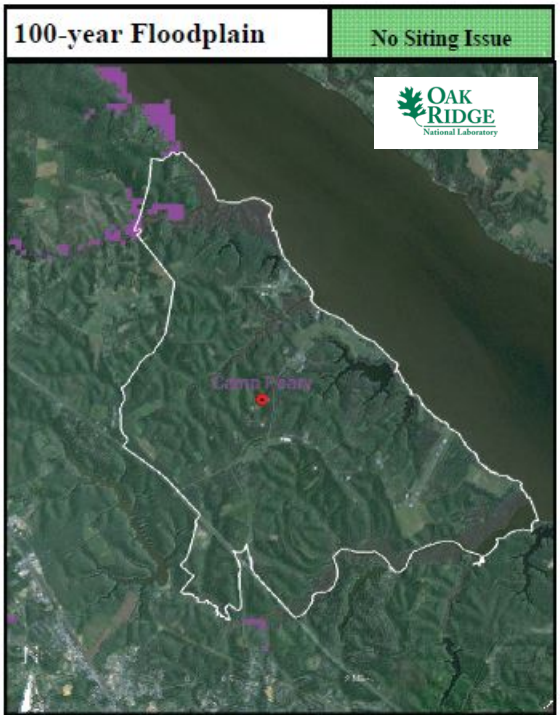
Fig. A.3. Camp Peary composite map.

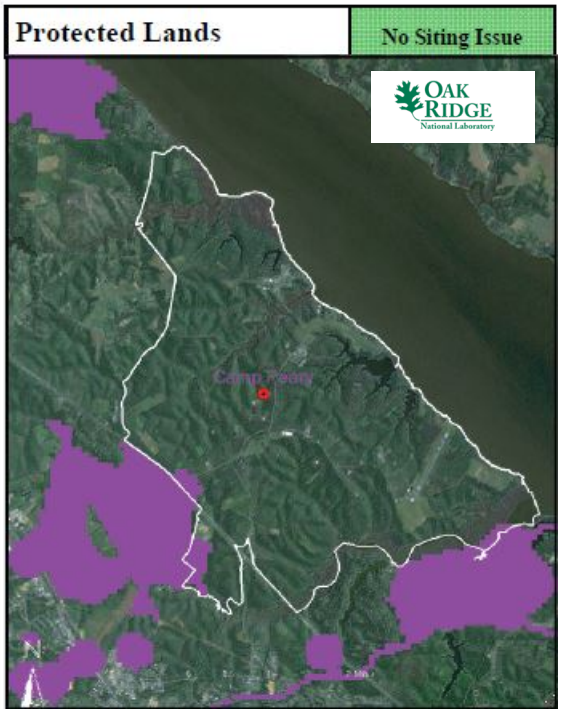

Stream flow
No Siting Issue
OAK RIDGE National Laboratory
Camp Peary
Based on selected input values
Slope
No Siting Issue
OAK RIDGE National Laboratory
Camp Peary
Based on selected input values
Safe Shutdown Earthquake
No Siting Issue
OAK RIDGE National Laboratory
Camp Peary
Based on selected input values
Proximity to Hazard
No Siting Issue
OAK RIDGE National Laboratory
Camp Peary
Based on selected input values

Camp Peary


Proximity to Fault Lines
No Siting Issue
OAK RIDGE National Laboratory
Camp Peary
N


Wetlands/Open Water
Partial Siting Issue
OAK RIDGE National Laboratory
Camp Peary
N


100-year Floodplain
No Siting Issue
OAK RIDGE National Laboratory
Camp Peary
N


Protected Lands
No Siting Issue
OAK RIDGE National Laboratory
Camp Peary
N

Camp Peary

Camp Peary

A.1.6 Site Evaluation

As shown in the maps above, the northwestern portion of the Camp Peary site is predominantly favorable for siting an iPWR. The southeastern portion of the site has a moderate to high probability for a landslide hazard. Landslide hazards are based on a probabilistic evaluation by the USGS. Therefore, the southeastern section of the site may also be favorable for siting an iPWR, pending further onsite geological evaluation.

Table A.2 further indicates a partial siting issue for wetlands and open water. There are numerous streams flowing through the site and bordering the site. These do not appear to create a barrier to siting an iPWR at the site.

There are public parks and green space recreation areas on the three land-based sides of the camp. These include the York River State Park to the north, the Walter Mill Reservoir to the west, and Queens Creek to the south. The Colonial National Historic parkway also runs near the southeastern edge of the property. The York River flows along the remaining face of the property. A Naval Supply Center is adjacent to Camp Peary to the southeast on the York River. Therefore, the potential for population growth in the immediate vicinity of the camp property is limited. As shown in Fig. 4, the site is outside an area evaluated at 500 people per square mile within ten miles.

Multiple transportation opportunities are favorable for iPWR construction. The adjacent Naval Supply Center has a pier on the York River with access to the Chesapeake Bay and beyond. Interstate 64 would allow heavy haul delivery overland. A rail line parallels Interstate 64 further west and at one time, a rail spur to the site existed. Finally, a short runway is available for small part delivery.

Current security at the site would limit access to the Camp Peary property and add a layer of security to the required reactor facility security force. Overall, the Camp Peary site meets multiple conventional standards for consideration of siting an iPWR at the proposed location. There are no current or near-term foreseeable SMR SSEC siting issues that should preclude this site from further SMR siting consideration.

A.2 CHESAPEAKE POWER STATION (CHESAPEAKE ENERGY CENTER)

A.2.1 Location Detail

Chesapeake Power Station is located in the city of Chesapeake, Virginia. As shown in Fig. A.4, the land is located on the Elizabeth River. Rail, barge, and interstate access are all readily available to the site.

- Location: Chesapeake Power Station
- Owner: Dominion Resources
- Coordinates: lat. 36.7709° N, long. 76.300625° W

Fig. A.4. Chesapeake Power Station location map.

A.2.2 Site Description and Status

Chesapeake Power Station is a four-unit coal power plant. The four units total 595 MW, and were built in stages from 1953 through 1962. The site also includes 122 MW of natural gas turbines, bringing the total power generation capacity to 717 MW. The coal plants are scheduled for closure by 2015.

As noted in Table A.3, there are no fault lines in the immediate vicinity and maximum earthquake ground acceleration is minimal. Adequate utility grid capacity for an iPWR facility is available within 2 miles. Sufficient fresh water makeup is available for a closed-cycle cooling system. Once-through cooling may also be available given the proximity to the Chesapeake Bay and reprocessed (gray) water cooling may be an option given the proximity to population centers.

Chesapeake Power Station is roughly 35 miles from the Surry Nuclear Power Station (down the James River and up the Elizabeth River) and 12 miles from the Norfolk Naval Base in the central part of the region of interest (up the Elizabeth River).

The permanent population within 1 mile of the camp is approximately 10,000 people, yielding a population density of approximately 3,100 people per square mile. The permanent population within 10 miles of the plant is approximately 1,200,000 people, yielding a population density of about 3,800 people per square mile.

Table A.3. Chesapeake Power Station site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Boundary	~ 3,000	> 400 MWe	~ 2 mi
1 mi of Site Boundary	~ 10,000	> 800 MWe	~ 1 mi
5 mi of Site Boundary	~ 350,000	> 1600 MWe	~ 28 mi
10 mi of Site Boundary	~ 1,200,000	> 3200 MWe	~ 182 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Poquoson, VA	> 50,000 gpm	~ 0.1 mi (Big Lost River)
> 50,000	Suffolk, VA	> 100,000 gpm	~ 0.1 mi (Big Lost River)
> 100,000	Chesapeake, VA	> 200,000 gpm	~ 0.1 mi (Big Lost River)
> 500,000	Washington, DC	> 500,000 gpm	~ 0.1 mi (Big Lost River)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.05 g	Distance to Major Roadway	~ 0.8 mi (I-64)
Max Slope	~ 4%	Distance to Water Transport	~ 0.2 mi (Elizabeth River)
Nearest Fault Line	~ 1169 mi	Distance to Rail Transport	~ 0.2 mi (NS)
Nearest Hazard Site	~ 9.6 mi (Airport—Norfolk Int'l)	Distance to Airport	~ 9.6 mi (Norfolk Int'l)

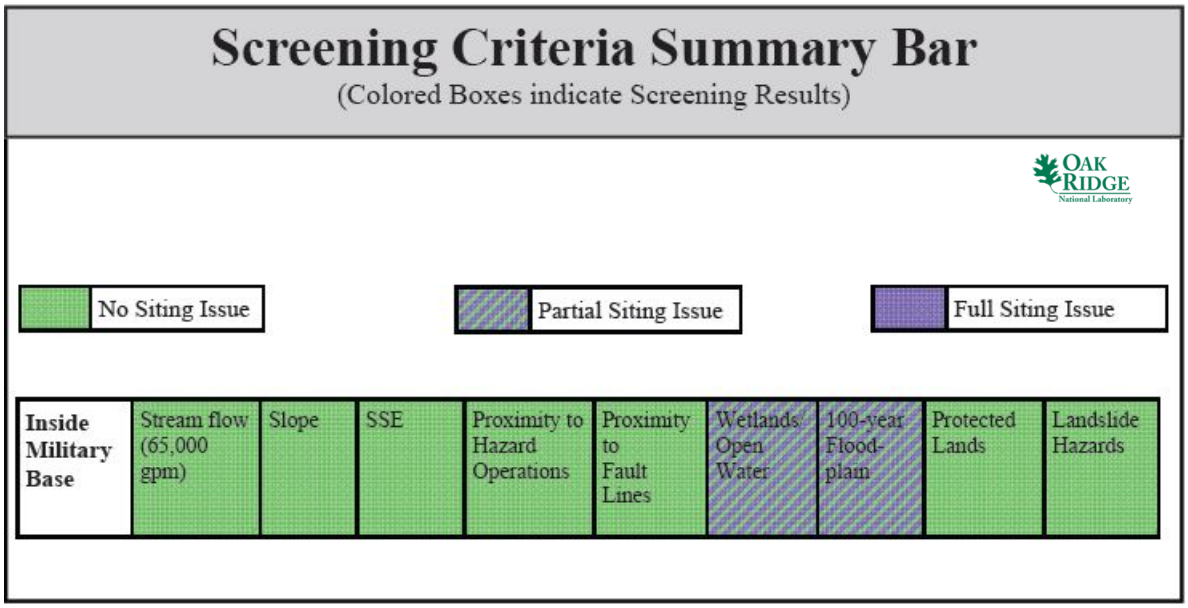
A.2.3 Aerial Imagery

The aerial imagery in Fig. A.5 shows the plant sits at the bend of the Elizabeth River between Interstate 64 and US Highway 13. There is ample open space on the site.

Fig. A.5. Satellite view of Chesapeake Power Station proximity.

A.2.4 Screening Criteria Overview

Table A.4. Chesapeake Power Station siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports—5 miles and oil refineries—1 mile)

A.2.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to Chesapeake Power Station is shown in Fig. A.6. As shown, (independent of population) most of the site outlined is favorable for siting an iPWR. Following this map are maps of the individual SMR siting criteria based on selected input values.

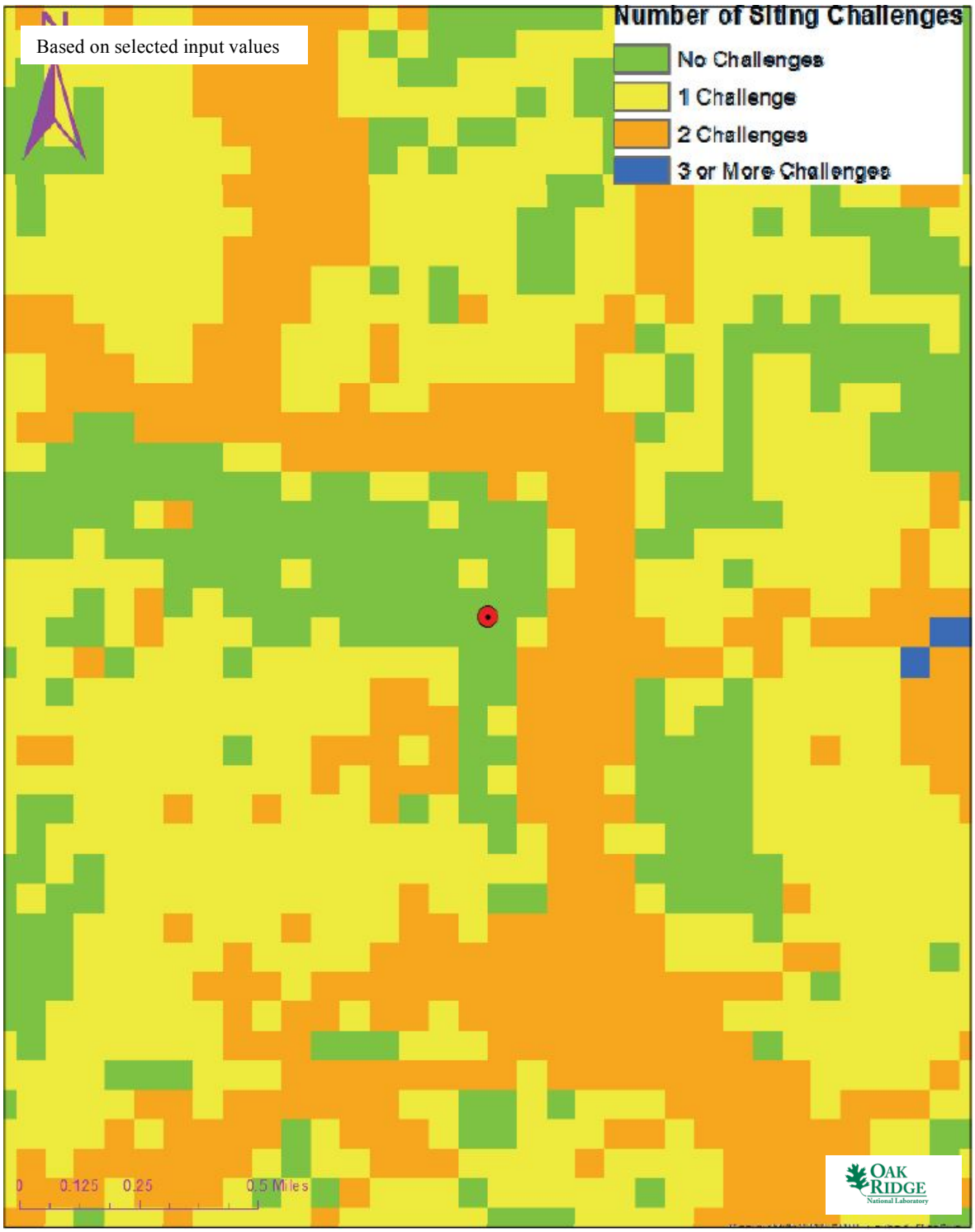
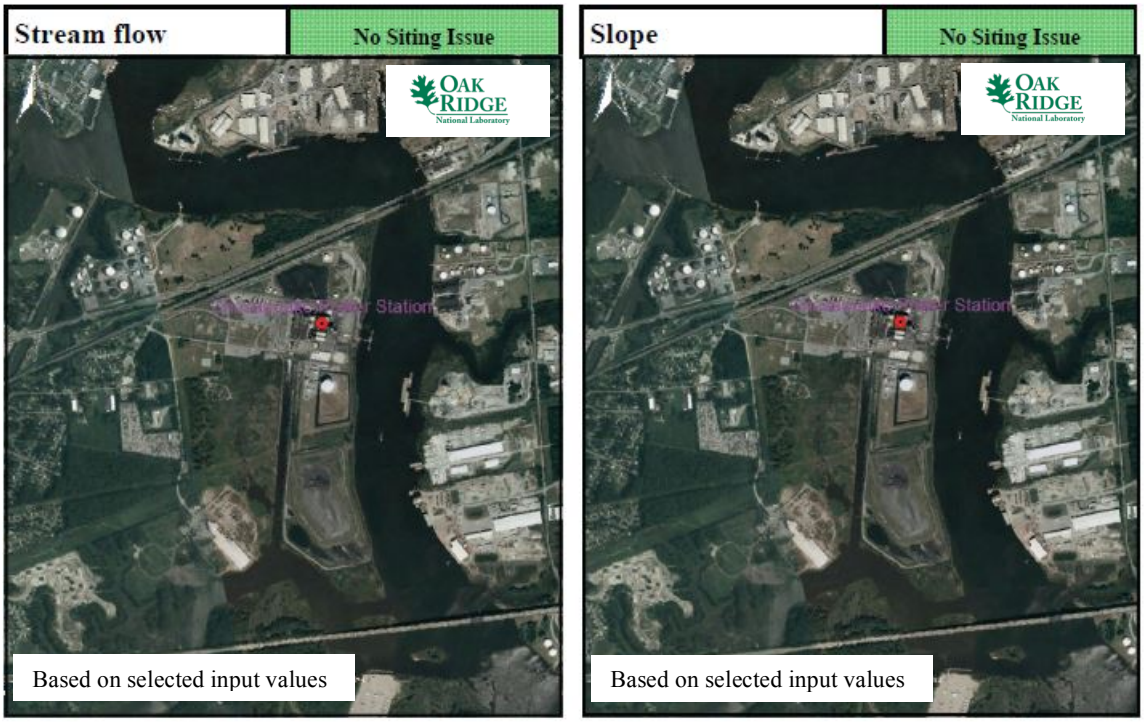
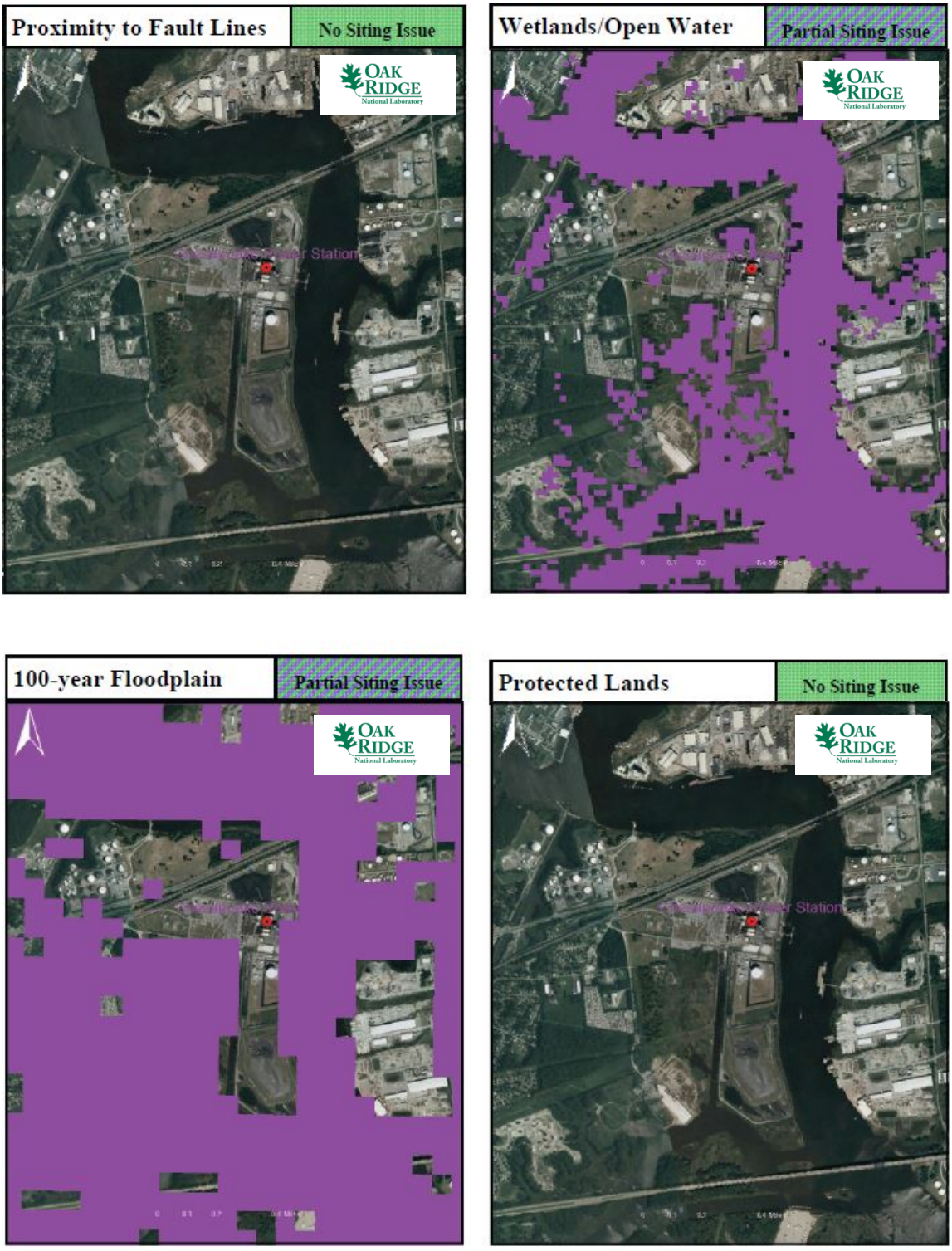


Fig. A.6. Chesapeake Power Station composite map.



Chesapeake Power Station



Chesapeake Power Station

Chesapeake Power Station

A.2.6 Site Evaluation

As shown in the maps above, the majority of the Chesapeake Power Station site is predominantly favorable for siting an iPWR. The only identified partial issues are the presence of wetlands/open water, and the 100-year flood plain, and their overlapping areas in the composite map are the only areas on the site with more than one issue. Neither issue is surprising given the site location on a river.

The Elizabeth River bounds the site on the north and east, and the city of Chesapeake sits directly east across the river. Residential neighborhoods exist along the western boundary, and Deep Creek forms its southern boundary. As shown in Fig. 4, the site is well within an area evaluated at 500 people per square mile within ten miles. However, the immediate area is very industrial and Fig. 5 confirms that the population is less dense near the plant site.

Multiple transportation opportunities are favorable for iPWR construction. The site already has water access on the Elizabeth River. Interstate 64 would allow heavy haul delivery overland. A Norfolk Southern rail line exists onsite. The site is less than 10 miles (direct) from Norfolk International Airport, but is greater than 5 miles.

Overall, the Chesapeake Power Station site meets multiple conventional standards for consideration of siting an iPWR at the proposed location. There are no current or near-term foreseeable SMR SSEC siting issues that should preclude this site from further iPWR siting consideration. Existing site infrastructure would directly support an iPWR.

A.3 CRANEY ISLAND

A.3.1 Location Detail

Craney Island is located in the city of Portsmouth, Virginia. As shown in Fig. A.7, the land is located on the Elizabeth River. Rail, barge, and interstate access are all readily available to the site.

- Location: Craney Island
- Owner: Department of Defense (U.S. Army Corps of Engineers/U.S. Navy)
- Coordinates: lat. 36.893356° N, long. 76.370089° W

Fig. A.7. Craney Island location map.

A.3.2 Site Description and Status

Craney Island is an industrial area operated by the U.S. Army Corps of Engineers and is used for placement of dredged materials. It sits adjacent to a U.S. Navy refueling depot. The site consists of more than 1700 acres, most of which is in an unimproved state.

As noted in Table A.5, there are no fault lines in the immediate vicinity and maximum earthquake ground acceleration is less than 0.2g. Adequate utility grid capacity for an iPWR facility is available within 1

mile. Sufficient fresh water makeup is available for a closed-cycle cooling system. Once-through cooling may also be available given the proximity to the Chesapeake Bay and reprocessed (gray) water cooling may be an option given the proximity to population centers.

Craney Island is roughly 26 miles from the Surry Nuclear Power Station (down the James River) and 5 miles from the Norfolk Naval Base in the central part of the region of interest (across the Elizabeth River).

The permanent population within 1 mile of the camp is approximately 6,500 people, yielding a population density of approximately 2,000 people per square mile. The permanent population within 10 miles of the plant is approximately 1,100,000 people, yielding a population density of about 3,500 people per square mile.

Table A.5. Craney Island site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Boundary	~ 2,100	> 400 MWe	~ 1 mi
1 mi of Site Boundary	~ 6,500	> 800 MWe	~ 4 mi
5 mi of Site Boundary	~ 324,000	> 1600 MWe	~ 21 mi
10 mi of Site Boundary	~ 1,100,000	> 3200 MWe	~ 179 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Poquoson, VA	> 50,000 gpm	~ 1.7 mi (Elizabeth River)
> 50,000	Suffolk, VA	> 100,000 gpm	~ 1.7 mi (Elizabeth River)
> 100,000	Portsmouth, VA	> 200,000 gpm	~ 1.7 mi (Elizabeth River)
> 500,000	Washington, DC	> 500,000 gpm	~ 1.7 mi (Elizabeth River)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.2 g	Distance to Major Roadway	~ 1.3 mi (SR 164)
Max Slope	~ 4%	Distance to Water Transport	~ 1.7 mi (Elizabeth River)
Nearest Fault Line	~ 1166 mi	Distance to Rail Transport	~ 1.5 mi (CWRY)
Nearest Hazard Site	~ 8.8 mi (Airport—Norfolk Int'l)	Distance to Airport	~ 8.8 mi (Norfolk Int'l)

A.3.3 Aerial Imagery

The aerial imagery in Fig. A.8 indicates abundant open space near and within the Craney Island boundary.

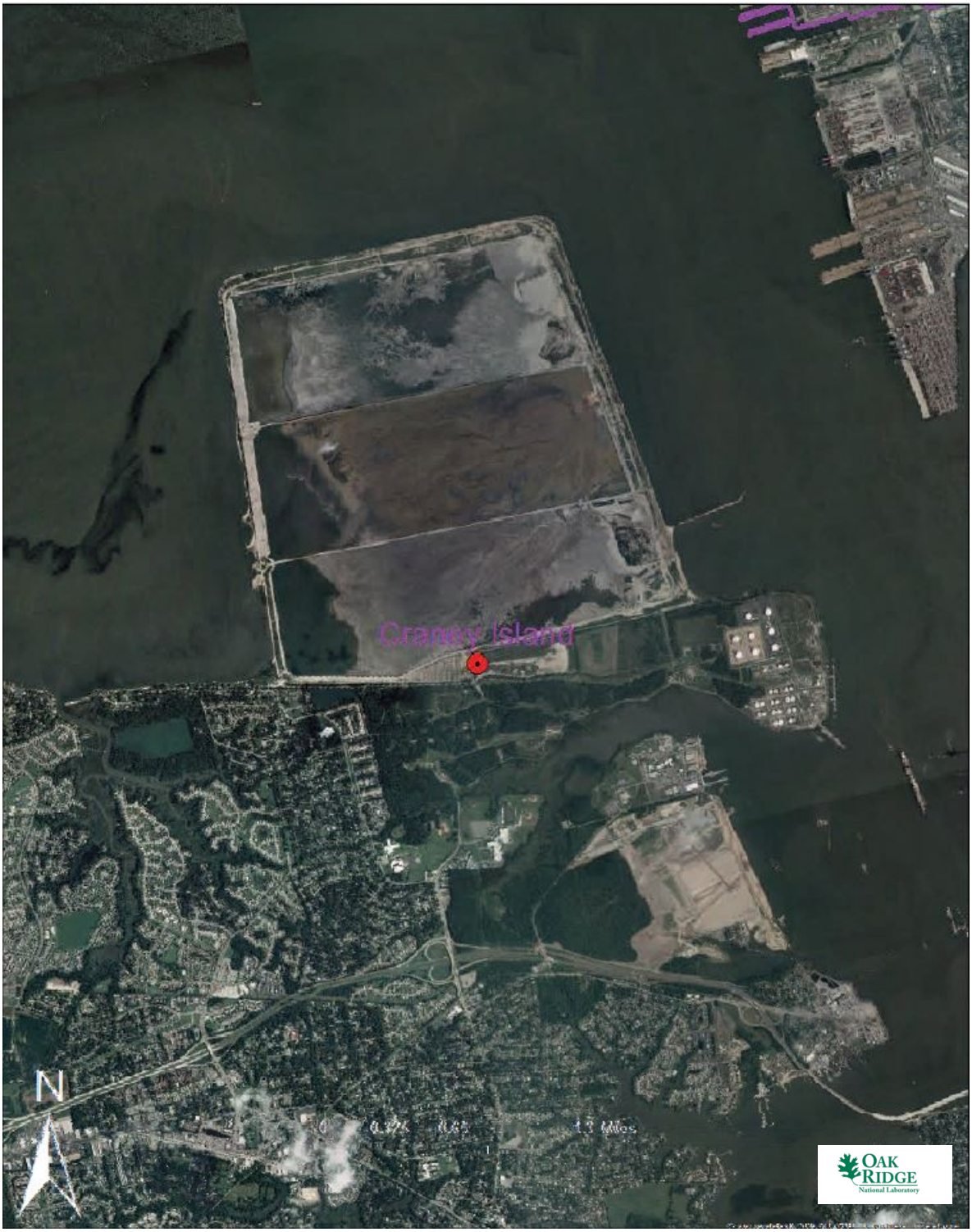
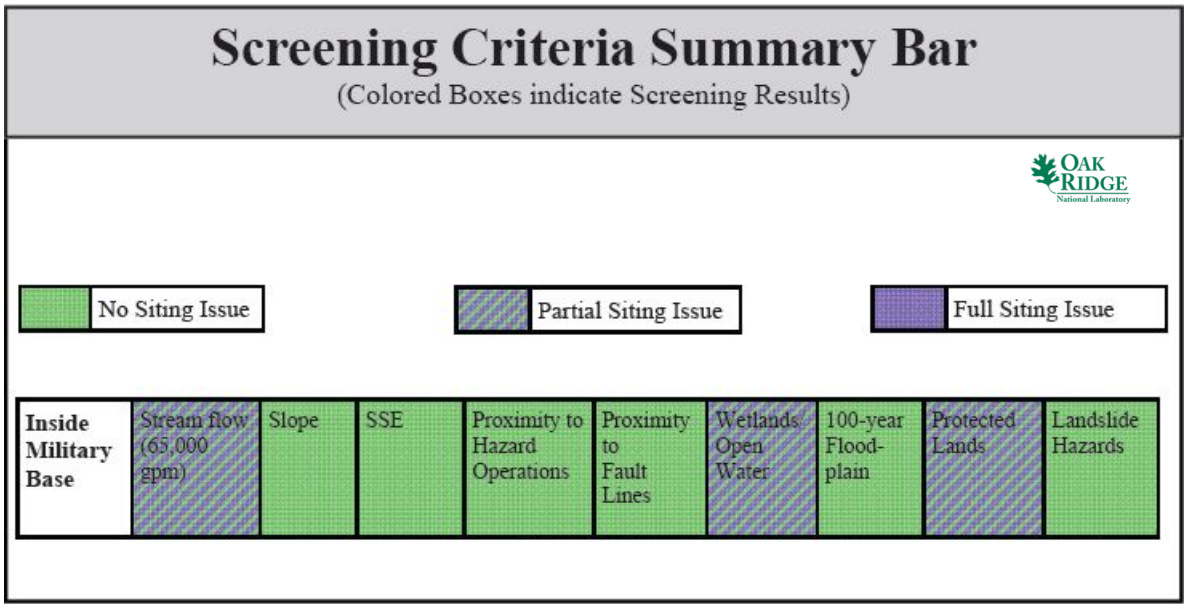


Fig. A.8. Satellite view of Craney Island proximity.

A.3.4 Screening Criteria Overview

Table A.6. Craney Island siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports—5 miles and oil refineries—1 mile)

A.3.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to Craney Island is shown in Fig. A.9. As shown, (independent of population) half of the property outlined shows no challenges for siting an iPWR. Following this map are maps of the individual SMR siting criteria based on selected input values.

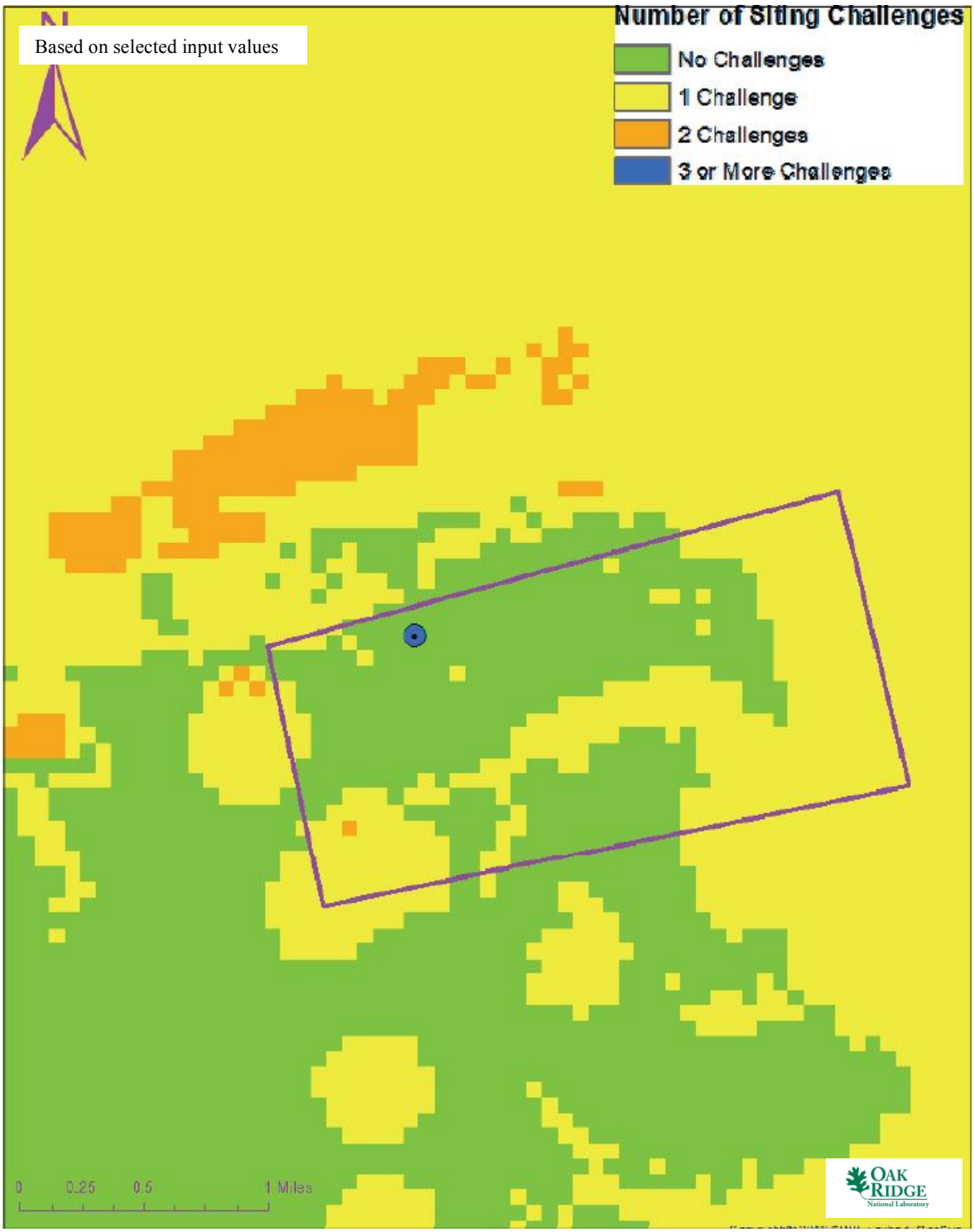
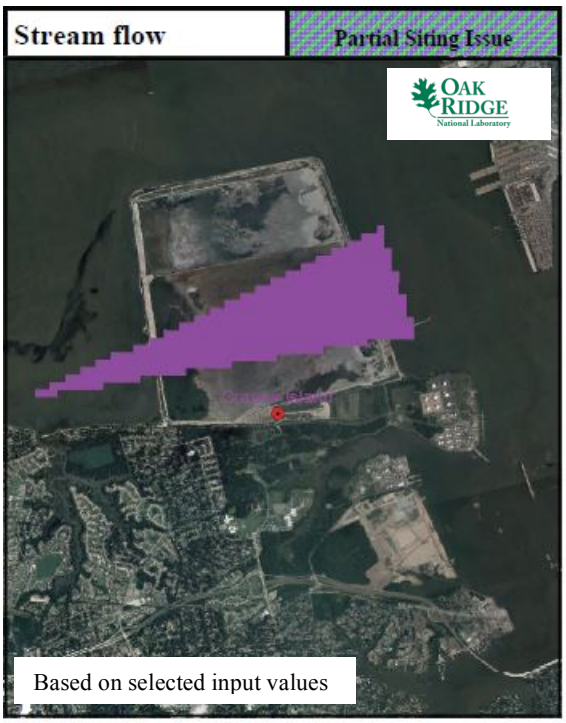
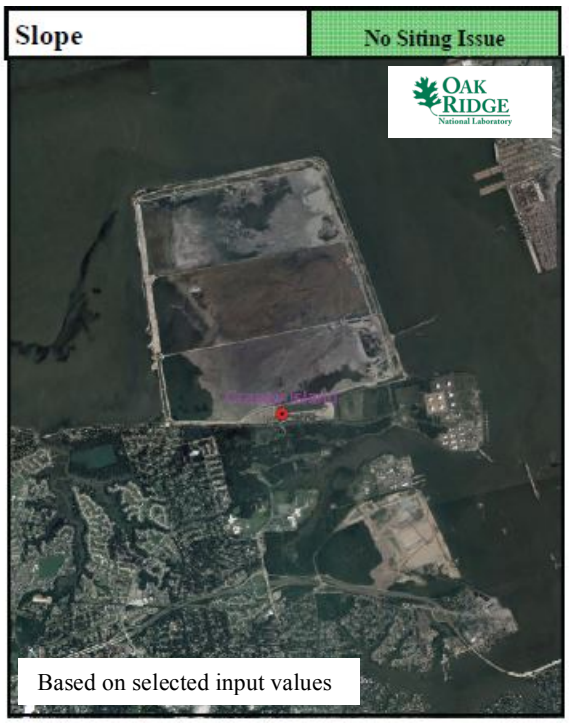
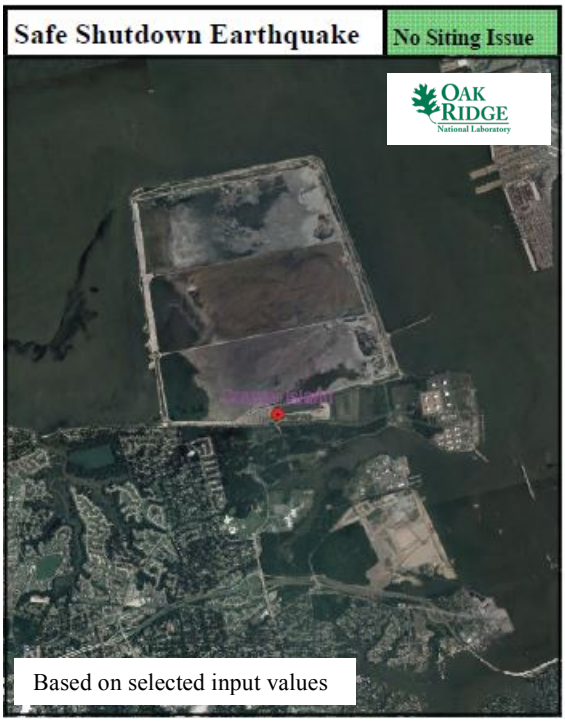


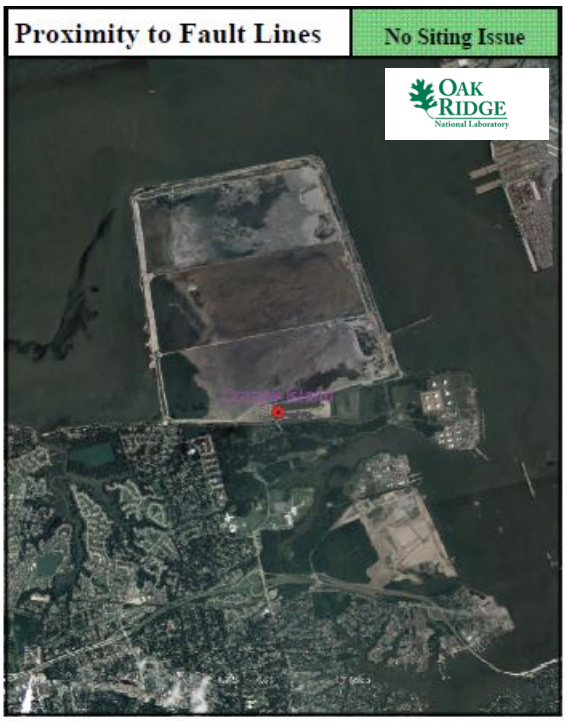
Fig. A.9. Craney Island composite map.

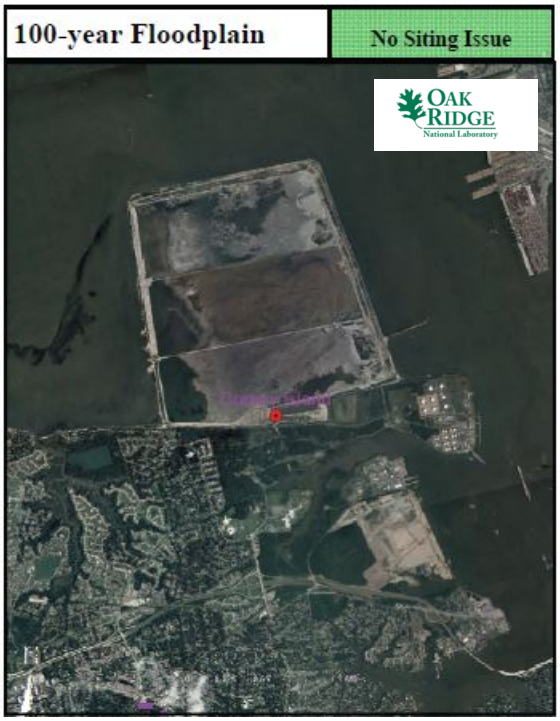




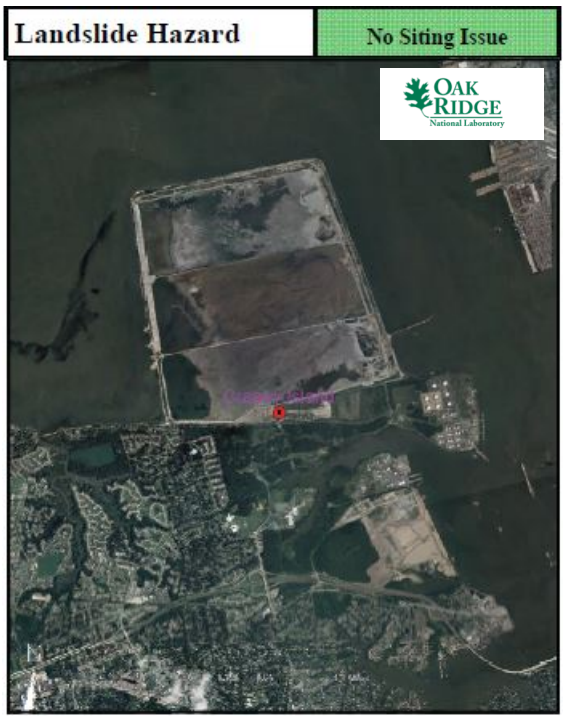


Craney Island





Craney Island



Craney Island

A.3.6 Site Evaluation

As shown in the maps above, the majority of the Craney Island site is predominantly favorable for siting an iPWR. The eastern portion and some central portions of the site have an issue with wetlands/open water, and there are some protected lands (schools) along the southwest border.

Multiple transportation opportunities are favorable for iPWR construction. The adjacent Navy refueling depot has access to the Chesapeake Bay and beyond. VA State Route 164 is less than 2 miles away, and it meets Interstate 664 in around 3 miles. Commonwealth Railway is less than 2 miles away, and Norfolk International Airport is less than 9 miles away.

In addition to schools, there is significant housing to the west of the site. Likewise, across the Elizabeth River from the site, there is significant housing. As shown in Fig. 4, the site is within an area evaluated at 500 people per square mile within ten miles.

Current security at the site would limit access to the Craney Island property and add a layer of security to the required reactor facility security force.

Overall, the Craney Island site meets multiple conventional standards in the near term for consideration of siting an iPWR at the proposed location, but there may be longer-term issues that could potentially preclude this site from further iPWR siting consideration. Though a significant portion of the site meets all the screening criteria, the proximity of several schools could make this site a difficult choice.

A.4 FORT EUSTIS

A.4.1 Location Detail

Fort Eustis is located on the northwestern edge of Newport News, Virginia. As shown in Fig. A.10, the site is located south of Interstate 64 on the north shore of the James River. The base center is approximately 10 miles southeast of Colonial Williamsburg. Rail, barge, and interstate access are all readily available to the site. An airfield is also available on the site.

- Location: Fort Eustis
- Owner: U.S. Army
- Coordinates: lat. 37.132147° N, long. 76.598894° W

Fig. A.10. Fort Eustis location map.

A.4.2 Site Description and Status

Fort Eustis is an Army installation; part of Joint Base Langley Eustis. Fort Eustis is the home of the Army Transportation Corps Training Center, but also accommodates other tenant commands. Over 30,000 soldiers, family members and civilian employees work or live onsite.

The station center is approximately 6 miles east of the Surry Nuclear Power Plant (across the James River) and approximately 6 miles due south of the Yorktown Naval Weapons Station on the Virginia Peninsula. The fort is approximately 20 miles northwest of the Norfolk Naval Base in the central part of the region of interest.

The fort has been in the possession of the Army as a transportation school since 1946. It resides on more than 8,000 acres; much of which is developed. There is undeveloped area available in the Mulberry Island portion of the site. As noted in Table A.7, there are no fault lines in the immediate vicinity and maximum earthquake ground acceleration is minimal. The land is reasonably flat. Adequate utility grid capacity for an iPWR facility is available within 3 miles. Sufficient fresh water makeup is available for a closed-cycle cooling system from the James River.

The permanent population within 1 mile of the camp is approximately 4,500 people, yielding a population density of approximately 1,400 people per square mile. The permanent population within 10 miles of the plant is approximately 500,000 people, yielding a population density of about 1,600 people per square mile. There is significant housing onsite and along the eastern border of the fort property. There are also numerous schools and business centers adjacent to the property.

Table A.7. Fort Eustis site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Boundary	~ 0	> 400 MWe	~ 3 mi
1 mi of Site Boundary	~ 4,500	> 800 MWe	~ 3 mi
5 mi of Site Boundary	~ 140,000	> 1600 MWe	~ 5 mi
10 mi of Site Boundary	~ 500,000	> 3200 MWe	~ 169 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Gloucester Point, VA	> 50,000 gpm	~ 2.2 mi (James River)
> 50,000	Suffolk, VA	> 100,000 gpm	~ 2.2 mi (James River)
> 100,000	Newport News, VA	> 200,000 gpm	~ 2.2 mi (James River)
> 500,000	Washington, DC	> 500,000 gpm	~ 2.2 mi (James River)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.2 g	Distance to Major Roadway	~ 3.5 mi (I-64)
Max Slope	~ 4%	Distance to Water Transport	~ 2.2 mi (James River)
Nearest Fault Line	~ 1154 mi	Distance to Rail Transport	~ 2.2 mi (USG)
Nearest Hazard Site	~ 5.5 mi (Airport—Williamsburg Int'l)	Distance to Airport	~ 5.5 mi (Williamsburg Int'l)

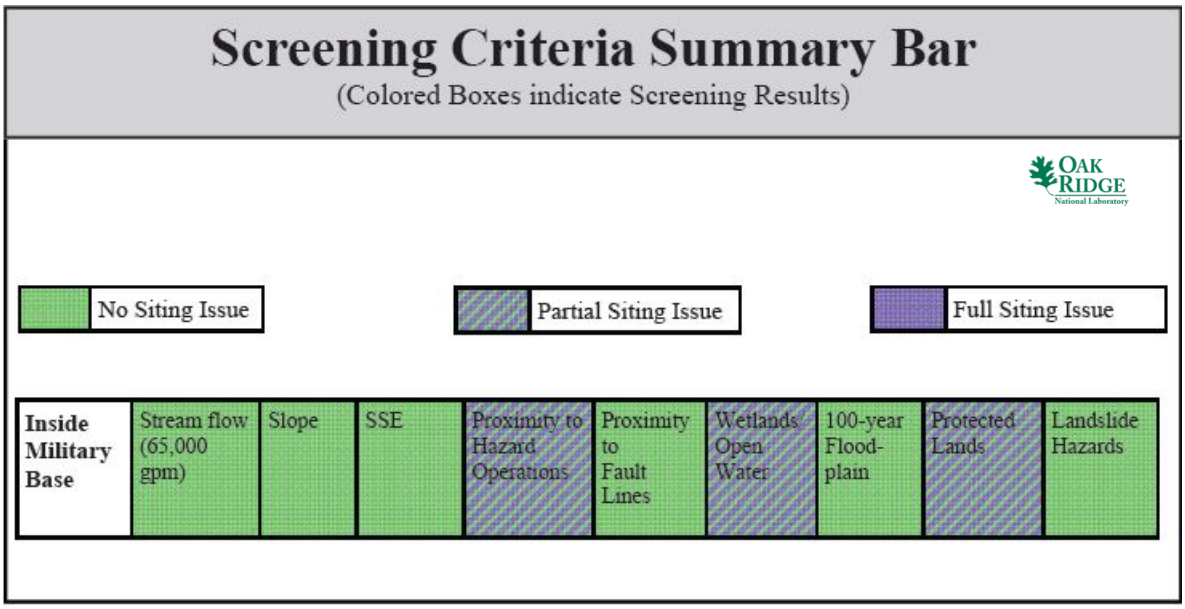
A.4.3 Aerial Imagery

The aerial imagery in Fig. A.11 indicates moderate open space within the Mulberry Island portion of the Fort Eustis boundary.

Fig. A.11. Satellite view of Fort Eustis proximity.

A.4.4 Screening Criteria Overview

Table A.8. Fort Eustis siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports—5 miles and oil refineries—1 mile)

A.4.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to Fort Eustis is shown in Fig. A.12. As shown, (independent of population) half of the property outlined is favorable for siting an iPWR. Following this map are maps of the individual SMR siting criteria based on selected input values.

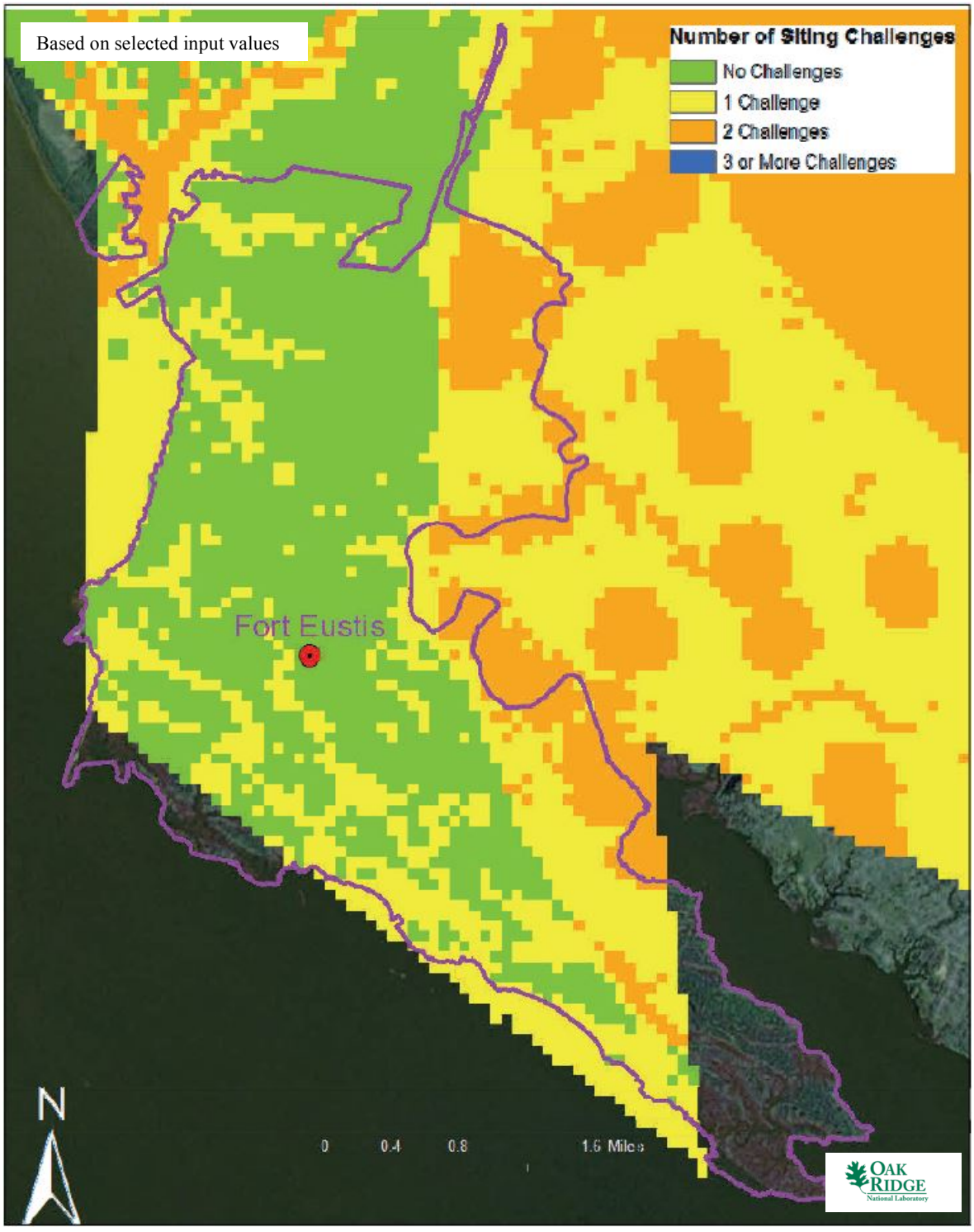
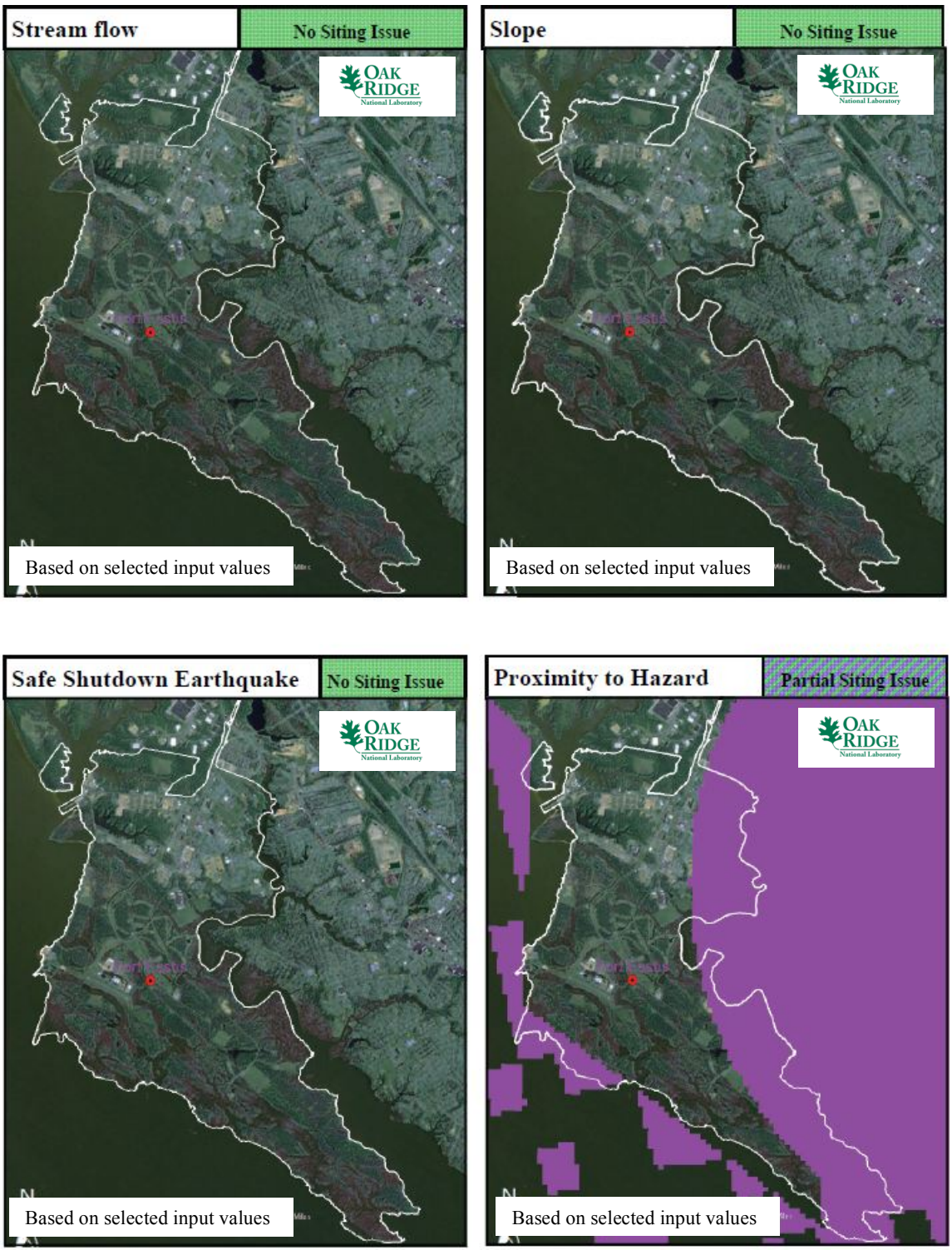


Fig. A.12. Fort Eustis composite map.


Stream flow
No Siting Issue
OAK RIDGE National Laboratory
Based on selected input values
Slope
No Siting Issue
OAK RIDGE National Laboratory
Based on selected input values
Safe Shutdown Earthquake
No Siting Issue
OAK RIDGE National Laboratory
Based on selected input values
Proximity to Hazard
Partial Siting Issue
OAK RIDGE National Laboratory
Based on selected input values

Fort Eustis


Proximity to Fault Lines
No Siting Issue
OAK RIDGE National Laboratory
N


Wetlands/Open Water
Partial Siting Issue
OAK RIDGE National Laboratory
N


100-year Floodplain
No Siting Issue
OAK RIDGE National Laboratory
N


Protected Lands
Partial Siting Issue
OAK RIDGE National Laboratory
N

Fort Eustis

Fort Eustis

A.4.6 Site Evaluation

As shown in the maps above, a significant portion of the base, including the upper portion of the boot-shape boundary for the Fort Eustis site is favorable for siting an iPWR. However, the upper portion of Fort Eustis is densely occupied and developed, and would otherwise not be favorable for siting an iPWR. Only the section of the property in the foot of the boot (Mulberry Island) should be considered any further. The northern portion of Mulberry Island is noted for proximity to a hazard because it is within 5 miles of the Newport News/Williamsburg International Airport. The main runway is perpendicular to the central axis of Mulberry Island, which could be problematic. In addition, the base airfield runs along the Mulberry Island axis at the heel of the Fort Eustis boot shape.

Table A.8 further indicates a partial siting issue for wetlands and open water. There are numerous streams flowing through the site and bordering the site. These do not appear to create a barrier to siting an iPWR at the site. A partial siting issue also exists for protected land. The overlapping dots of land are a buffer around a satellite campus for St. Leo College and nearby schools. None of these buffered areas appears to create a barrier to siting an iPWR at the site.

The Yorktown battlefield area lies to the north of the base and industrial areas lie northeast of the base. Both of these factors would limit population growth in these directions. However, there is significant housing to the east of Fort Eustis. As shown in Fig. 4, the site is within an area evaluated at 500 people per square mile within ten miles.

Multiple transportation opportunities are favorable for iPWR construction. Fort Eustis has a pier on the James River with access to the Chesapeake Bay and beyond. Interstate 64 would allow heavy haul delivery overland and a rail line spur provides direct access to the site. Finally, an air strip is available onsite.

Current military security at the site would limit access to the Fort Eustis property and add a layer of security to the required reactor facility security force.

The Fort Eustis site is not a likely candidate for consideration of siting an iPWR. Rail and barge access onsite make Fort Eustis desirable. However, the alignment of nearby runways and the number of dwellings immediately adjacent to the fort are negative factors. If the fort runway is not active, then an iPWR site on the lower end of Mulberry Island becomes favorable.

A.5 FORT STORY

A.5.1 Location Detail

Fort Story is located within the city of Virginia Beach, Virginia at Cape Henry. As shown in Fig. A.13, the site is located just north of US Highway 60 at the mouth of the Chesapeake Bay. The site is approximately 5 miles east of the Chesapeake Bay Bridge-Tunnel. Highway access is readily available to the site.

- Location: Fort Story
- Owner: U.S. Army
- Coordinates: lat. 36.926197° N, long. 76.031142° W

Fig. A.13. Fort Story location map.

A.5.2 Site Description and Status

Fort Story is part of the Army Transportation Corps Training Center located at Fort Eustis. Fort Story is approximately 35 miles southeast of Fort Eustis. Unlike Fort Eustis, there is no pier or rail head available at Fort Story. The Department of Defense uses Fort Story to train on amphibious landings and ship-to-shore transfer of cargo. Just 2,500 soldiers and family members live onsite.

The fort has been in the possession of the Army as part of the transportation school since 1946. The fort resides on approximately 1,500 acres; about half is developed. As noted in Table A.9, there are no fault lines in the immediate vicinity and maximum earthquake ground acceleration is minimal. The land is reasonably flat. Adequate utility grid capacity for an iPWR facility is available within 6 miles. Insufficient fresh water makeup is available for a closed-cycle cooling system. However, once-through cooling from the Chesapeake Bay or reprocessed (gray) water cooling may be an option given the proximity to population centers.

The station is roughly 41 miles from the Surry Nuclear Power Station (up the James River) and 17 miles east of the Norfolk Naval Base in the central part of the region of interest.

The permanent population within 1 mile of the camp is approximately 3,000 people, yielding a population density of approximately 950 people per square mile. The permanent population within 10 miles of the plant is approximately 720,000 people, yielding a population density of about 2,300 people per square mile. First Landing State Park and Broad Bay provide a significant buffer along the southern boundary of Fort Story.

Table A.9. Fort Story site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Boundary	~ 1,100	> 400 MWe	~ 6 mi
1 mi of Site Boundary	~ 3,000	> 800 MWe	~ 17 mi
5 mi of Site Boundary	~ 136,000	> 1600 MWe	~ 37 mi
10 mi of Site Boundary	~ 720,000	> 3200 MWe	~ 197 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Poquoson, VA	> 50,000 gpm	~ 1.1mi (Chesapeake Bay)
> 50,000	Suffolk, VA	> 100,000 gpm	~ 1.1mi (Chesapeake Bay)
> 100,000	Virginia Beach, VA	> 200,000 gpm	~ 1.1mi (Chesapeake Bay)
> 500,000	Washington, DC	> 500,000 gpm	~ 1.1mi (Chesapeake Bay)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.05 g	Distance to Major Roadway	~ 0.4mi (SUS 60)
Max Slope	~ 4%	Distance to Water Transport	~ 1.1mi (Chesapeake Bay)
Nearest Fault Line	~ 1183 mi	Distance to Rail Transport	~ 6.3 mi (NS)
Nearest Hazard Site	~ 9.1 mi (Airport—Norfolk Int'l)	Distance to Airport	~ 9.1 mi (Norfolk Int'l)

A.5.3 Aerial Imagery

The aerial imagery in Fig. A.14 indicates moderate open space within the Fort Story boundary.

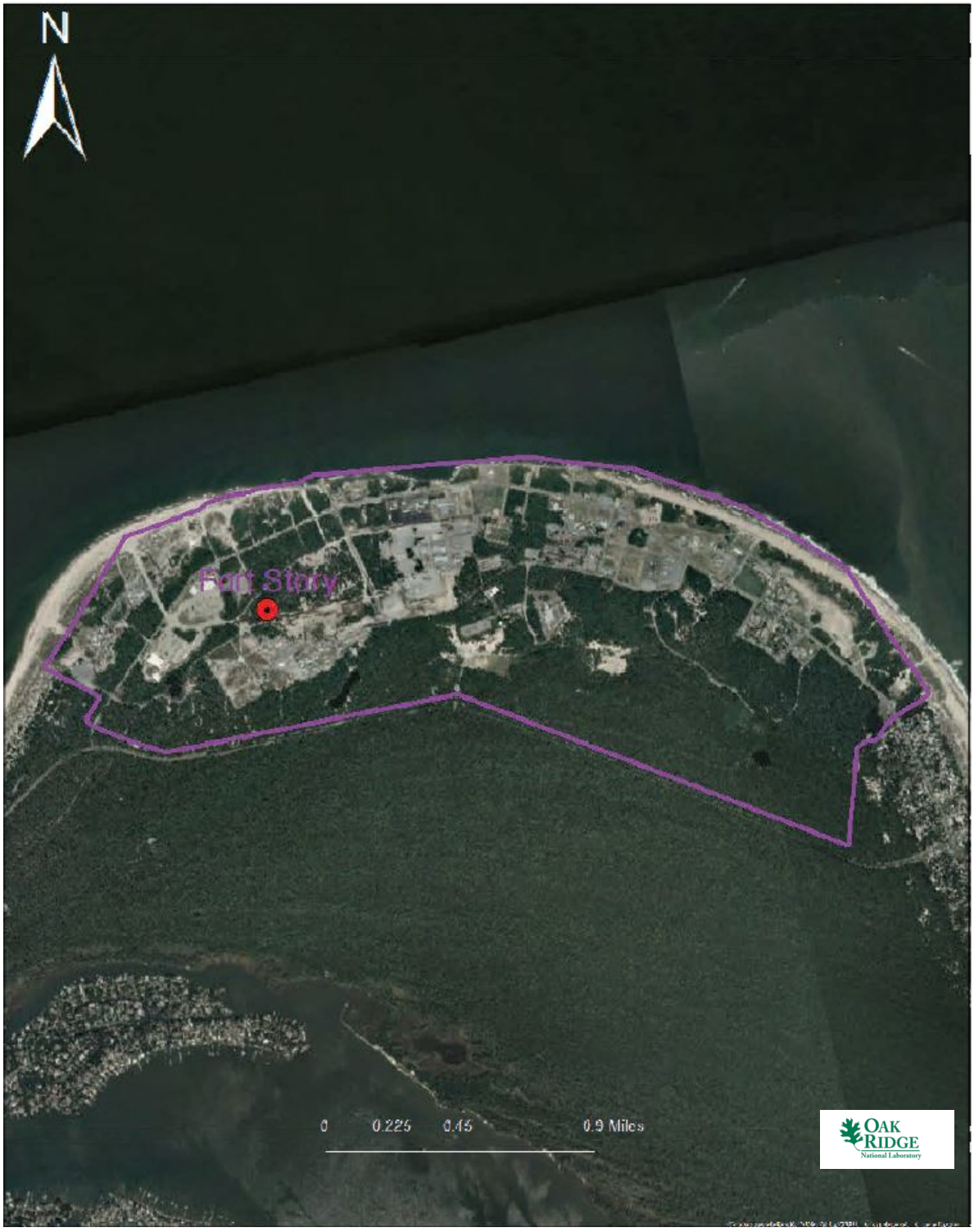
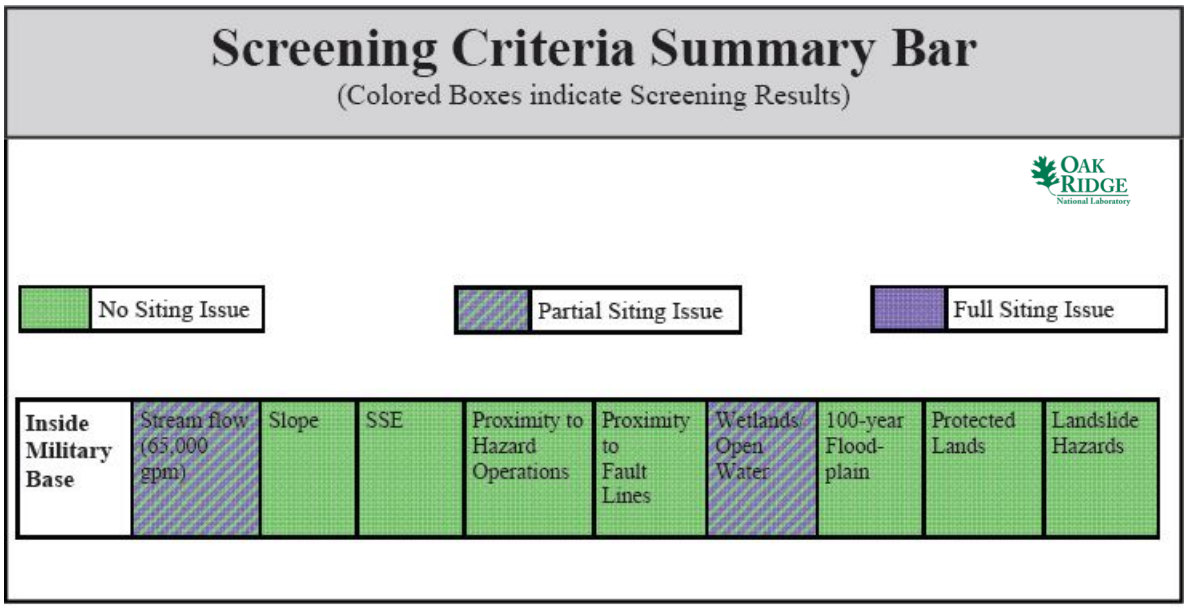


Fig. A.14. Satellite view of Fort Story proximity.

A.5.4 Screening Criteria Overview

Table A.10. Fort Story siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports—5 miles and oil refineries—1 mile)

A.5.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to Fort Story is shown in Fig. A.15. As shown, (independent of population) most of the property has a single screening issue for siting an iPWR. Following this map are maps of the individual SMR siting criteria based on selected input values.

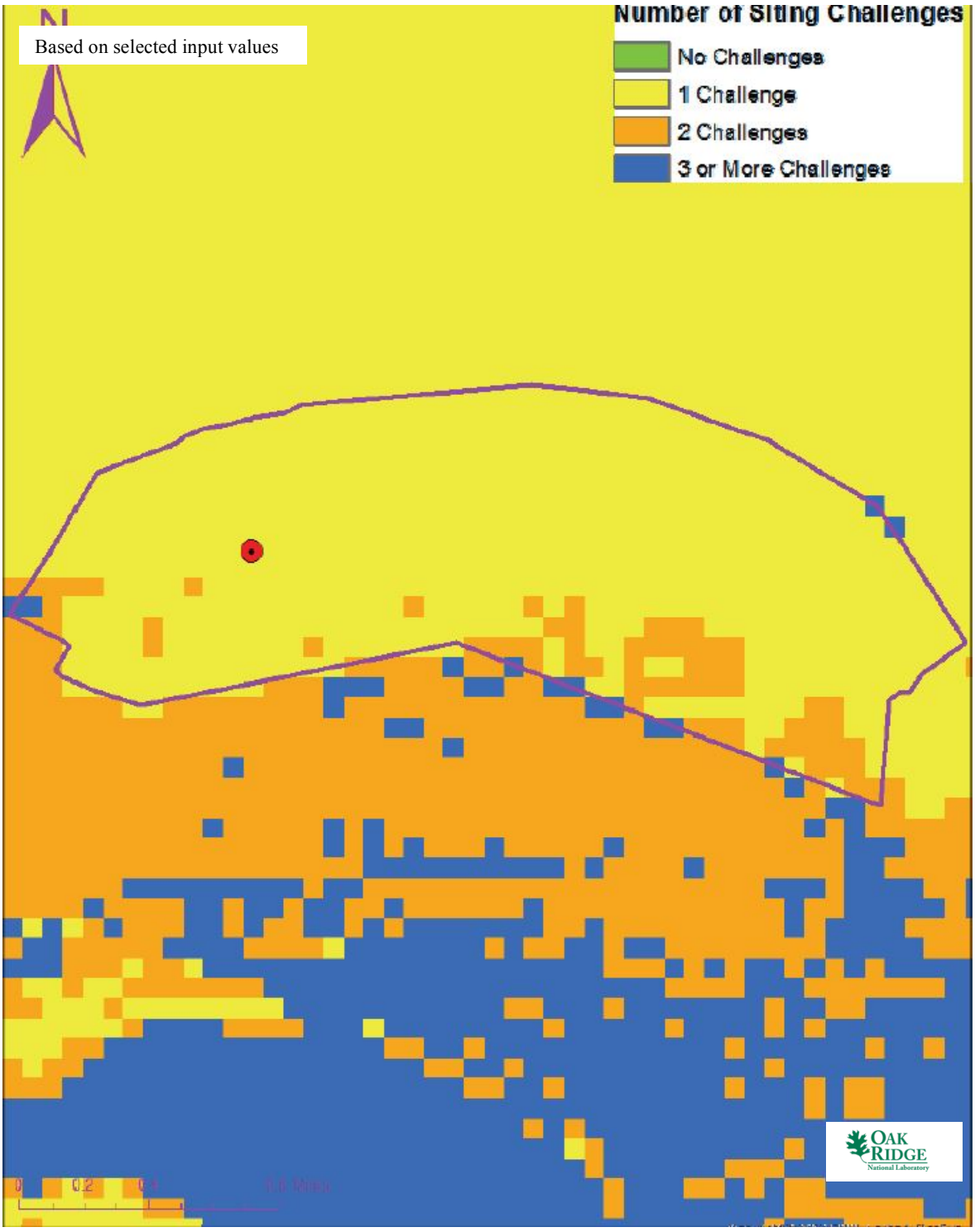
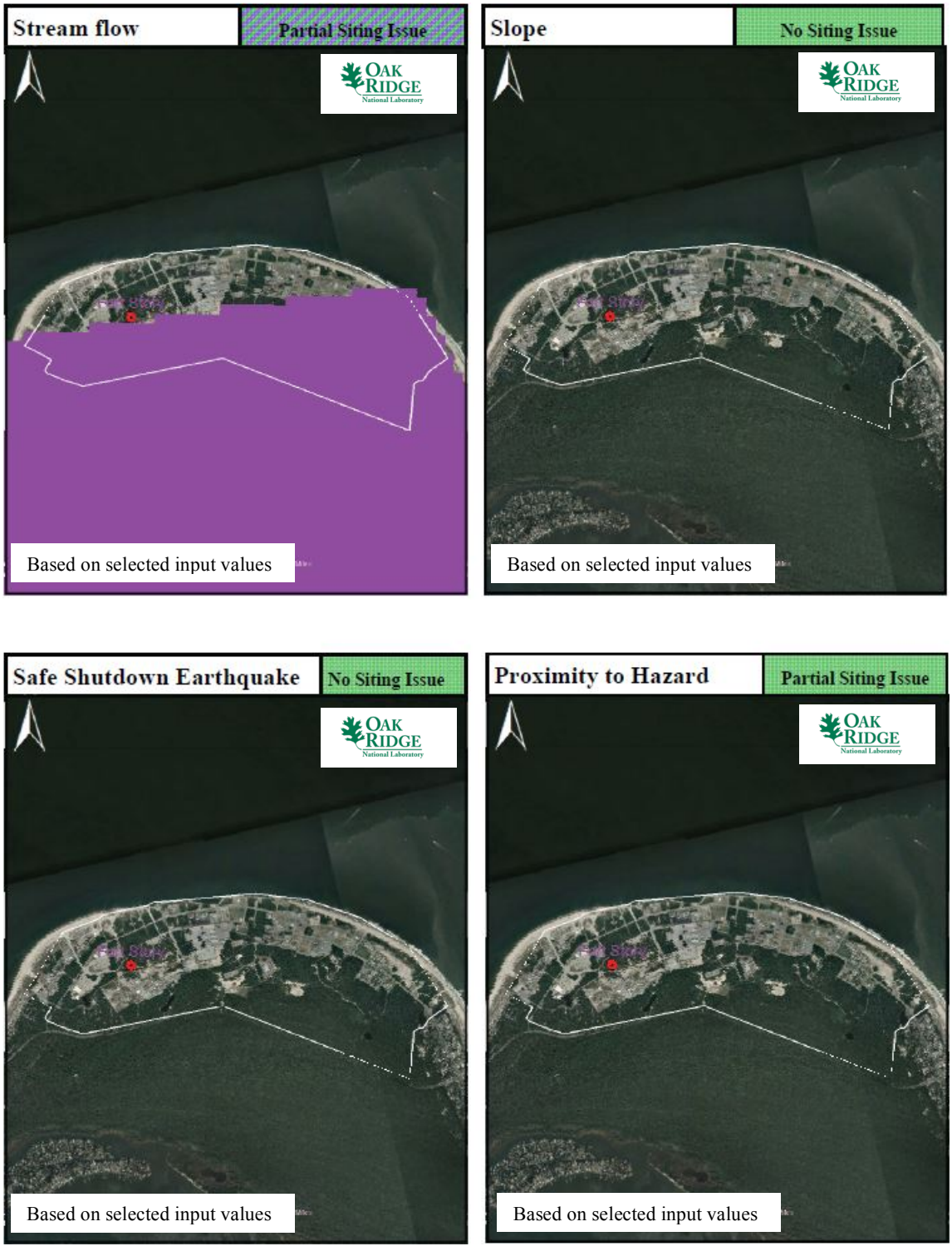
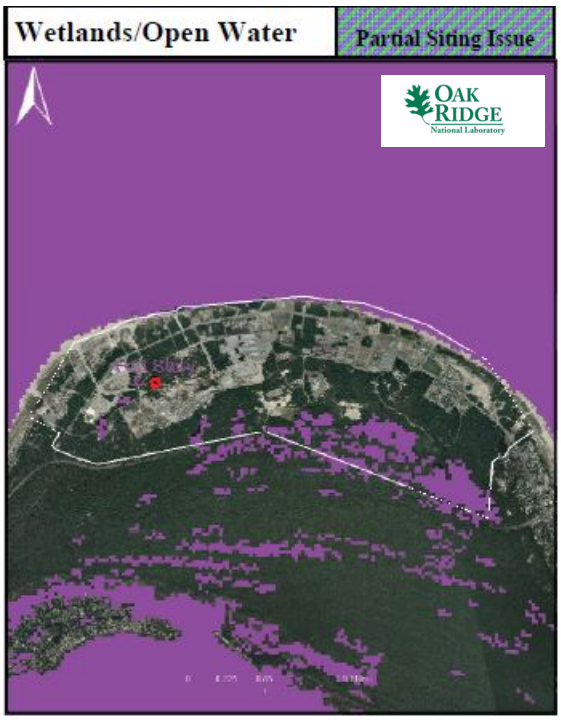


Fig. A.15. Fort Story composite map.


Stream flow
Partial Siting Issue
OAK RIDGE National Laboratory
Based on selected input values
Slope
No Siting Issue
OAK RIDGE National Laboratory
Based on selected input values
Safe Shutdown Earthquake
No Siting Issue
OAK RIDGE National Laboratory
Based on selected input values
Proximity to Hazard
Partial Siting Issue
OAK RIDGE National Laboratory
Based on selected input values

Fort Story


Proximity to Fault Lines
No Siting Issue
OAK RIDGE
National Laboratory


Wetlands/Open Water
Partial Siting Issue
OAK RIDGE
National Laboratory


100-year Floodplain
No Siting Issue
OAK RIDGE
National Laboratory


Protected Lands
No Siting Issue
OAK RIDGE
National Laboratory

Fort Story

Fort Story

A.5.6 Site Evaluation

As shown in the maps above, Cape Henry has a single screening issue. The issue is a lack of adequate freshwater for makeup to a closed cycle cooling system. Other cooling options are available based on the site location at the mouth of the Chesapeake Bay.

Table A.10 further indicates a partial siting issue for wetlands and open water. There are numerous areas of open water in the undeveloped portion of the site. These do not appear to create a barrier to siting an iPWR at the site, especially in areas that have been developed previously.

First Landing State Park and Broad Bay border the southern boundary of Fort Story. Both of these areas would limit population growth immediately adjacent to the site. As shown in Fig. 4, the site is at the outside edge an area evaluated at 500 people per square mile within ten miles. While the overall population density may be high in the general area; the population density at a localized level is low and likely to remain low. This is confirmed by Fig. 5.

Transportation could be more challenging for the Fort Story site. Direct barge access is unavailable and the nearest railway is over 6 miles away.

Current military security at the site would limit access to the Fort Eustis property and add a layer of security to the required reactor facility security force.

The Fort Story site meets multiple conventional standards in the near term for consideration of siting an iPWR at the proposed location, but there may be longer-term issues that could potentially preclude this site from further iPWR siting consideration. The availability of freshwater cooling can be solved and the site is reasonably remote given the overall population in the area.

A.6 Langley Air Force Base

A.6.1 Location Detail

Langley Air Force Base is located within Hampton, Virginia. The site is surrounded by Poquoson to the north and Newport News to the east. As shown in Fig. A.16, the site is located off the Back River facing the Chesapeake Bay. Rail, barge, and interstate access are all readily available to the site. A substantial runway is also available on the site.

- Location: Langley Air Force Base
- Owner: U.S. Air Force
- Coordinates: lat. 37.082678° N, long. 76.355336° W

Fig. A.16. Langley Air Force Base location map.

A.6.2 Site Description and Status

Langley Air Force Base is an Air Force installation; it is part of Joint Base Langley Eustis. The base has been in the possession of the military since 1916 and is the home of the Air Combat Command, but also accommodates other tenant commands. In addition, the NASA Langley Research Center abuts the base to the west. Langley Air Force Base resides on more than 3,000 acres; much of which is developed. There is undeveloped area in the northern portion of the base, away from and perpendicular to the runway. Approximately 25,000 airmen, family members and civilian employees work or live onsite

The station is roughly 19 miles southeast of the Surry Nuclear Power Station (across the James River) and 10 miles northwest of the Norfolk Naval Base in the central part of the region of interest.

As noted in Table A.11, there are no fault lines in the immediate vicinity and maximum earthquake ground acceleration is minimal. The land is reasonably flat. Adequate utility grid capacity for an iPWR facility is available within 6 miles. Brackish cooling water is available from the Back River, though much of the site is more than 20 miles from fresh water makeup for a closed cycle cooling system.

The permanent population within 1 mile of the camp is approximately 5,000 people, yielding a population density of approximately 1,600 people per square mile. The permanent population within 10 miles of the plant is approximately 750,000 people, yielding a population density of about 2,400 people per square mile. There is housing onsite and in the surrounding communities. There are also numerous schools and business centers adjacent to the property.

Table A.11. Langley Air Force Base site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Boundary	~ 5,000	> 400 MWe	~ 6 mi
1 mi of Site Boundary	~ 11,000	> 800 MWe	~ 12 mi
5 mi of Site Boundary	~ 270,000	> 1600 MWe	~ 19 mi
10 mi of Site Boundary	~ 750,000	> 3200 MWe	~ 181 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Poquoson, VA	> 50,000 gpm	~ 1.2 mi (Back River)
> 50,000	Suffolk, VA	> 100,000 gpm	~ 1.2 mi (Back River)
> 100,000	Hampton, VA	> 200,000 gpm	~ 1.2 mi (Back River)
> 500,000	Washington, DC	> 500,000 gpm	~ 1.2 mi (Back River)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.2 g	Distance to Major Roadway	~ 3.1 mi (I-64)
Max Slope	~ 4%	Distance to Water Transport	~ 1.2 mi (Back River)
Nearest Fault Line	~ 1166 mi	Distance to Rail Transport	~ 3.2 mi (CSXT)
Nearest Hazard Site	~ 7.8 mi (Airport—Williamsburg Int'l)	Distance to Airport	~ 7.8 mi (Williamsburg Int'l)

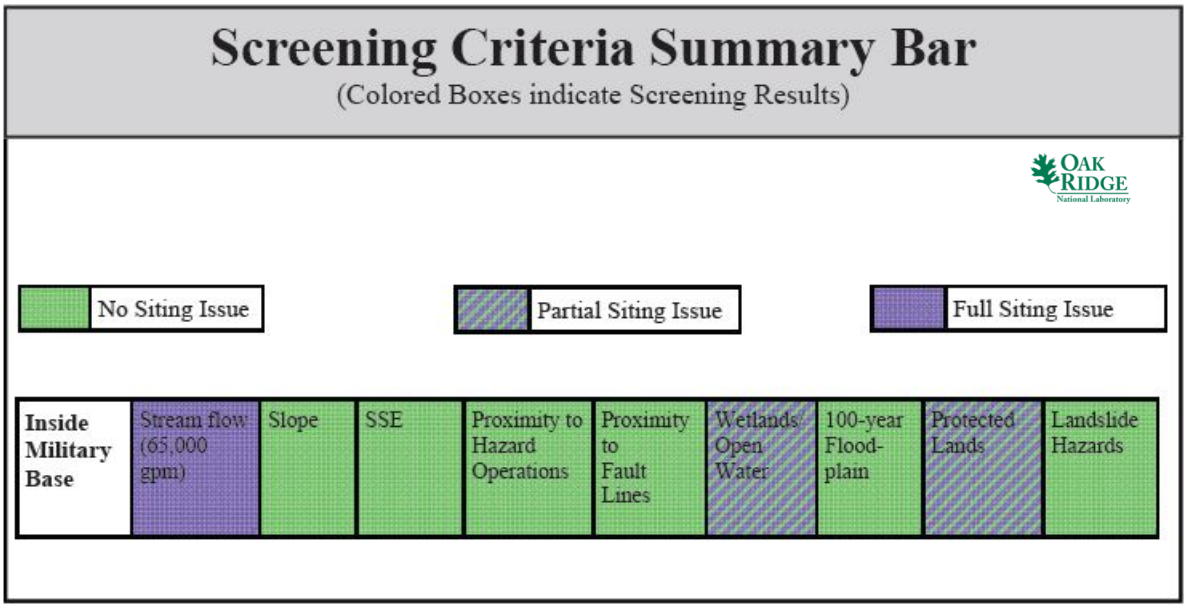
A.6.3 Aerial Imagery

The aerial imagery in **Error! Reference source not found.**Fig. A.17 indicates moderate open space in the northern portion of the Langley Air Force Base boundary.

Fig. A.17. Satellite view of Langley Air Force Base proximity.

A.6.4 Screening Criteria Overview

Table A.12. Langley Air Force Base siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports—5 miles and oil refineries—1 mile)

A.6.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to Langley Air Force Base is shown in Fig. A.18. As shown, (independent of population) most of the property has a single screening issue for siting an iPWR. Following this map are maps of the individual SMR siting criteria based on selected input values.

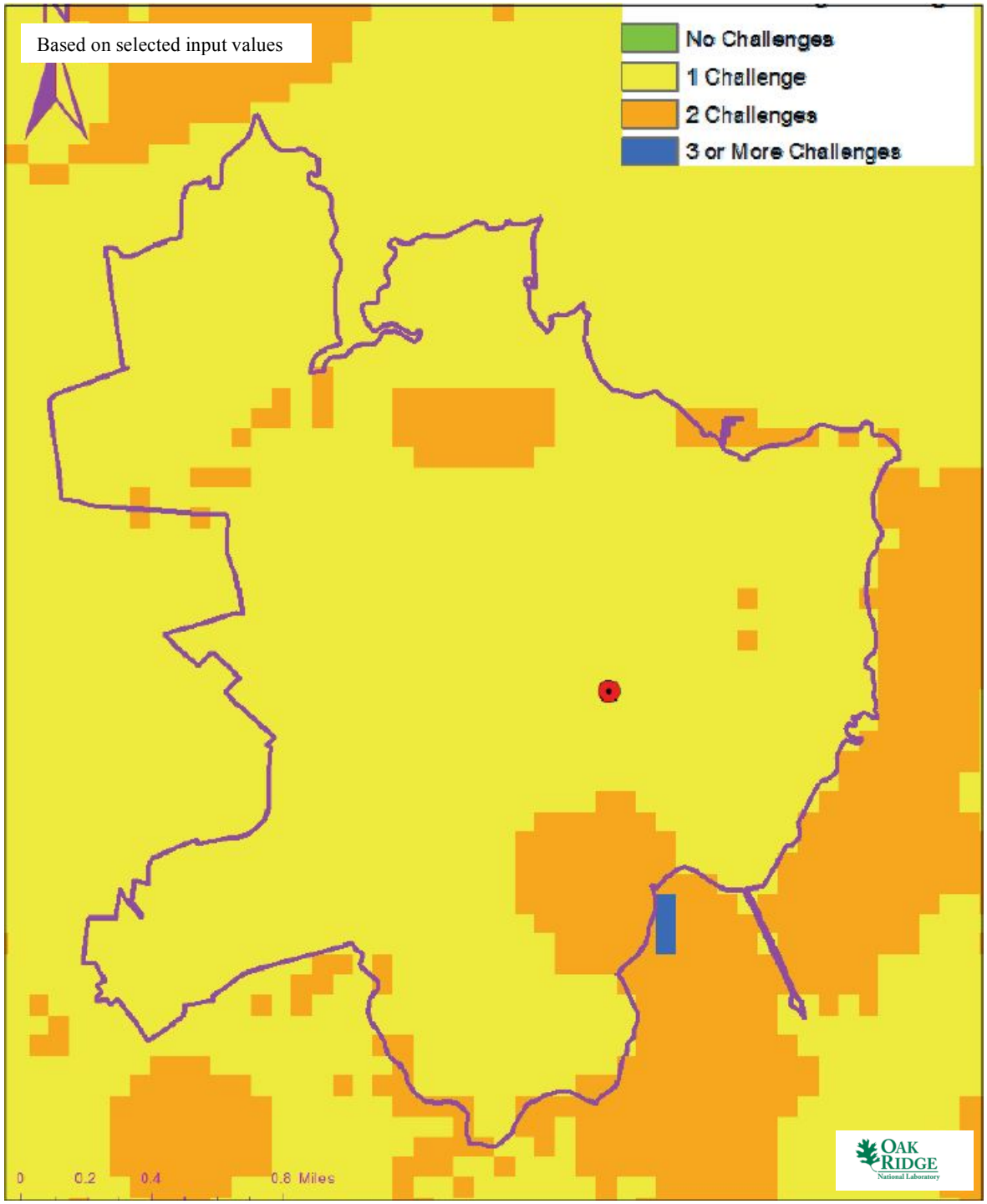
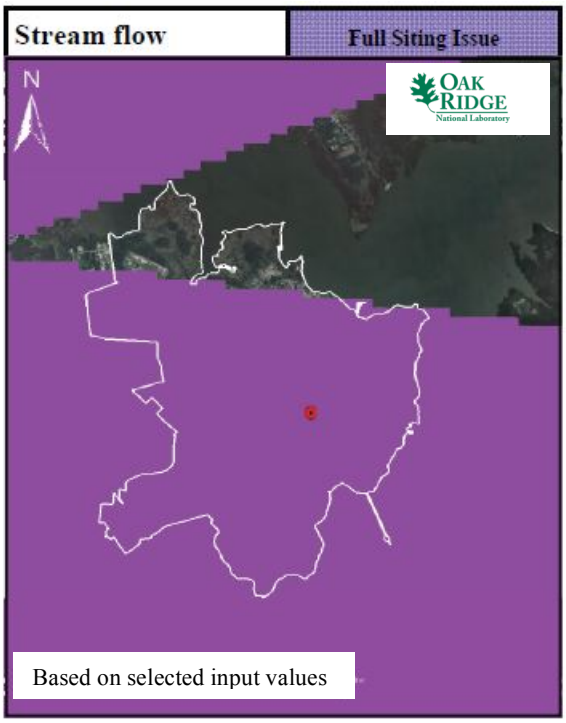
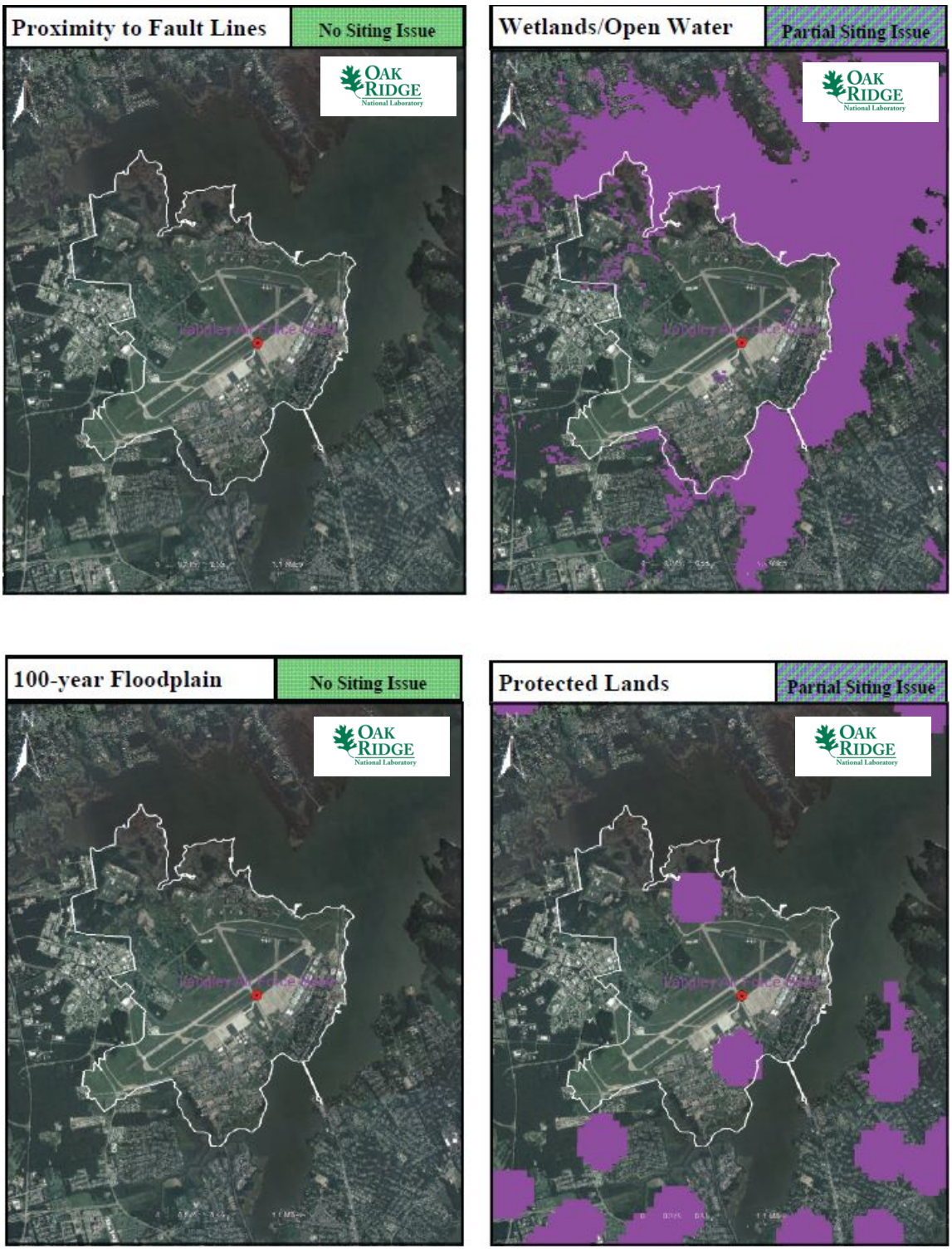


Fig. A.18. Langley Air Force Base composite map.



Langley Air Force Base



Langley Air Force Base

Langley Air Force Base

A.6.6 Site Evaluation

As shown in the maps above, the Langley Air Force Base site has a single screening issue. There is an indicated lack of fresh water makeup to support a closed cycle cooling water system for an iPWR. Given the site's proximity to the Back River, the Chesapeake Bay, and recycled water from population centers, there are clearly other cooling options for the site.

Table A.12 further indicates a partial siting issue for wetlands and open water. This results from the eastern edge of the base bordering the Back River and some resulting wetlands in the northern portion of the base. These do not appear to create a barrier to siting an iPWR at the site. In addition, a partial siting issue exists due to protected land within the site border. The southern dot of land is a buffer around the base hospital and the northern dot of land is a buffer around a satellite campus for Troy University. Neither of these buffered areas appears to create a barrier to siting an iPWR at the site.

The eastern circumference of the base is surrounded by branches of the Back River and the NASA Langley Research Center bonds the western border of the base. Both of these factors would limit population growth in the immediate vicinity of the base. As shown in Fig. 4, the site is within an area evaluated at 500 people per square mile within ten miles. However, the northern portion of the base is near the edge of the area evaluated at greater than 500 people per square mile within ten miles. The population is lighter in the immediate vicinity of the power station, as confirmed by Fig. 5.

Multiple transportation opportunities are favorable for iPWR construction. Easy access exists to the Chesapeake Bay and beyond. Interstate 64 would allow heavy haul delivery overland and nearby rail access would facilitate parts and equipment deliveries to the site. Finally, a sizable runway is available onsite.

Current military security at the site would limit access to the base property and add a layer of security to the required reactor facility security force.

The Langley Air Force Base site meets multiple conventional standards in the near term for consideration of siting an iPWR at the proposed location, but there may be longer-term issues that could potentially preclude this site from further iPWR siting consideration. Proximity to the centroid of the region of interest and transportation opportunities are favorable for the site. Alternatives to freshwater stream flow providing makeup water for a closed cycle cooling system will need to be identified. Only areas well off the axis of the base runway should be considered, which could be limiting.

A.7 LITTLE CREEK AMPHIBIOUS BASE (NAVAL AMPHIBIOUS BASE, LITTLE CREEK)

A.7.1 Location Detail

Little Creek Amphibious Base is located in the city of Virginia Beach, Virginia. As shown in Fig. A.19, the land is located at the mouth of Chesapeake Bay. Rail, barge, and interstate access are all readily available to the site.

- Location: Little Creek Amphibious Base
- Owner: Department of Defense (U.S. Navy)
- Coordinates: lat. 36.914547° N, long. 76.160708° W

Fig. A.19. Little Creek Amphibious Base location map.

A.7.2 Site Description and Status

Little Creek Amphibious Base was established during World War II by the Navy as an amphibious assault training base. It is currently used by the Navy as the major operating base for the Amphibious Forces in the Atlantic Fleet. The camp consists of more than 2,000 acres. As noted in Table A.13, there are no fault lines in the immediate vicinity and maximum earthquake ground acceleration is minimal. Adequate utility grid capacity for an iPWR facility is available within 5 miles. Sufficient fresh water makeup is available for a closed-cycle cooling system. Once-through cooling may also be available given

the proximity to the Chesapeake Bay and reprocessed (gray) water cooling may be an option given the proximity to population centers.

Little Creek Amphibious Base is roughly 35 miles from the Surry Nuclear Power Station (down the James River) and 8 miles from the Norfolk Naval Base in the central part of the region of interest (along the Chesapeake Bay), and 13 miles from the Chesapeake Power Station.

The permanent population within 1 mile of the camp is approximately 12,500 people, yielding a population density of approximately 4,000 people per square mile. The permanent population within 10 miles of the plant is approximately 1,240,000 people, yielding a population density of about 4,000 people per square mile. There is significant housing surrounding the base and a college is just east of the base.

Table A.13. Little Creek Amphibious Base site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Boundary	~ 3,300	> 400 MWe	~ 5 mi
1 mi of Site Boundary	~ 12,500	> 800 MWe	~ 13 mi
5 mi of Site Boundary	~ 315,000	> 1600 MWe	~ 31 mi
10 mi of Site Boundary	~ 1,240,000	> 3200 MWe	~ 190 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Poquoson, VA	> 50,000 gpm	~ 0.1 mi (Big Lost River)
> 50,000	Suffolk, VA	> 100,000 gpm	~ 0.1 mi (Big Lost River)
> 100,000	Norfolk, VA	> 200,000 gpm	~ 0.1 mi (Big Lost River)
> 500,000	Washington, DC	> 500,000 gpm	~ 0.1 mi (Big Lost River)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.05 g	Distance to Major Roadway	~ 1.3 mi (US 13)
Max Slope	~ 4%	Distance to Water Transport	~ 0.9 mi (Little River)
Nearest Fault Line	~ 1177 mi	Distance to Rail Transport	~ 0.9 mi (BCR)
Nearest Hazard Site	~ 2.5 mi (Airport—Norfolk Int'l)	Distance to Airport	~ 2.5 mi (Norfolk Int'l)

A.7.3 Aerial Imagery

The aerial imagery in Fig. A.20 indicates the base waterfront boundary and proximity to Norfolk International Airport.

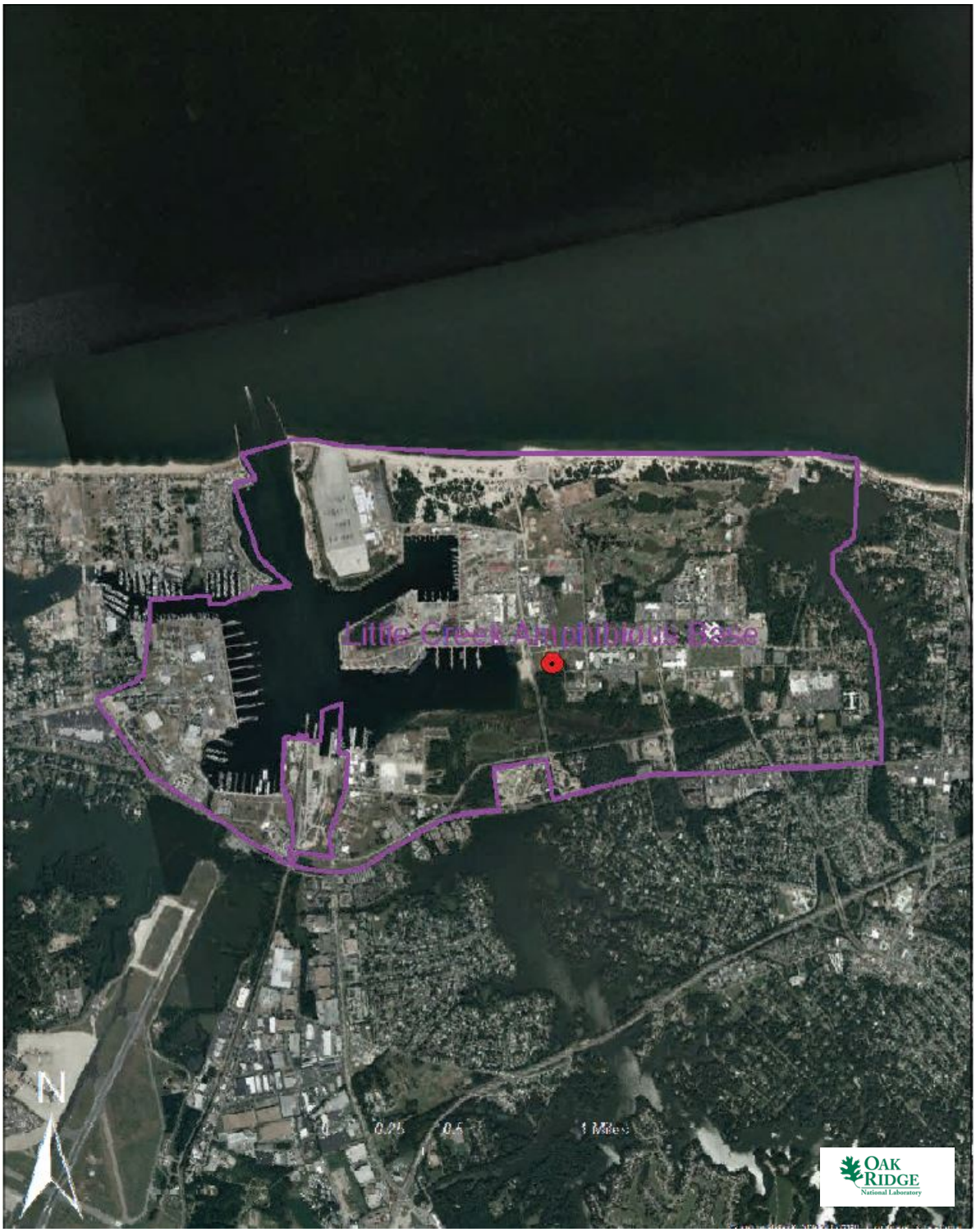
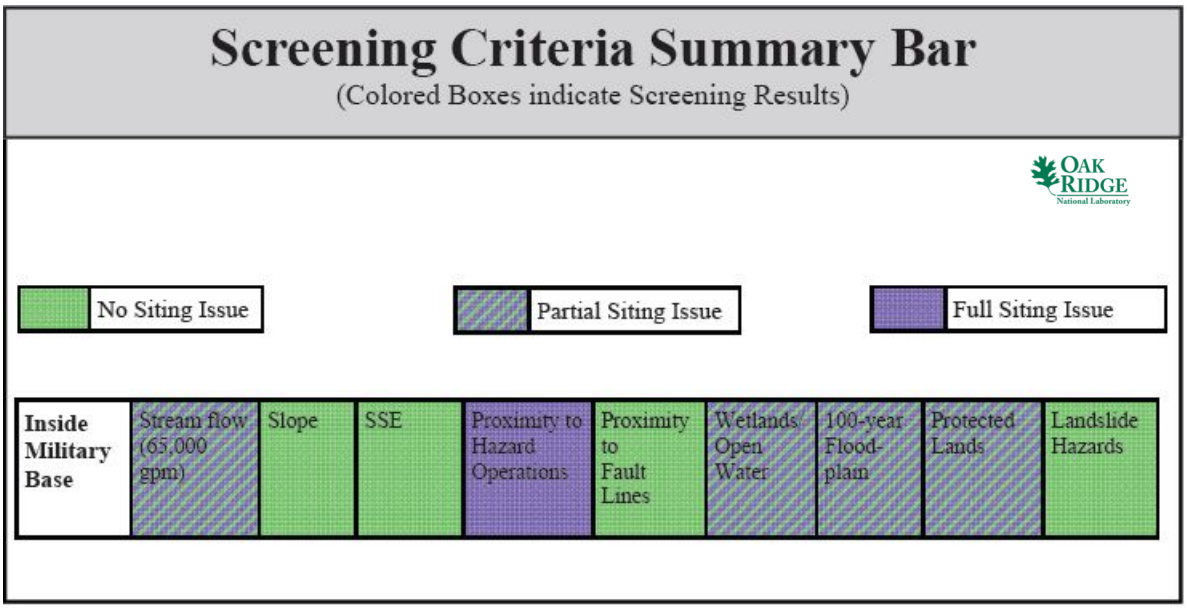


Fig. A.20. Satellite view of Little Creek Amphibious Base proximity.

A.7.4 Screening Criteria Overview

Table A.14. Little Creek Amphibious Base siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports—5 miles and oil refineries—1 mile)

A.7.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to Little Creek Amphibious Base is shown in Fig. A.21. As shown, (independent of population) half of the property outlined has only one siting issue, in this case the proximity to the Norfolk International Airport. The remainder of the site has one or two additional issues. Following this map are maps of the individual SMR siting criteria based on selected input values.

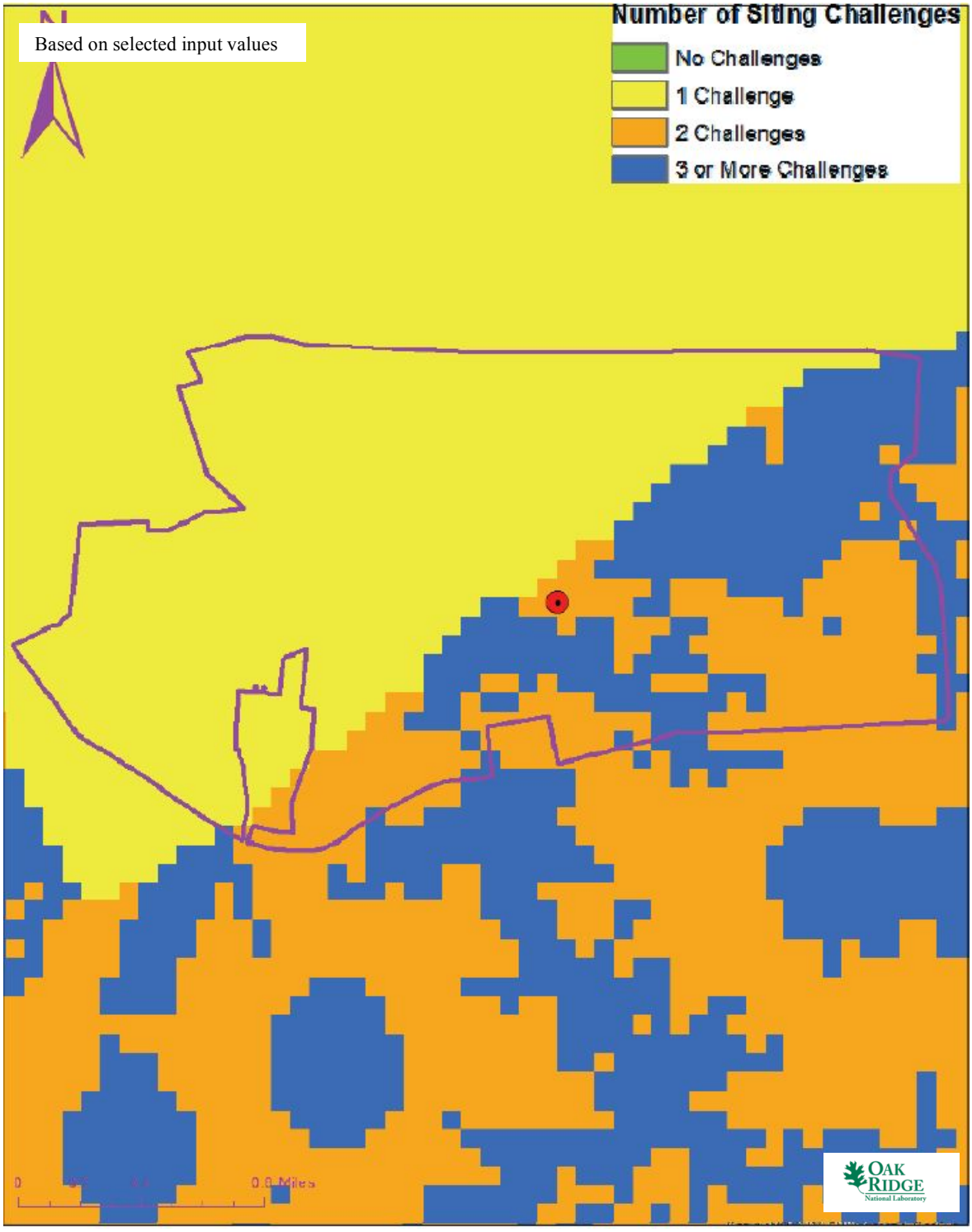


Fig. A.21. Little Creek Amphibious Base composite map.

Little Creek Amphibious Base

Little Creek Amphibious Base

Little Creek Amphibious Base

A.7.6 Site Evaluation

As shown in the maps above, the western portion of the Little Creek Amphibious Base has a single screening issue. The entire site is within 5 miles of the Norfolk International Airport. The main runway is perpendicular to the core of the base, which could be problematic.

Additionally, the eastern portion of the site has a lack of access to freshwater stream flow for closed-cycle cooling. However, this may be overcome by the use of brackish once-through cooling or gray water, given its proximity to high-population areas. There are numerous areas of wetlands and open water within the base boundary, which also leads to categorization within the 100-year flood plain; this is typical for waterfront sites. There is one area of unspecified protected land within the site boundary. However, it is only in the eastern half of the site. Overall, the site is heavily developed.

Multiple transportation opportunities are favorable for iPWR construction. The site has access to the Chesapeake Bay and beyond, and it is less than 2 miles from US Highway 13. A Bay Coast Railroad line is less than 1 mile from the site.

Current security at the site would limit access to the Little Creek Amphibious Base property and add a layer of security to the required reactor facility security force.

The Little Creek Amphibious Base site is not a likely candidate for consideration of siting an iPWR. Rail and barge access onsite make the base desirable. However, the alignment of nearby runways and the number of dwellings immediately adjacent to the fort are negative factors. In addition, the site is heavily developed, with little area to exploit for the installation of an iPWR.

A.8 NORFOLK NAVAL BASE (NAVAL STATION NORFOLK)

A.8.1 Location Detail

Norfolk Naval Base is located in the city of Norfolk, Virginia. As shown in Fig. A.22, the site is located between the mouth of the James River and Interstate 64. Rail, barge, and interstate access are all readily available to the site.

- Location: Norfolk Naval Base
- Owner: U.S. Navy
- Coordinates: lat. 36.943711° N, long. 76.298583° W

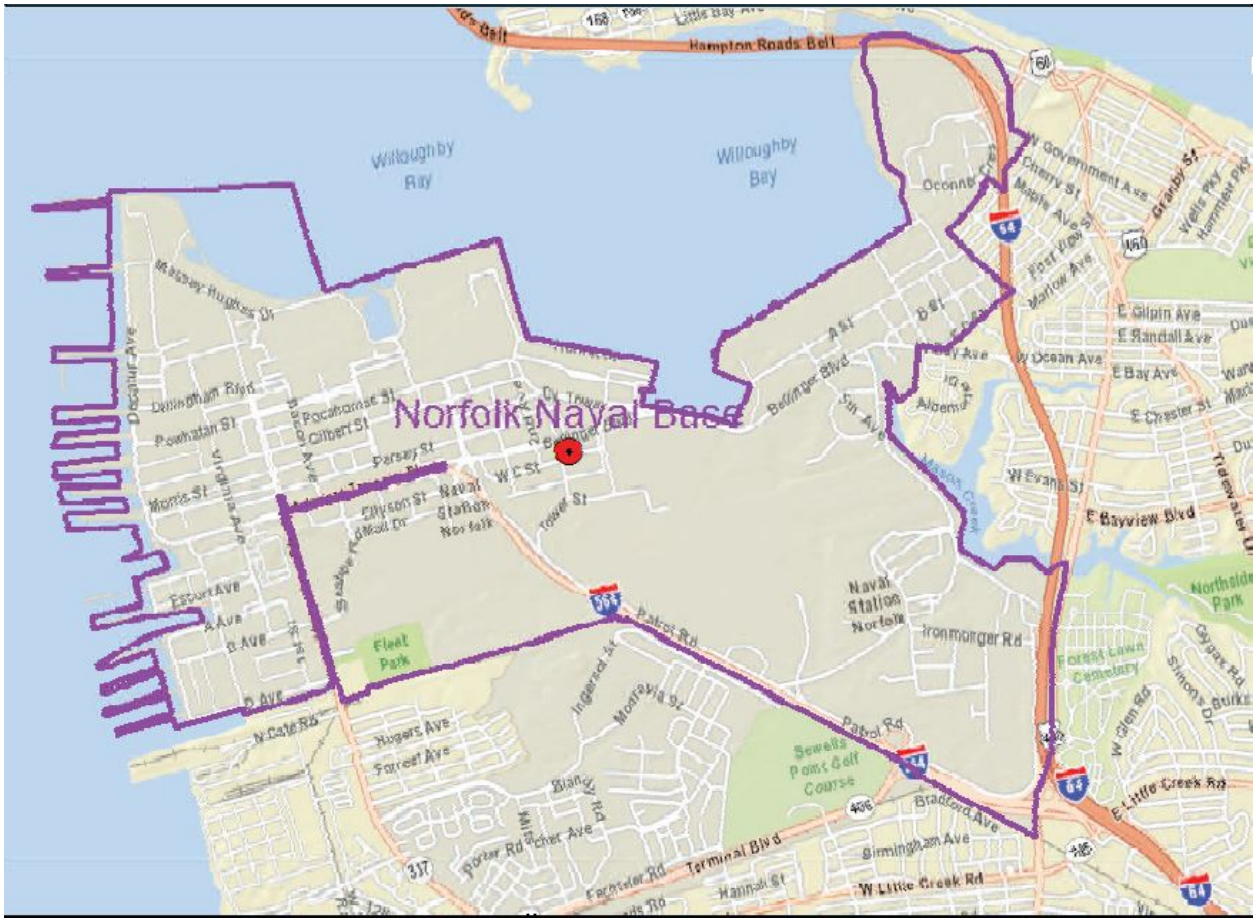


Fig. A.22. Norfolk Naval Base location map.

A.8.2 Site Description and Status

Norfolk Naval Base was established near the end of World War I by the Navy as a combined training center, air station, hospital, and submarine station. Its primary mission is Atlantic Fleet support. The camp consists of about 3400 acres on Sewells Point, and is the world's largest naval station.

As noted in Table A.15, there are no fault lines in the immediate vicinity and maximum earthquake ground acceleration is minimal. Adequate utility grid capacity for an iPWR facility is available within 6 miles. Sufficient fresh water makeup is available for a closed-cycle cooling system. Once-through cooling

may also be available given the proximity to the Chesapeake Bay and reprocessed (gray) water cooling may be an option given the proximity to population centers.

Norfolk Naval Base is roughly 26 miles from the Surry Nuclear Power Station (down the James River) and 12 miles from the Chesapeake Power Station (down the Elizabeth River).

The permanent population within 1 mile of the camp is approximately 20,000 people, yielding a population density of approximately 6,400 people per square mile. The permanent population within 10 miles of the plant is approximately 1,200,000 people, yielding a population density of about 3,800 people per square mile.

Table A.15. Norfolk Naval Base site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Boundary	~ 7,100	> 400 MWe	~ 6 mi
1 mi of Site Boundary	~ 20,000	> 800 MWe	~ 9 mi
5 mi of Site Boundary	~ 290,000	> 1600 MWe	~ 23 mi
10 mi of Site Boundary	~ 1,200,000	> 3200 MWe	~ 183 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Poquoson, VA	> 50,000 gpm	~ 1.3mi (Willoughby Bay)
> 50,000	Suffolk, VA	> 100,000 gpm	~ 1.3mi (Willoughby Bay)
> 100,000	Hampton, VA	> 200,000 gpm	~ 1.3mi (Willoughby Bay)
> 500,000	Washington, DC	> 500,000 gpm	~ 1.3mi (Willoughby Bay)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.2 g	Distance to Major Roadway	~ 1.5 mi (I-64)
Max Slope	~ 11%	Distance to Water Transport	~ 1.3 mi (Willoughby Bay)
Nearest Fault Line	~ 1170 mi	Distance to Rail Transport	~ 0.7 mi (NS)
Nearest Hazard Site	~ 6 mi (Airport—Norfolk Int'l)	Distance to Airport	~ 6 mi (Norfolk Int'l)

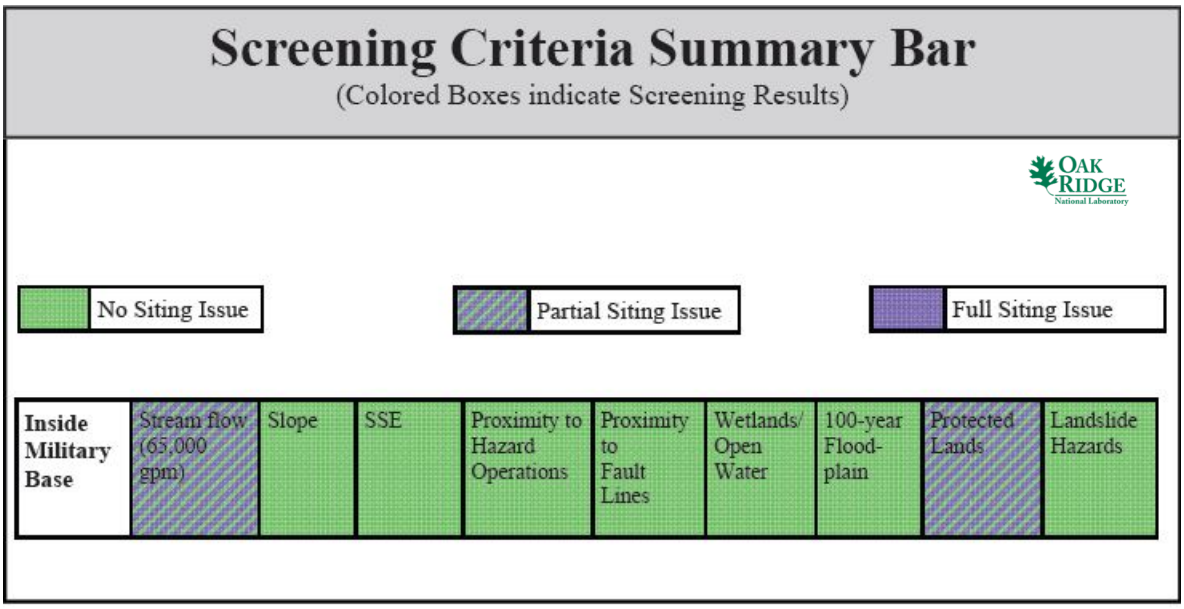
A.8.3 Aerial Imagery

The aerial imagery in Fig. A.23 shows the metropolitan area outside the Norfolk Naval Base boundary. The city of Norfolk, VA, is immediately south of the boundary of the image.

Fig. A.23. Satellite view of Norfolk Naval Base proximity.

A.8.4 Screening Criteria Overview

Table A.16. Norfolk Naval Base siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports—5 miles and oil refineries—1 mile)

A.8.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to Norfolk Naval Base is shown in Fig. A.24. As shown, (independent of population) the pier area of the base is immediately favorable for siting an iPWR. Following this map are maps of the individual SMR siting criteria based on selected input values.

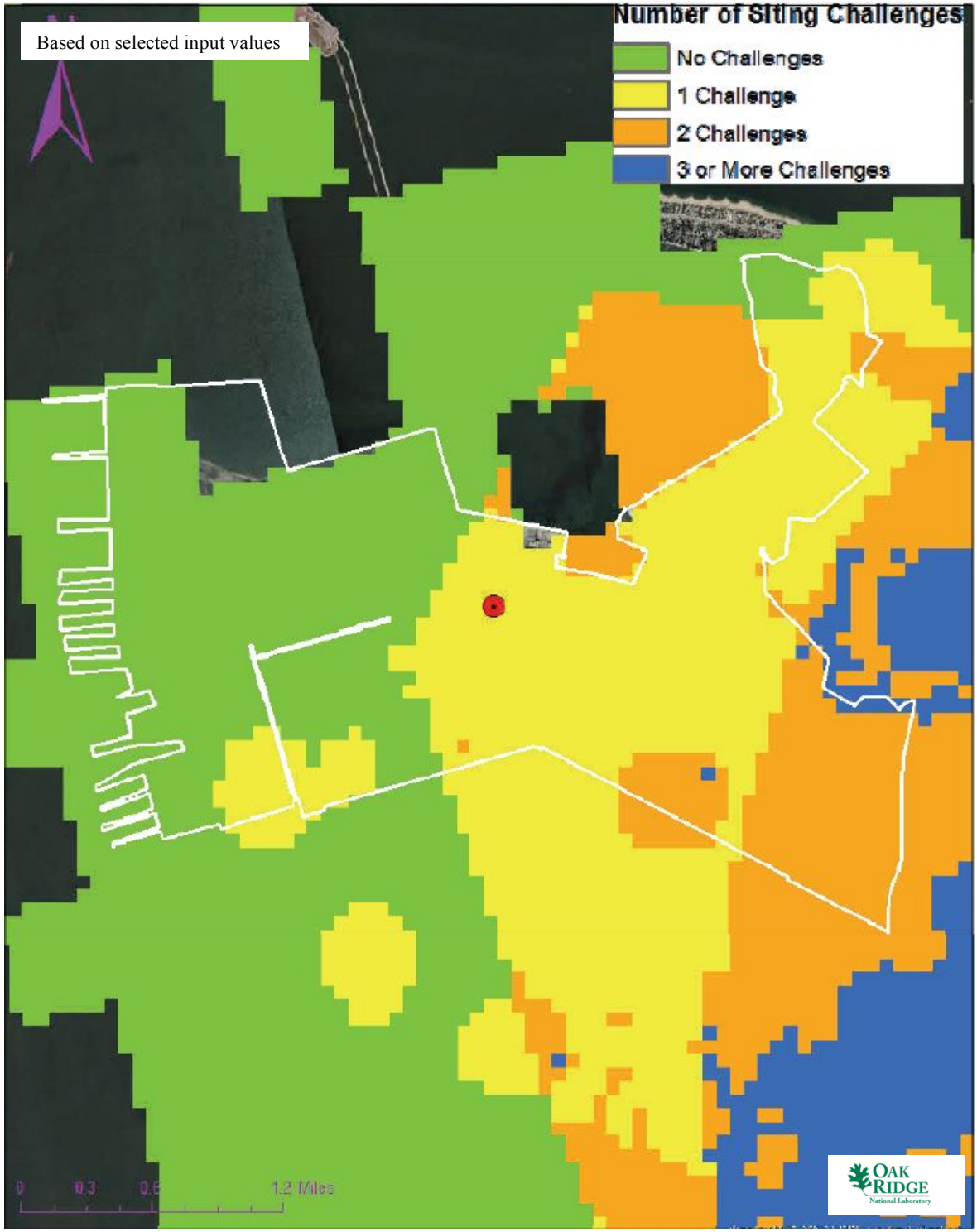


Fig. A.24. Norfolk Naval Base composite map.

Norfolk Naval Base

Norfolk Naval Base

Norfolk Naval Base

A.8.6 Site Evaluation

As shown in the maps above, the western portion of the Norfolk Naval Base site is predominantly favorable for siting an iPWR. The eastern portion of the site has an issue with stream flow, but its proximity to Chesapeake Bay and high-population areas may provide an opportunity for once-through cooling or gray water cooling.

There are some protected lands within the perimeter of the site. These are schools and unspecified federal lands. However, these lands are predominantly along the southern border. Overall, the site is heavily developed, including significant housing areas. As shown in Fig. 4, the site is on the edge of an area evaluated at 500 people per square mile within ten miles. In addition, Fig. 5 confirms that population is lighter in the immediate vicinity of the base.

Multiple transportation opportunities are favorable for iPWR construction. The site has access to the Chesapeake Bay. Interstate 64 is less than 2 miles away. A Norfolk Southern rail line is less than 1 mile away. Finally, the site is less than 6 miles from Norfolk International Airport. A runway also exists on the base.

Current security at the site would limit access to the Norfolk Naval Base property and add a layer of security to the required reactor facility security force.

Overall, the Norfolk Naval Base site meets multiple conventional standards in the near term for consideration of siting an iPWR at the proposed location, but there may be longer-term issues that could potentially preclude this site from further iPWR siting consideration. Identifying a 50-acre area away from the runway and base housing may prove difficult, given the amount of development on the base.

A.9 SURRY NUCLEAR POWER STATION

A.9.1 Location Detail

The Surry Nuclear Power Station is located in Surry County, Virginia. As shown in Fig. A.25, the site is located on the southern bank of the James River due south of Colonial Williamsburg. The station center is approximately 7 miles south of Colonial Williamsburg. Barge access is readily available to the site. Rail access is within 4 miles.

- Location: Surrey Nuclear Power Station
- Owner: Dominion Resources
- Coordinates: lat. 37.157739° N, long. 76.685608° W

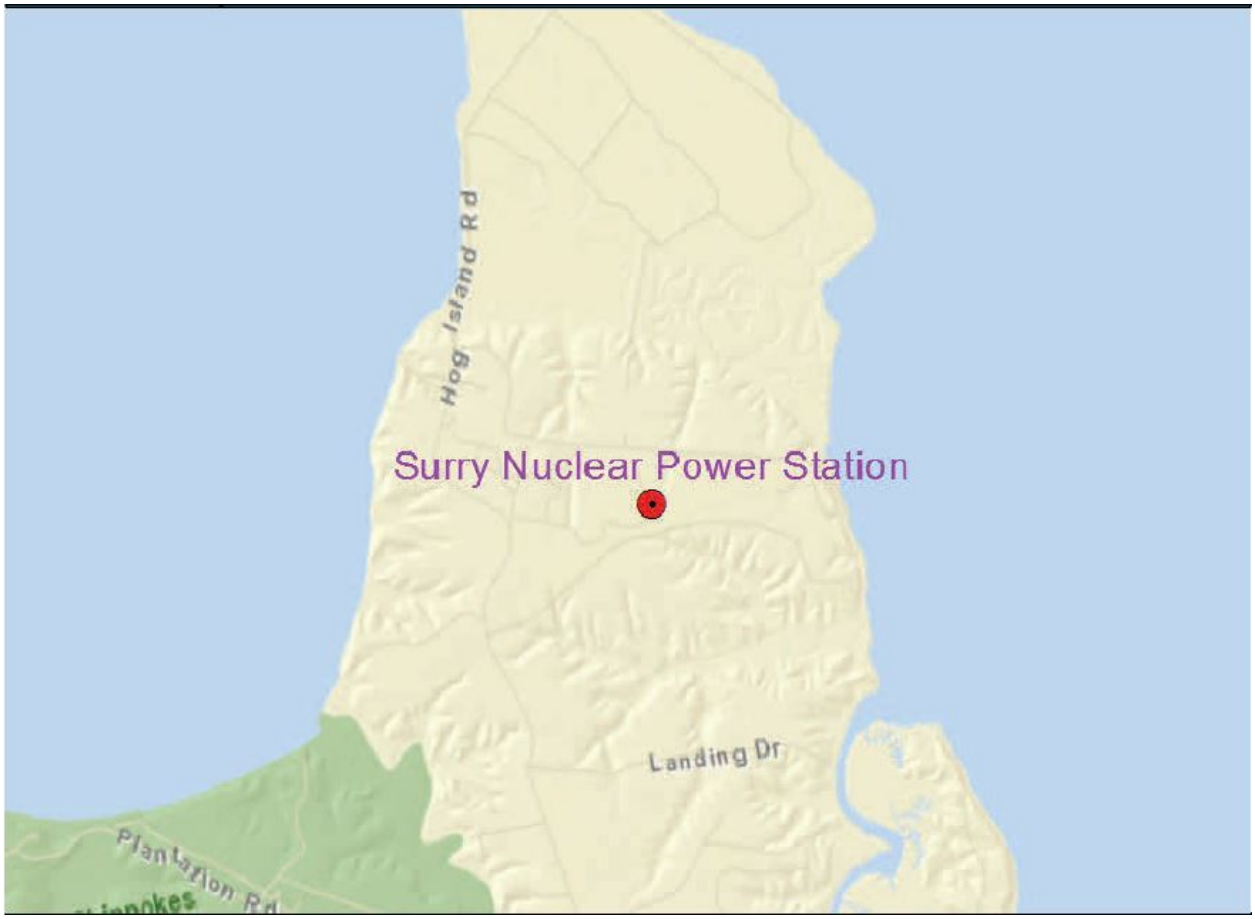


Fig. A.25. Surry Nuclear Power Station location map.

A.9.2 Site Description and Status

The Surry Nuclear Power Station generates 1676 MWe from two pressurized water reactors. Unit 1 was commissioned in 1972 and unit 2 was commissioned in 1973. The plant resides on approximately 1000 acres, though Dominion Resources has access to an additional 750 acres adjacent to the Surry site.

As noted in Table A.17, there are no fault lines in the immediate vicinity and maximum earthquake ground acceleration is minimal. The land is reasonably flat. Adequate utility grid capacity for an iPWR

facility is available onsite. Sufficient fresh water makeup from the James River is available for a closed-cycle cooling system. The existing Surry plants use once-through cooling.

The station is roughly 25 miles northwest of the Norfolk Naval Base in the central part of the region of interest.

The permanent population within 1 mile of the camp is approximately 1,300 people, yielding a population density of approximately 400 people per square mile. The permanent population within 10 miles of the plant is approximately 315,000 people, yielding a population density of about 1,000 people per square mile. The peninsula of land occupied by the Surry Nuclear Power Station is largely undeveloped and contains limited housing.

Table A.17. Surry Nuclear Power Station site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Boundary	~ 500	> 400 MWe	~ 1.0mi
1 mi of Site Boundary	~ 1,300	> 800 MWe	~ 0.1 mi
5 mi of Site Boundary	~ 47,000	> 1600 MWe	~ 1.0 mi
10 mi of Site Boundary	~ 315,000	> 3200 MWe	~ 165 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Williamsburg, VA	> 50,000 gpm	~ 1.8 mi (James River)
> 50,000	Suffolk, VA	> 100,000 gpm	~ 1.8 mi (James River)
> 100,000	Newport News, VA	> 200,000 gpm	~ 1.8 mi (James River)
> 500,000	Washington, DC	> 500,000 gpm	~ 1.8 mi (James River)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.2 g	Distance to Major Roadway	~ 4.1 mi (SR 10)
Max Slope	~ 4%	Distance to Water Transport	~ 1.8 mi (James River)
Nearest Fault Line	~ 1150 mi	Distance to Rail Transport	~ 3.7 mi (USG)
Nearest Hazard Site	~ 10.2 mi (Airport—Williamsburg Int'l)	Distance to Airport	~ 10.2 mi (Williamsburg Int'l)

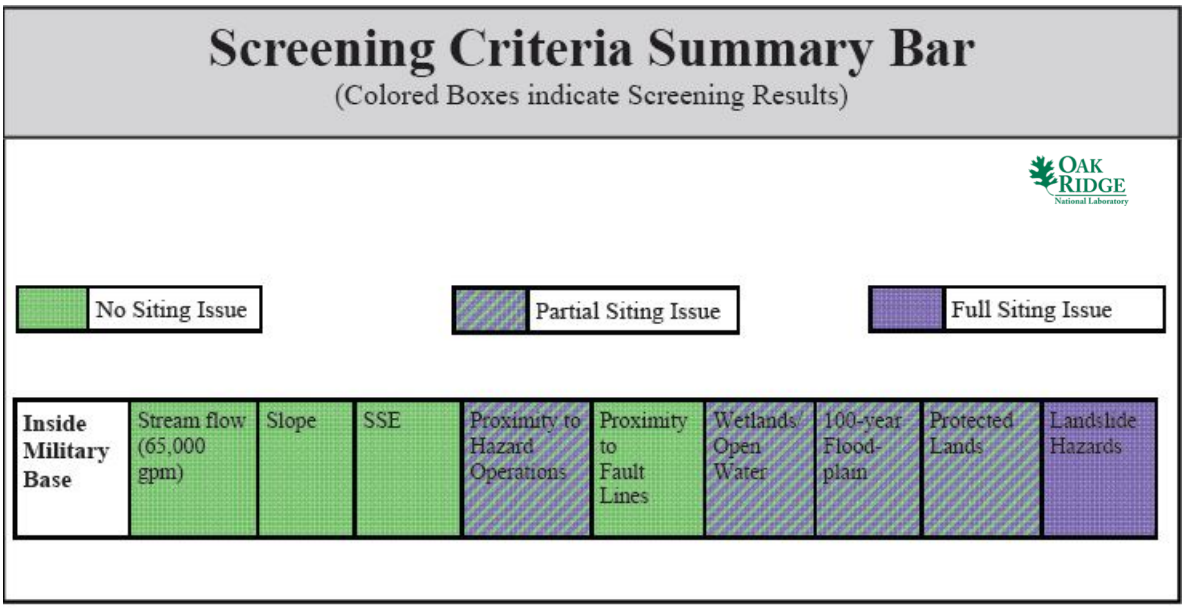
A.9.3 Aerial Imagery

The aerial imagery in Fig. A.26 indicates abundant open space near and within the plant boundary.

Fig. A.26. Satellite view of Surry Nuclear Power Station proximity.

A.9.4 Screening Criteria Overview

Table A.18. Surry Nuclear Power Station siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports—5 miles and oil refineries—1 mile)

A.9.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to the Surry Nuclear Power Station is shown in Fig. A.27. As shown, (independent of population) most of the property has a single screening issue for siting an iPWR. Following this map are maps of the individual SMR siting criteria based on selected input values.

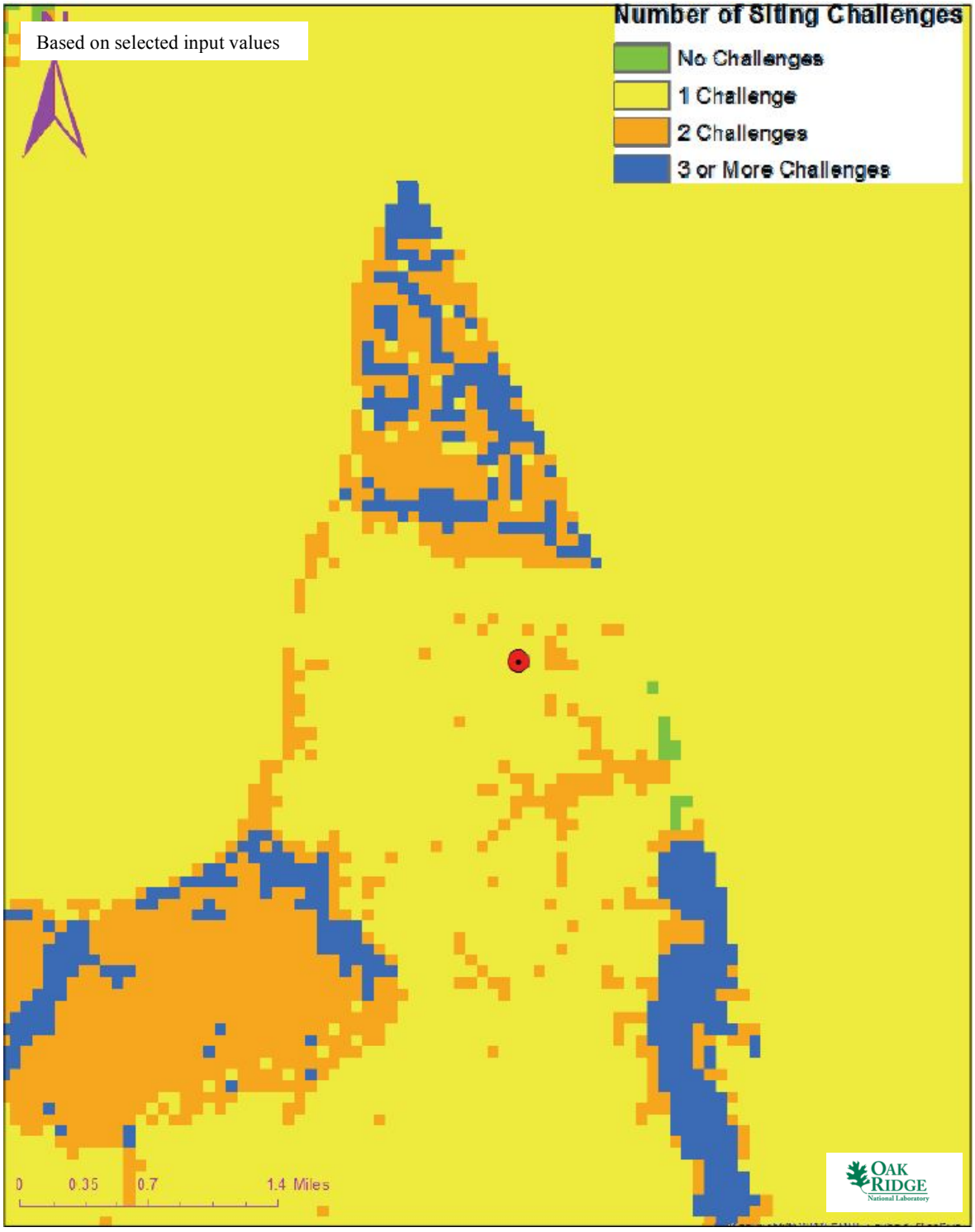
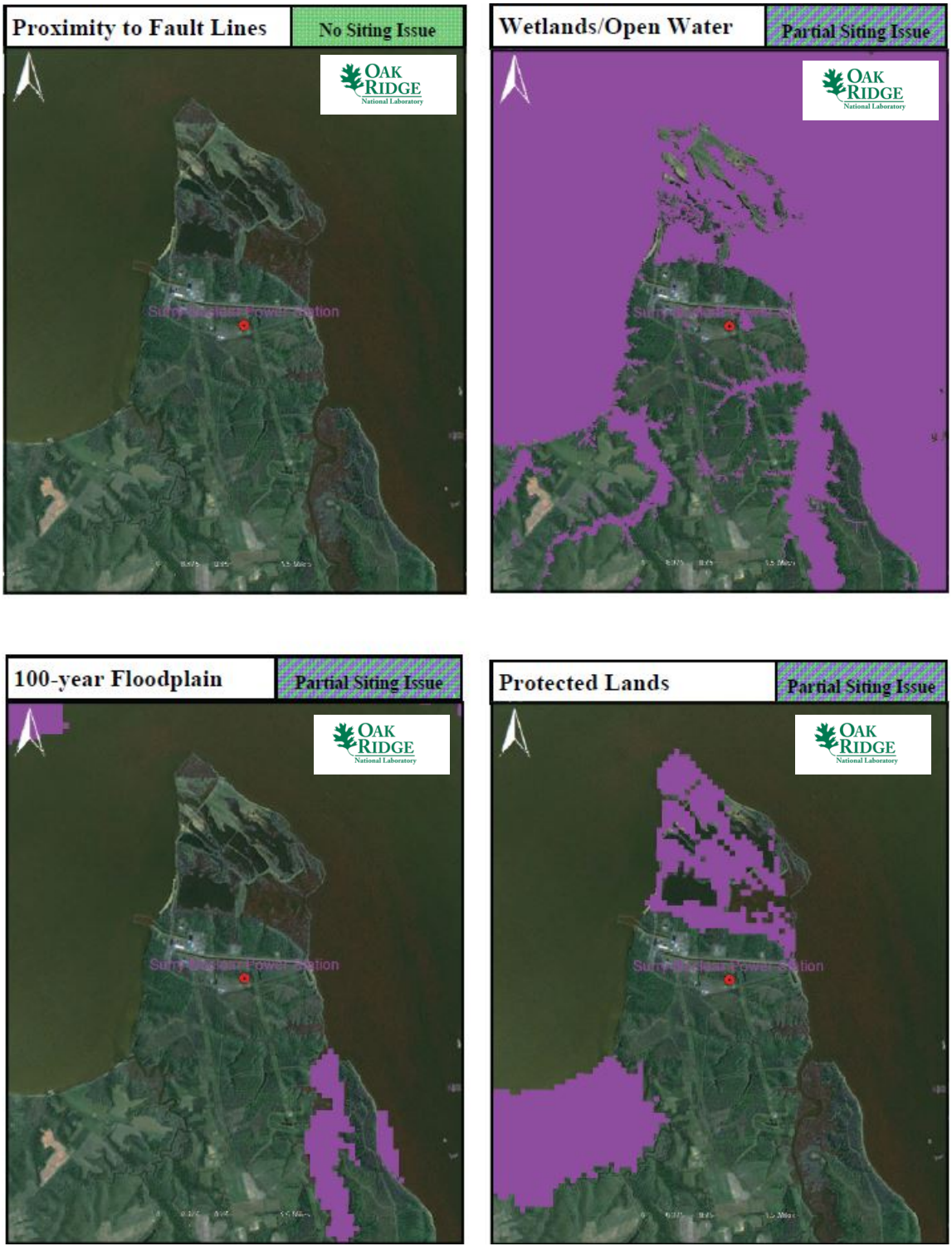


Fig. A.27. Surry Nuclear Power Station composite map.

Surry Nuclear Power Station



Surry Nuclear Power Station

Surry Nuclear Power Station

A.9.6 Site Evaluation

As shown in the maps above, the peninsula occupied by the Surry Nuclear Power Station has a single screening issue. There is a moderate to high probability for a landslide hazard on the peninsula. Landslide hazards, including sink holes, are based on a probabilistic evaluation by the USGS and not on site-specific geological analyses. Given that Dominion Resources performed due diligence for the Surry site in the initial environmental analysis of the area and that the Surry site has been occupied and in operation since the early 1970s without incidence of landslides, this does not appear to be a factor limiting further use of the site.

The proximity to hazard areas shown above surrounding the peninsula are attributed to mapping edge effects. This occurs when specific GIS data is not available for these map coordinates. There is no known hazard typically mapped by the OR-SAGE process affecting this site. The tip of the peninsula is protected and designated as the Hog Island State Waterfowl Refuge. In addition, the Surry County Chippokes Plantation State Park is just south of the Surry plant.

Table A.18 further indicates a partial siting issue for wetlands and open water. There are numerous streams flowing through the site and bordering the site, especially in the Hog Island refuge. These do not appear to create a barrier to siting an iPWR at the site. The land controlled by Dominion Resources is south of this area. A partial issue for the 100-year floodplain is also identified. However, areas designated in the floodplain are well away from the plant property.

The James River, parkland, and largely undeveloped rural land surround the plant boundary. These areas are not likely to be developed much further in the future. Therefore, the potential for population growth in the immediate vicinity of the plant property is limited. Furthermore, there is ongoing power production from current nuclear units onsite, so opposition to additional units may not be strong. As shown in Fig. 4 and Fig. 5, the site is well outside an area evaluated at 500 people per square mile within ten miles.

Multiple transportation opportunities are favorable for iPWR construction. The plant site has barge access on the James River with access to the Chesapeake Bay and beyond. Heavy haul delivery is a little more limited to local state roads. However, State Road 10 is within 4 miles. Likewise, rail access is roughly 4 miles from the site.

Support logistics, including security, would be available from the existing power station. Overall, the Surry Nuclear Power Station site meets multiple conventional standards for consideration of siting an iPWR at the proposed location. There are no current or near-term foreseeable SMR SSEC siting issues that should preclude this site from further iPWR siting consideration.

A.10 YORKTOWN NAVAL WEAPONS STATION

A.10.1 Location Detail

The Yorktown Naval Weapons Station is located principally in York County, Virginia. As shown in Fig. A.28, the site is located between the York River, the Colonial Parkway, and Interstate 64. The station center is approximately 6.75 miles southeast of Colonial Williamsburg. Rail, barge, and interstate access are all readily available to the site. A helipad is also available on the site.

- Location: Yorktown Naval Weapons Station
- Owner: U.S. Navy
- Coordinates: lat. 37.243503° N, long. 76.572433° W

Fig. A.28. Yorktown Naval Weapons Station location map.

A.10.2 Site Description and Status

The Yorktown Naval Weapons Station and Cheatham Annex accommodate 25 resident commands. The main area of the base has been in the possession of the Navy since 1943. The station, including the Cheatham Annex consists of more than 13,000 acres; much of which is in a natural state. As noted in Table A.19, there are no fault lines in the immediate vicinity and maximum earthquake ground acceleration is minimal. The land is reasonably flat. Adequate utility grid capacity for an iPWR facility is available onsite. Sufficient fresh water makeup is available for a closed-cycle cooling system. Once-

through cooling may also be available given the proximity to the York River and the Chesapeake Bay and reprocessed (gray) water cooling may be an option given the proximity to population centers.

The station is roughly 8 miles from the Surry Nuclear Power Station (across the York River) and 25 miles from the Norfolk Naval Base in the central part of the region of interest.

The permanent population within 1 mile of the camp is approximately 2000 people, yielding a population density of approximately 600 people per square mile. The permanent population within 10 miles of the plant is approximately 360,500 people, yielding a population density of about 1,150 people per square mile. There is some single family housing on the western border of the station property, but otherwise, there appears to be limited housing in the area. Only 457 housing units are available on the station property. There is also a waterpark and shopping center to the west of the property. Parkland associated with the Yorktown battlefield and the Newport News park system exists to the southeast of the station property.

Table A.19. Yorktown Naval Weapons Station site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Boundary	~ 550	> 400 MWe	~ 0.1 mi
1 mi of Site Boundary	~ 2,000	> 800 MWe	~ 8 mi
5 mi of Site Boundary	~ 74,000	> 1600 MWe	~ 8 mi
10 mi of Site Boundary	~ 360,500	> 3200 MWe	~ 171 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Gloucester Point, VA	> 50,000 gpm	~ 2.1 mi (King Creek)
> 50,000	Suffolk, VA	> 100,000 gpm	~ 2.1 mi (King Creek)
> 100,000	Hampton, VA	> 200,000 gpm	~ 2.1 mi (King Creek)
> 500,000	Washington, DC	> 500,000 gpm	~ 2.1 mi (King Creek)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.2 g	Distance to Major Roadway	~ 2.1 mi (I-64)
Max Slope	~ 4%	Distance to Water Transport	~ 2.1 mi (King Creek)
Nearest Fault Line	~ 1155 mi	Distance to Rail Transport	~ 2.4 mi (CSXT)
Nearest Hazard Site	~ 6.6 mi (Refinery — Giant Yorktown Refining)	Distance to Airport	~ 8.3 mi (Williamsburg Int'l)

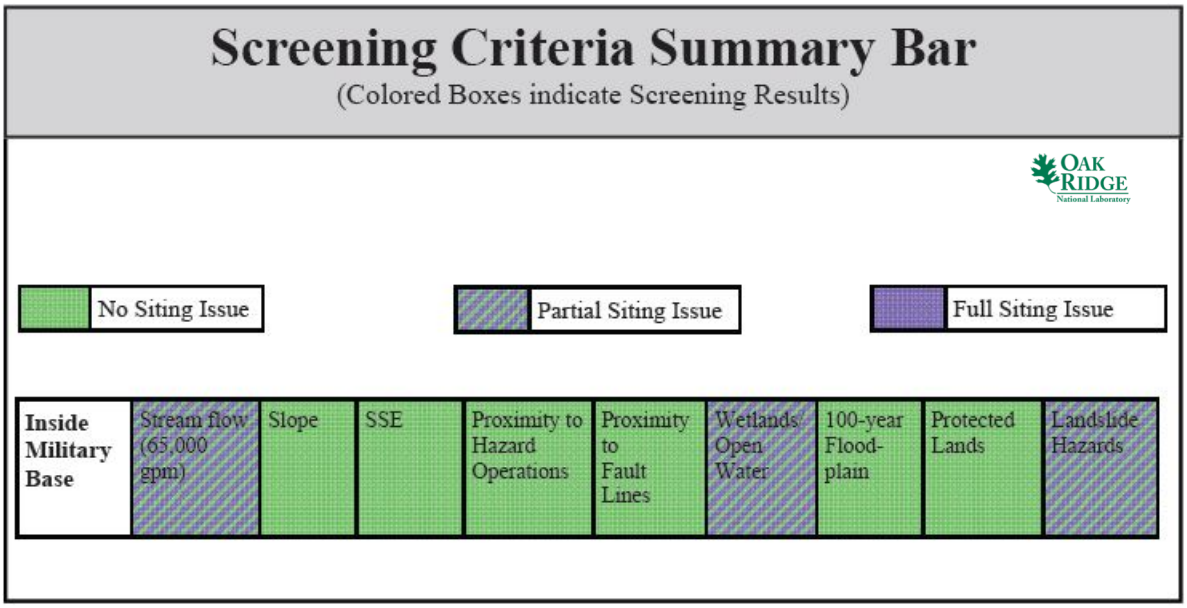
A.10.3 Aerial Imagery

The aerial imagery in Fig. A.29 indicates abundant open space near and within the weapons station boundary.

Fig. A.29. Satellite view of Yorktown Naval Weapons Station proximity.

A.10.4 Screening Criteria Overview

Table A.20.Yorktown Naval Weapons Station siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports—5 miles and oil refineries—1 mile)

A.10.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to the Yorktown Naval Weapons Station is shown in Fig. A.30. As shown, (independent of population) half of the property outlined is immediately favorable for siting an iPWR. Following this map are maps of the individual SMR siting criteria based on selected input values.

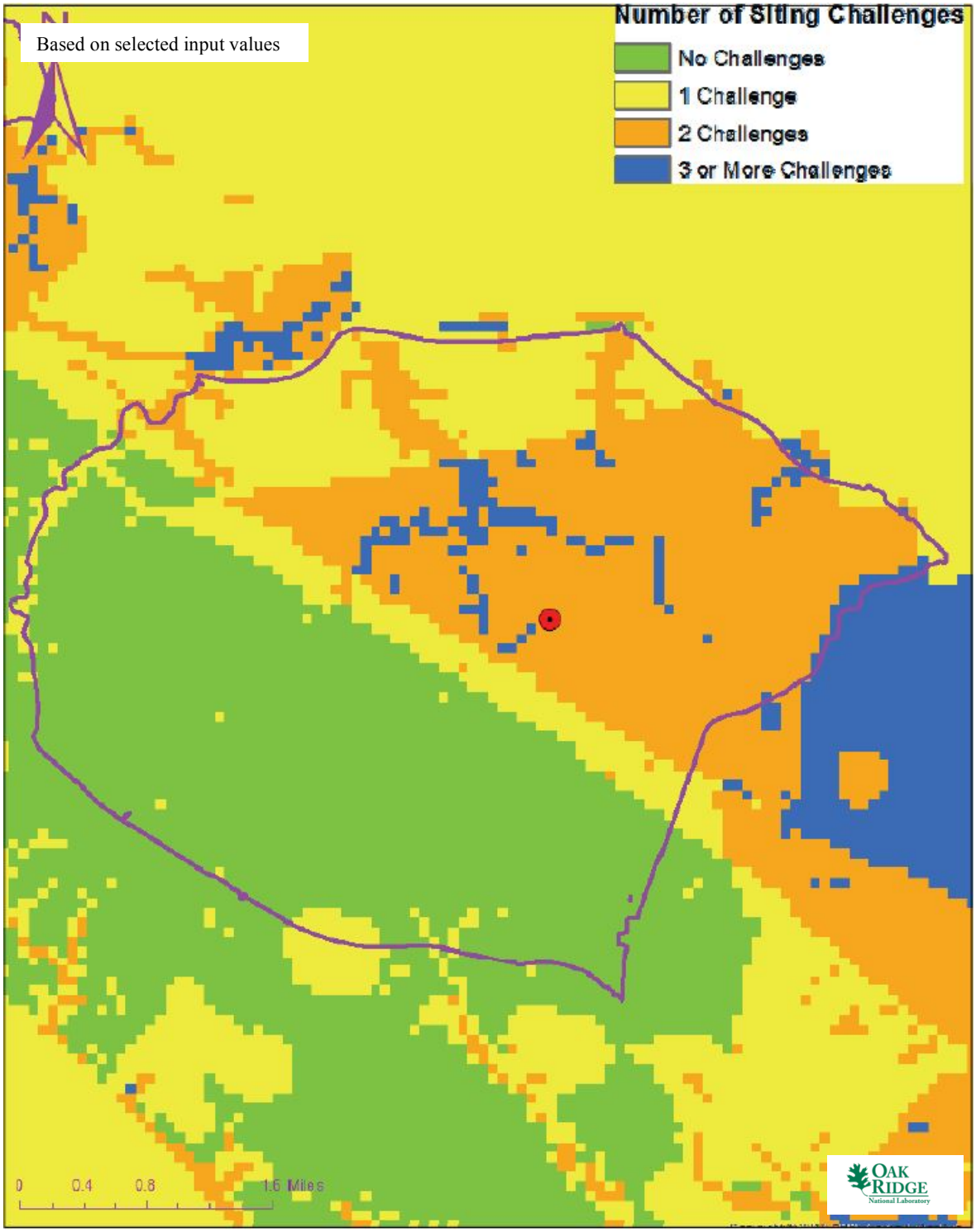
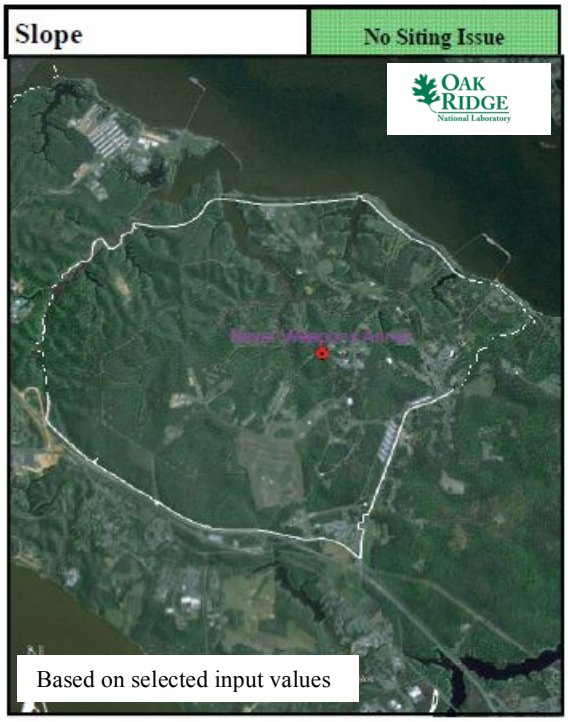
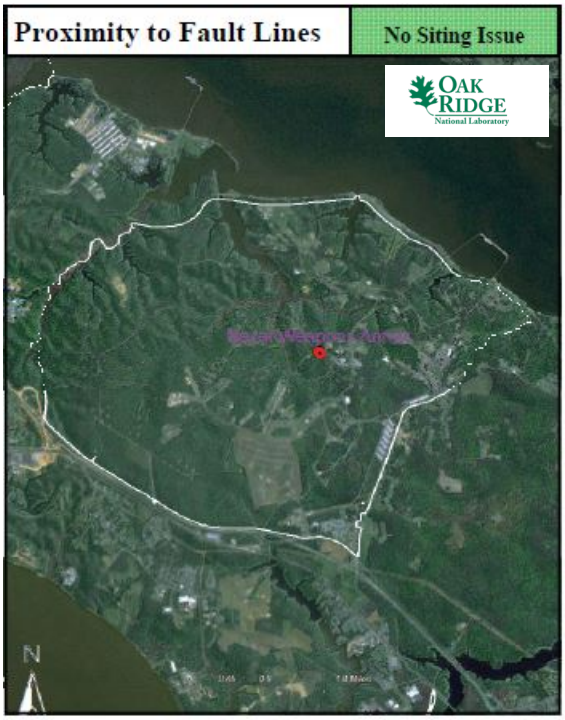


Fig. A.30. Yorktown Naval Weapons Station composite map.



Yorktown Naval Weapons Station



Yorktown Naval Weapons Station

Yorktown Naval Weapons Station

A.10.6 Site Evaluation

As shown in the maps above, the southern portion of the Yorktown Naval Weapons Station site is favorable for siting an iPWR. The northern portion of the site has a moderate to high probability for a landslide hazard (along the shore of the York River). Landslide hazards, including sink holes, are based on a probabilistic evaluation by the USGS. Therefore, the northern section of the site may also be favorable for siting an iPWR, pending further onsite geological evaluation. A wedge of land in the northern portion of the station is also noted for a lack of proximity to freshwater makeup for a closed-cycle cooling water system. Other forms of cooling could easily negate this issue in this area, including once-through cooling from the York River, gray water cooling, or dry cooling.

Table A.20 further indicates a partial siting issue for wetlands and open water. There are numerous streams flowing through the site and bordering the site. These do not appear to create a barrier to siting an iPWR at the site.

There are government lands, public parks and green space recreation areas on two of the three land-based sides of the camp. These include Queens Creek and the Cheatham Naval Supply Center to the northwest and the Yorktown battlefield area to the southeast. Across Interstate 64 to the southwest, there are some housing subdivisions. However, much of this areas is contains green space associated with a plantation, golf course, water reprocessing facility, and a jail facility. In addition, there are several large distribution warehouse facilities. These areas are not likely to be developed much further in the future. The Colonial National Historic parkway and the York River bound the remaining edge of the property. Therefore, the potential for population growth in the immediate vicinity of the camp property is limited. As shown in Fig. 4, the site is at the outside edge an area evaluated at 500 people per square mile within ten miles. However, Fig. 5 shows that population is light in the immediate vicinity of the base.

Multiple transportation opportunities are favorable for iPWR construction. The weapons station has a deep draft pier on the York River with access to the Chesapeake Bay and beyond. Interstate 64 would

allow heavy haul delivery overland. A rail line parallels Interstate 64 further west and at one time. Finally, a helipad is available onsite and a short runway is available at nearby Camp Peary.

Current military security at the site would limit access to the Yorktown Naval Weapons Station property and add a layer of security to the required reactor facility security force.

Overall, the Yorktown Naval Weapons Station site meets multiple conventional standards for consideration of siting an iPWR at the proposed location. There are no current or near-term foreseeable SMR SSEC siting issues that should preclude this site from further iPWR siting consideration.

A.11 YORKTOWN POWER STATION

A.11.1 Location Detail

The Yorktown Power Station is located within Yorktown, Virginia. As shown in Fig. A.31, the site is located on the south shore of the York River near the Yorktown battlefields. The plant is approximately 13 miles southeast of Colonial Williamsburg. Rail, barge, and interstate access are all readily available to the site.

- Location: Yorktown Power Station
- Owner: Dominion Resources
- Coordinates: lat. 37.213064° N, long. 76.460467° W

Fig. A.31. Yorktown Power Station location map.

A.11.2 Site Description and Status

The Yorktown Power Station is a three-unit plant; two units burn coal and the third unit burns oil. The total site capacity is 1141 MWe. The coal units are designated as Unit 1 and Unit 2; consuming 2,200 tons of coal per day. Unit 1, commissioned in 1957, is rated at 159 MWe and Unit 2, commissioned in 1958, is rated at 164 MWe. Unit 3, commissioned in 1974, is rated at 818 MWe and consumes 20,000 barrels of oil per day. Unit 1 and Unit 2 are scheduled for closure by 2015. The units are cooled by once-through cooling from the adjacent York River.

The property is immediately adjacent to a shutdown oil refinery. Numerous oil tanks dot this property, but there may be some opportunity to acquire this brownfield site to utilize the electricity infrastructure at the Yorktown Power Station. The power plant is estimated to sit on 250 acres.

The station is roughly 13.5 miles east of the Surry Nuclear Power Station (across the James River) and 20 miles northwest of the Norfolk Naval Base in the central part of the region of interest.

As noted in Table A.21, there are no fault lines in the immediate vicinity and maximum earthquake ground acceleration is minimal. The land is reasonably flat. Adequate utility grid capacity for an iPWR facility is available onsite.

Population very close to the site is almost non-existent. The permanent population within 1 mile of the camp is approximately 3,000 people, yielding a population density of approximately 950 people per square mile. The permanent population within 10 miles of the plant is approximately 440,000 people, yielding a population density of about 1,400 people per square mile. The oil refinery and a water reprocessing plant are the immediate plant neighbors, with substantial green fields around this combined industrial complex. The unincorporated community of Seaford is nearby, including an elementary school.

Table A.21. Yorktown Power Station site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Boundary	~ 0	> 400 MWe	~ 0.1 mi
1 mi of Site Boundary	~ 3,000	> 800 MWe	~ 12 mi
5 mi of Site Boundary	~ 86,000	> 1600 MWe	~ 13 mi
10 mi of Site Boundary	~ 440,000	> 3200 MWe	~ 177 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Gloucester Point, VA	> 50,000 gpm	~ 0.5mi (Wormley Creek)
> 50,000	Suffolk, VA	> 100,000 gpm	~ 0.5mi (Wormley Creek)
> 100,000	Hampton, VA	> 200,000 gpm	~ 0.5mi (Wormley Creek)
> 500,000	Washington, DC	> 500,000 gpm	~ 0.5mi (Wormley Creek)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.2 g	Distance to Major Roadway	~ 1.9 mi (US 17)
Max Slope	~ 4%	Distance to Water Transport	~ 0.5 mi (Wormley Creek)
Nearest Fault Line	~ 1161 mi	Distance to Rail Transport	~ 0.3 mi (CSXT)
Nearest Hazard Site	~ 0.5 mi (Refinery—Giant Yorktown Refining)	Distance to Airport	~ 5.5 mi (Williamsburg Int'l)

A.11.3 Aerial Imagery

The aerial imagery in Fig. A.32 indicates limited open field space within the Yorktown Power Station boundary. The oil refinery to the east is shutdown.

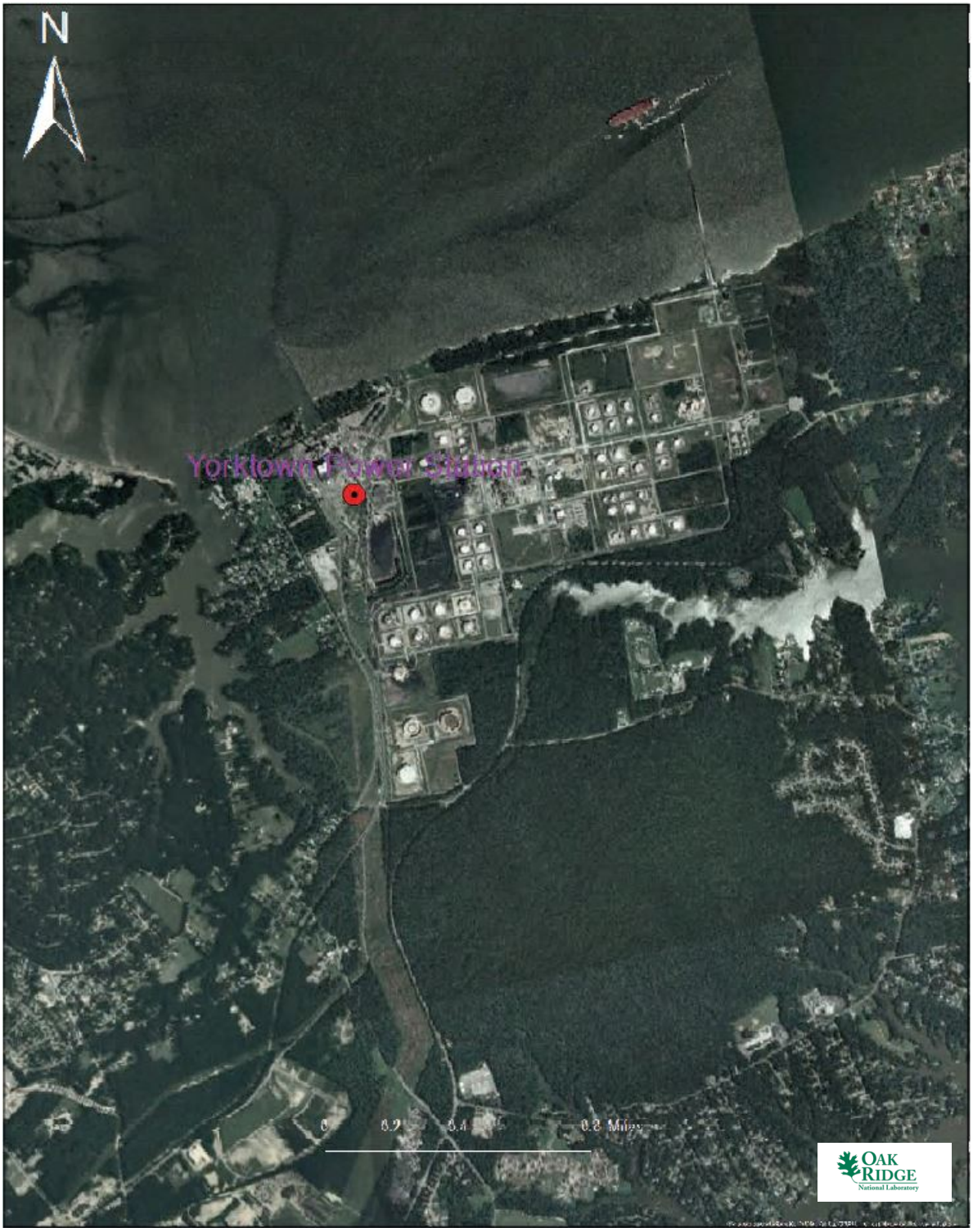
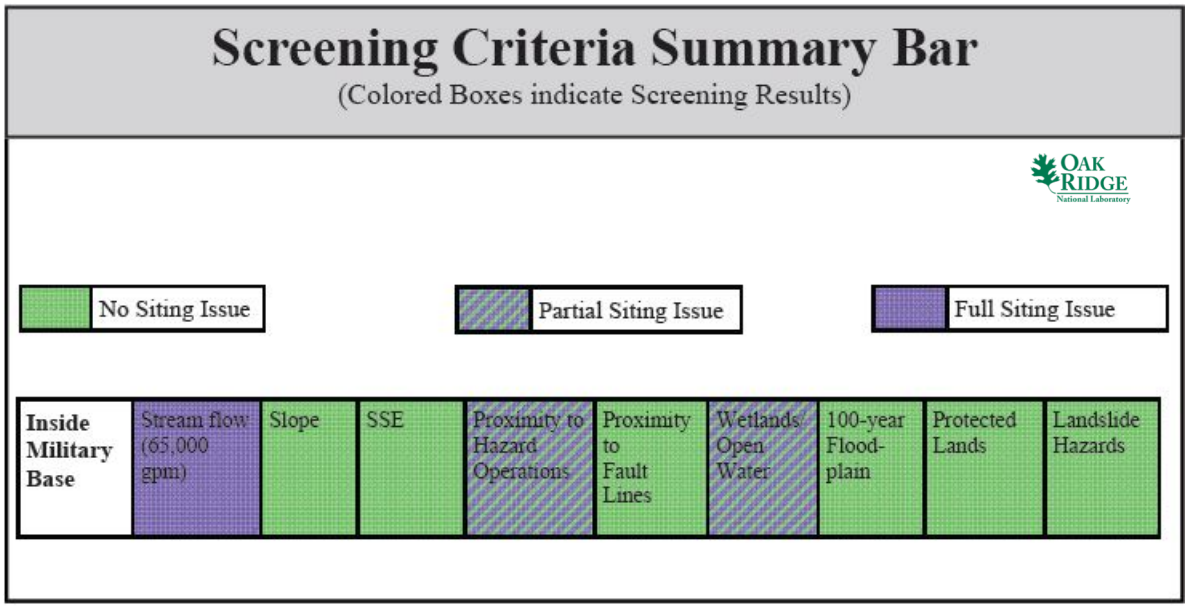


Fig. A.32. Satellite view of Yorktown Power Station proximity.

A.11.4 Screening Criteria Overview

Table A.22. Yorktown Power Station siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports—5 miles and oil refineries—1 mile)

A.11.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to the Yorktown Power Station is shown in Fig. A.33. As shown, (independent of population) the property has multiple siting issues for siting an iPWR. Following this map are maps of the individual SMR siting criteria based on selected input values.

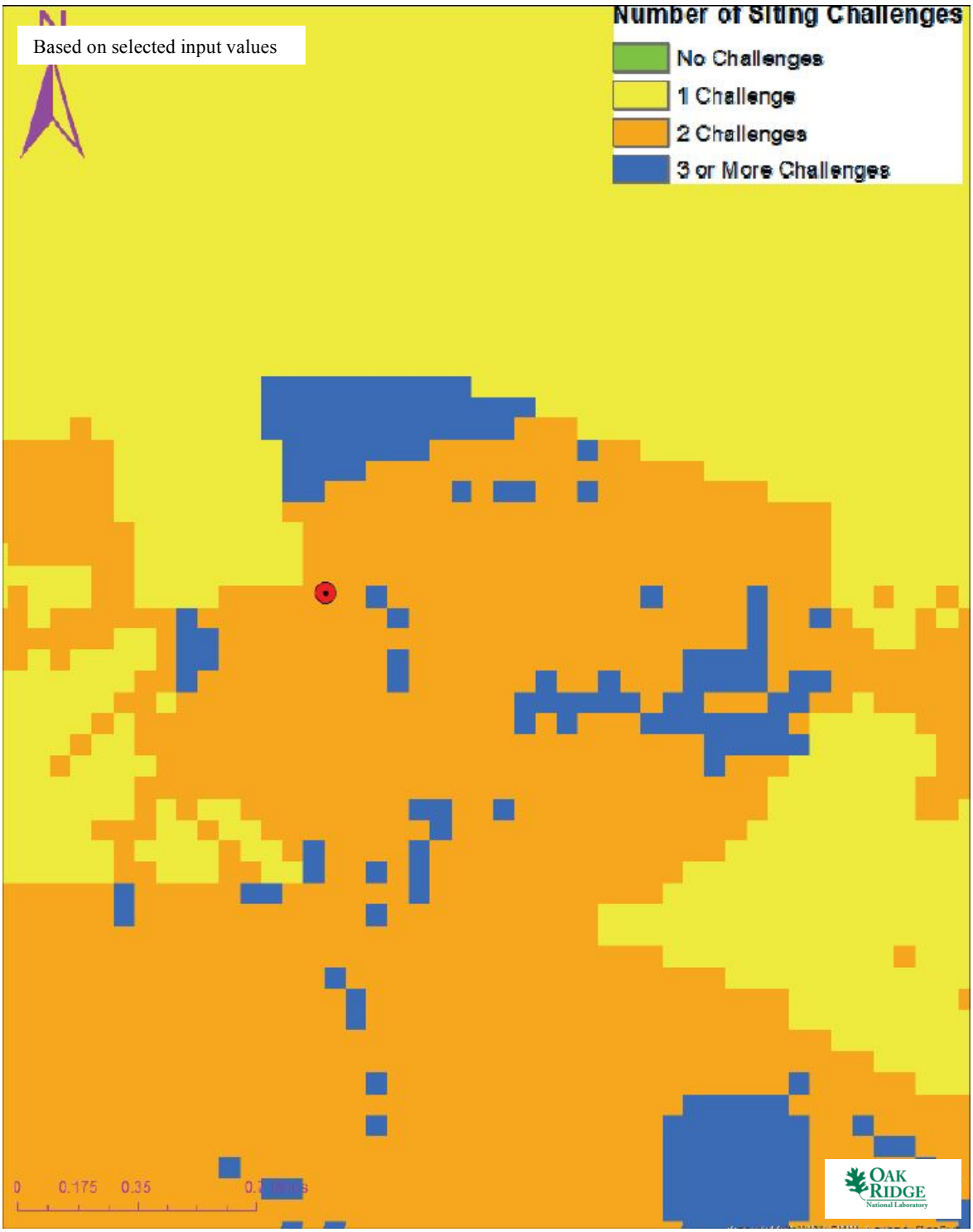
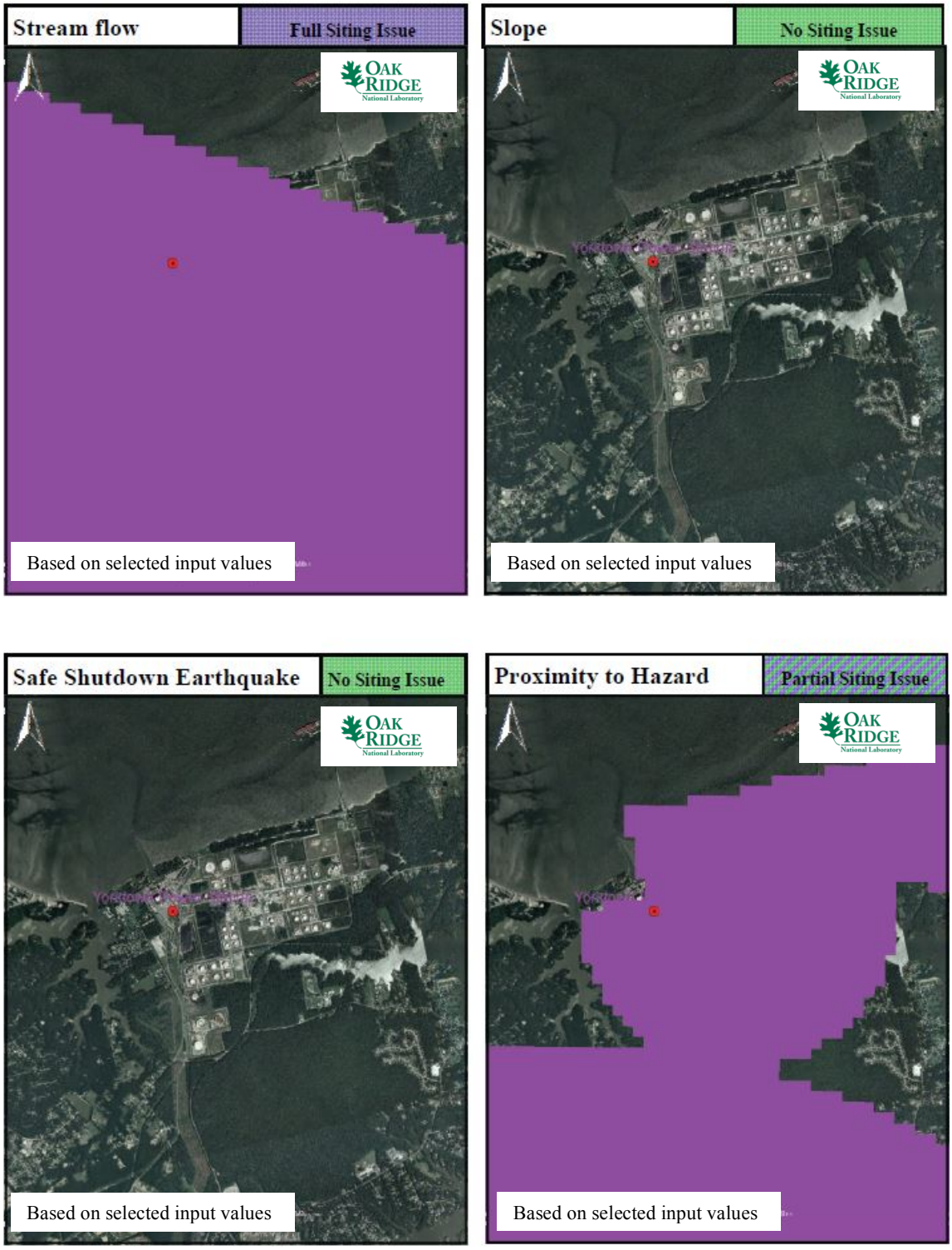
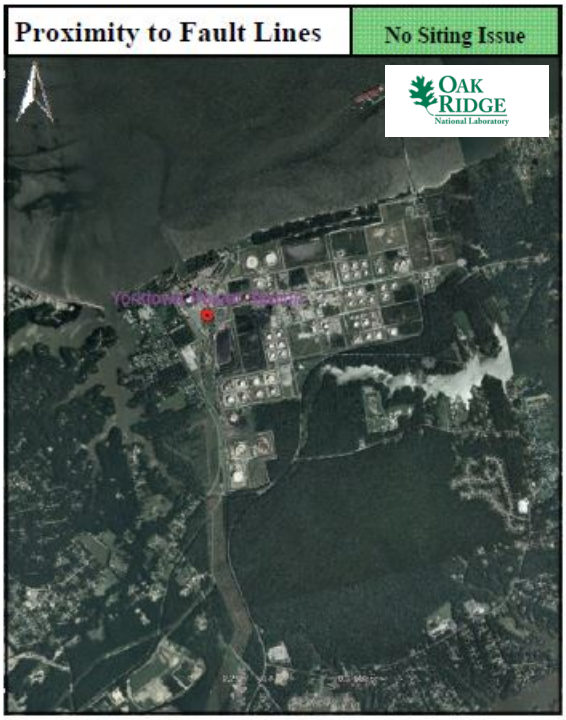
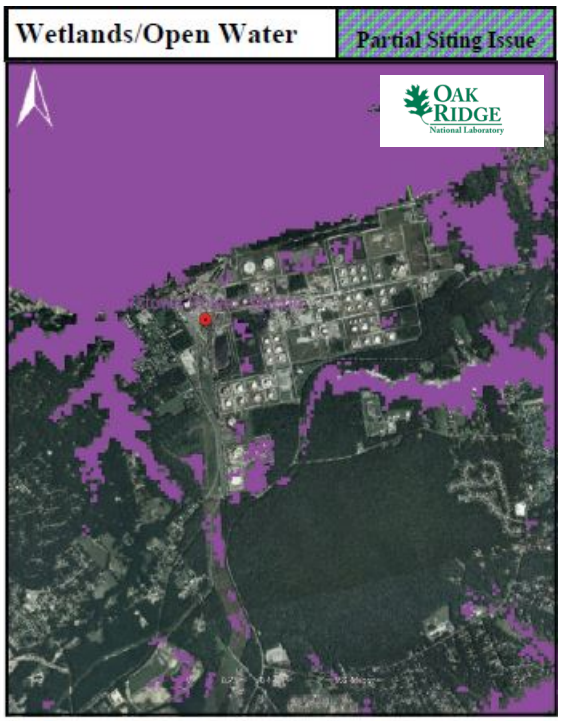


Fig. A.33. Yorktown Power Station composite map.

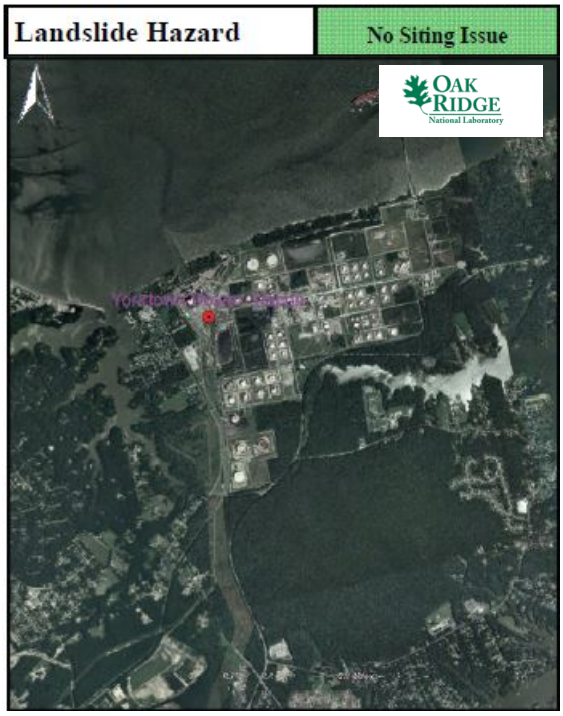


Yorktown Power Station





Yorktown Power Station



Yorktown Power Station

A.11.6 Site Evaluation

As shown in the maps above, the Yorktown Power Station site has two significant screening issues. There is a projected lack of fresh water makeup to support a closed cycle cooling water system for an iPWR at the site. Given the site's proximity to the York River, the Chesapeake Bay, and recycled water from a nearby reprocessing plant, there are clearly other cooling options for the site. In addition, the site has a once-through cooling system in operation at the site that is sized to cool at least 1141 MWe in generation capacity. So a lack of freshwater makeup does not appear to create a barrier to siting an iPWR at the site. Secondly, the maps indicate an issue with a proximity to hazards. This reflects the 1-mile buffer around adjacent oil refinery. Since the refinery is shutdown, it no longer poses a hazard to siting an iPWR at the site.

Table A.22 further indicates a partial siting issue for wetlands and open water. This results from the location of the plant on the south shore of the York River. There is a small park just east of the industrial area that shows up in the protected land map, as well as the Seaford Elementary School with a 1-mile buffer shown. These do not appear to create a barrier to siting an iPWR at the site.

The station is part of a larger industrial complex. There is little housing in very close proximity to the plant. However, the community at large is more densely populated. As shown in Fig. 4, the site is just within an area evaluated at 500 people per square mile within ten miles. However, Fig. 5 shows that population is lighter in the immediate vicinity of the power station.

Multiple transportation opportunities are favorable for iPWR construction. A rail spur exists onsite for coal delivery. Barge and interstate access are also available.

The Yorktown Power Station site meets multiple conventional standards for consideration of siting an iPWR at the proposed location. There are no current or near-term foreseeable SMR SSEC siting issues that should preclude this site from further iPWR siting consideration. Existing site infrastructure and an onsite railhead are favorable for the site.