Supplement to the Draft Programmatic Environmental Impact Statement:
Solar Energy Development in Six Southwestern States

ATTACHMENT 1 – APPENDIX B
NPS Geospatial Analysis of Proposed Solar Energy Program Lands

This section provides an overview of the resource data layers obtained by the NPS that were used in the analysis of proposed Solar Energy Program lands. Provided is a brief discussion of each resource data layer compiled by NPS and an example of the standard set of output layers processed for each of the 53 park units in the six-state study area. The discussion of each data layer is intended to provide context for the application of these layers. The example set of these layers represents the standard array of information available. NPS utilized regional or national datasets to generate these layers, and for some data layers, these data sets represent same data used in the Solar Energy PEIS (e.g. Critical Habitat), and others used in BLM's Rapid Ecological Assessments (e.g. Wind Erodibility and Water Erodibilty). Where parks relied upon additional, locally available information, this is cited in the park-specific narratives. All digital information generated to produce the standard map layers, and any park-specific digital information generated for the exclusion maps discussed in Appendix A, will be provided to the BLM under separate electronic transmittal.

1. Resource Data Layer Context Statements

The following tables provide descriptions of each standard resource data layer compiled by NPS to facilitate a review of proposed Solar Energy Program lands and to determine if a high potential for resource conflict exists. Each statement provides a brief overview of the resource of concern, available data and source utilized, and utility of information for making exclusion recommendations. It is important to note that the data output represented by each layer is not a representation of resource impact, rather these layers represent a regional level representation of resource conditions. The information provides an indication of potential for cumulative development impacts.

2. Standard Map Set of Data Layers: Great Basin NP

Following each table is a representative example of the resource data layer depicting the resource condition in the Area of Analysis. Refer to the preceding context statement for explanation of data used and utility of information displayed in the image. Each resource condition layer displays the proposed Solar Energy Program lands, including variance and SEZ areas.

Resource Data Layer Context Statements

Wind Erodibility (Soils)

Resources of concern: Soils that are less resistant to blowing wind are more likely to contribute to airborne particulate loading, and the cumulative increased disturbance of these soils is likely to produce increased local and regional windblown dust. Increased windblown dust from disturbed arid soils is an air quality concern in terms of the $PM_{2.5}$ and PM_{10} health-based standards, as well as its contribution to regional visibility impairment. Cumulative windblown dust, both local and regional, has been found to be a significant contributor to visibility impairment on the 20% worst visibility days in Class I areas in the six state study area (reference is in specific Air Quality comments). The cumulative disturbance of soils susceptible to wind erosion could increase downwind particulate concentrations and contribute to visibility impairment in Class I areas, including national parks in the six state study area. The NPS is concerned with the development of variance lands for solar energy because: a) site controls may be successful at the project level, but less than fully successful for cumulative dust minimization over broad geographic areas; b) there will be increased surface disturbance and dust emissions due to expansion into roadless, pristine areas; and c) projects located in high wind areas will exacerbate a growing problem of airborne particulate pollution in protected airsheds of downwind national parks.

Available data/source:
The NRCS classifies the sensitivity of soils to wind erosion on the basis of the properties of the soil surface layer. There is a close correlation between soil blowing and the size and durability of surface clodiness, fragments, organic matter, and the calcareous reaction. (NSSH, part 618.72). The most sensitive soils are Wind Erodibility Groups 1 and 2 (NSSH, part 618.16, revised March 2008). These data are found at:

NRCS STATSGO Soil Data. Wind Erosion sensitive soil criteria were obtained from BLM Rapid Ecological Assessments for the Mojave Basin and Range.

High wind erosion potential occurs at locations with Wind erosion groups (WEG) 1 and 2.

WEGs were derived from the whole soil, surface layer and all components.
NRCS STATSGO Database May/2011
Sources:
Natural Resources Conservation Service, United States Department of Agriculture. U.S. General Soil Map (STATSGO2). Available online at http://soildatamart.nrcs.usda.gov. Accessed May/2011

NPS utilized the STATSGO (general soil) map coverage of 1:250,000 to ensure consistent data available for the six-state study area. The minimum

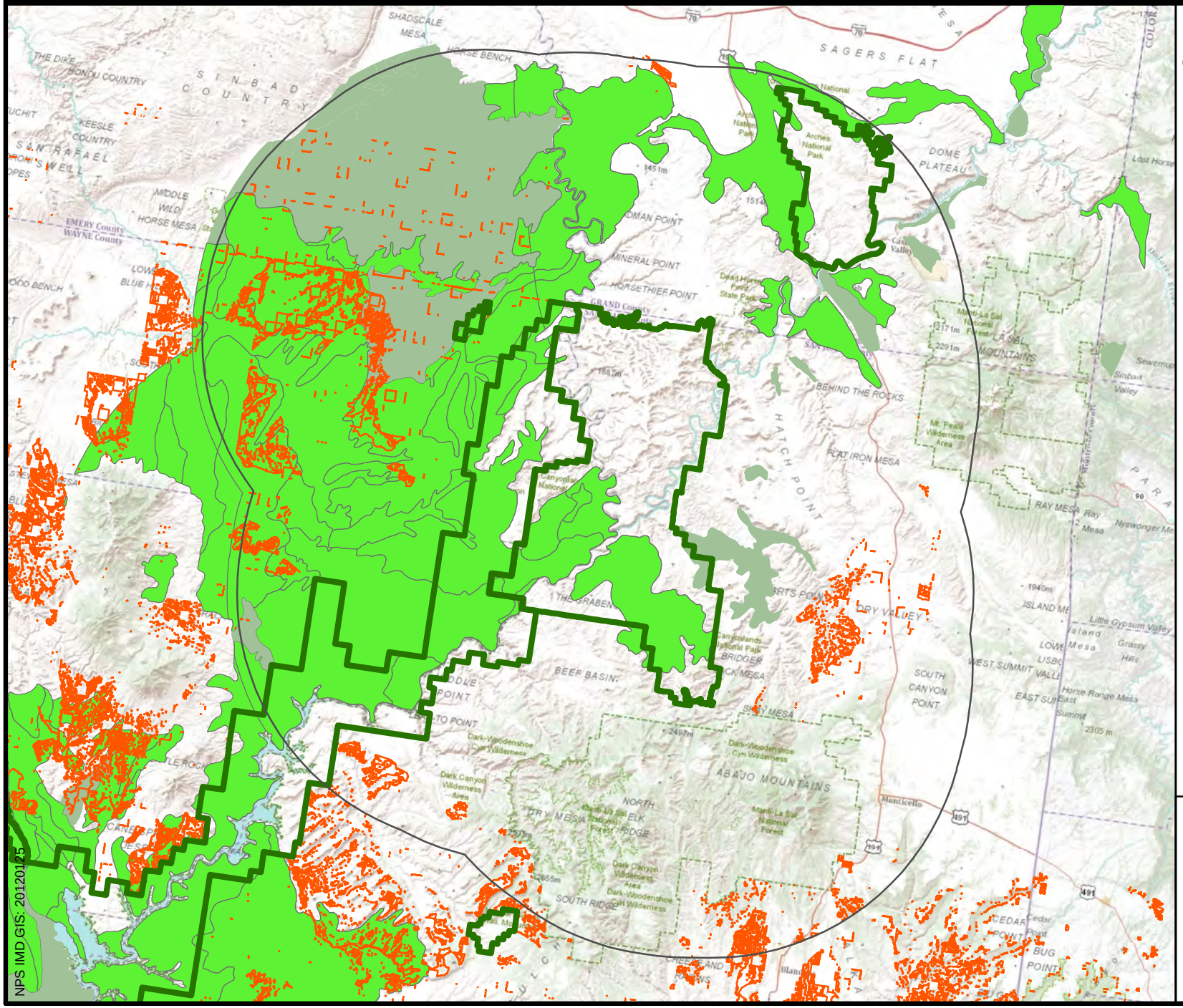
map unit size delineation for these maps is 2,500 acres. More detailed 1:24,000 scale SSURGO soil map coverage is not available for all areas of concern to NPS.

Utility of information for making exclusion recommendations:
The NPS obtained NRCS STATSGO geospatial data and generated polygons for wind erodibility groups (WEG) 1 and 2 within 25-miles surrounding NPS units. These areas were overlaid with variance and Solar Energy Zone areas and evaluated against the location of downwind national park areas. The NPS applied conservative assumptions that cumulative effects of utility-scale solar energy development on variance lands and within SEZs may not be fully mitigated. NPS units were provided wind erodibiilty maps to assist their evaluation of the significance of these areas in light of airshed values and identification of lands that should be removed from the preferred solar energy program.

Canyonlands NP

Soils (Statsgo) Wind Erodibility Group

National Park Service
U.S. Department of the Interior



NPS IMD GIS: 20120125

NPS Unit
Park AOA
Solar Energy Zones (BLM)
PEIS within 25 miles (NPS)

Wind Erodibility Group

1
2

0 4.75 9.5 19 Kilometers
0 4.5 9 18 Miles

N

Water Erodibility (Soils)

Resources of concern:
Erosion factors are used to predict the erodibility of soils and its tolerance to erosion when subject to certain kinds of construction activities and land uses. Sensitive soils are those which are extremely susceptible to impact and difficult to restore and reclaim, including those with high erosion potential. Soils that are susceptible to altered water erosion rates would negatively impact stream channels, water quantity and quality, riparian community dynamics, as well as other affects to habitat needs of aquatic species. The NPS is concerned that site controls may be less than fully successful for minimizing soil erosion risk due to access to previously undisturbed lands. Site-specific and cumulative affects to resources need to be avoided which may result from increased water erosion rates.

Available data/source:
Water erosion sensitive soil criteria were obtained from BLM's Rapid Ecological Assessments (REA) for the Mojave Basin and Range. Two data sources were used to derive soils prone to water erodibility: NRCS' STATSGO K Factor, and Slope derived from seamless 30 m digital elevation models (DEM).

In combining details of soil K-factors and slope, high water erosion potential occurs at locations with:
KW<0.20 & Slope > 40 or,
KW 0.20 - 0.36 & Slope > 35 or,
KW > 0.36 & Slope > 25.

For this process, K factor was derived from the whole soil, surface layers and all components. Sources: Natural Resources Conservation Service, United States Department of Agriculture. U.S. General Soil Map (STATSGO2). Available online at http://soildatamart.nrcs.usda.gov. Accessed May, 2011

NPS utilized the STATSGO (general soil) map coverage of 1:250,000 to ensure consistent data available for the six-state study area. The minimum map unit size delineation for these maps is 2,500 acres. More detailed 1:24,000 scale SSURGO soil map coverage is not available for all areas of concern to NPS.

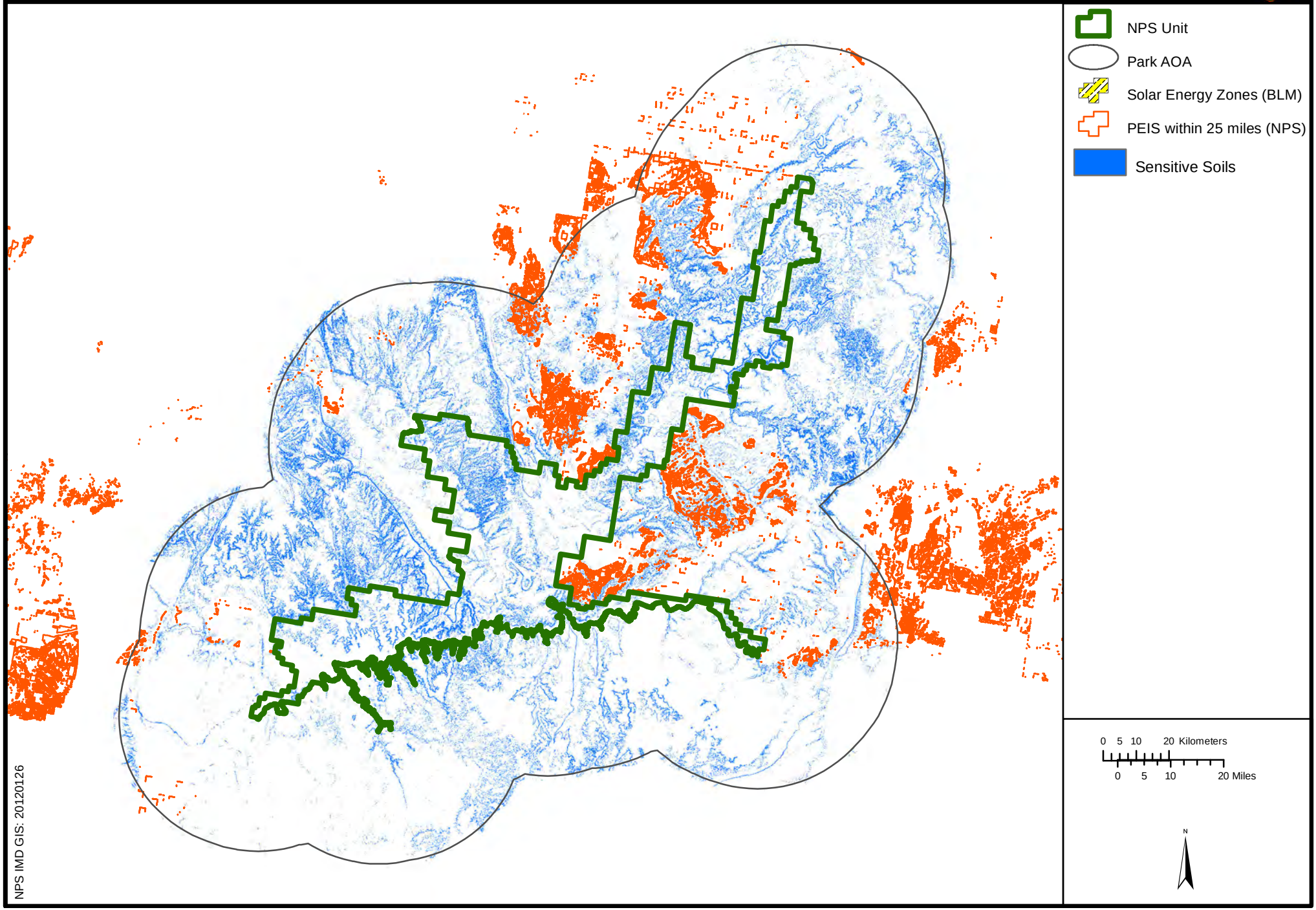
Utility of information for making exclusion recommendations:
Based on NRCS recommendations for calculating erosion potential and adopted BLM REA criteria, the water erosion potential of a given soil map unit was calculated as the product of the "K" factor, or the "soil erodibility index" and the percent slope. The NPS obtained NRCS STATSGO geospatial data and seamless digital elevation models for the analyses. Polygons depicting high water erosion potential areas were within 25-miles

surrounding NPS units. These areas were then overlayed with variance and Solar Energy Zone areas and evaluated against their location relative to national park areas. The NPS applied conservative assumptions that cumulative affects of utility-scale solar energy development on variance lands and within SEZs may not be fully mitigated. NPS units having these sensitive soil areas evaluated the significance of these areas in light of lands that should be removed from the preferred solar energy program.

Glen Canyon NRA

Soils (Statsgo) K Factor and Slope - Water Erosion

National Park Service
U.S. Department of the Interior



Wetlands

Resources of concern:

Wetlands, both jurisdictional and non-jurisdictional, are susceptible to impacts from solar energy development through changes in hydrologic regimes. This can result in wetland dewatering, hydroperiod changes, increased sedimentation, loss of connectivity to water sources, loss of obligate and facultative wetland vegetation species, drying of plant communities (e.g., conversion of wetland to upland), encroachment of exotic species, drying and oxidation (loss) of organic soils (peats, mucks), and damage to fish and invertebrate communities. The cumulative disturbance of wetlands would reduce biological diversity of species, including endemic, rare, threatened or endangered species in national parks. Such damages or losses can adversely affect the wetland-related visitor enjoyment and recreational opportunities for which parks were established, such as hiking, photography, wildlife viewing, boating, and fishing. The NPS is concerned with the development of variance lands for solar energy because: a) site controls may be successful at the project level but less than fully successful for cumulative impacts to wetlands over the desert environments of the six-state area, b) there will be increased sediment loading due to expansion into roadless, pristine areas, c) cumulative loss of hydrologic functions and ecological processes will exacerbate loss of endemic, rare, threatened or endangered species in national parks, and d) visitor enjoyment and recreational opportunities may be degraded or lost.

Available data/source:

U.S. Fish and Wildlife Service National Wetlands Inventory layer for the six-state Solar PEIS project area. From USFWS' Data limitations and uses documentation http://www.fws.gov/wetlands/Data/Limitations.html:

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are

prepared from the analysis of high altitude imagery with limited ground truthing. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis. The minimum mapping unit is approximately one acre, so smaller wetlands are unlikely to be mapped. The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems. Wetlands or other mapped features may have changed since the date of the imagery and/or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Exclusions - Certain wetland habitats are excluded from the national mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include wetlands within heavily forested areas or sites with very steep slopes or overhangs. By policy, the Service also excludes certain types of "farmed wetlands" as may be defined by the Food Security Act or that do not coincide with the

Cowardin et al. definition. Contact the Service's Regional Wetland Coordinator for additional information on what types of farmed wetlands are included on wetland maps.

Precautions - Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory.
There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Maps prepared for the PEIS review depict USFWS National Wetlands Inventory Data with a 500 meter buffer applied to the wetlands data.

Date of information varies by location

Sources:
USFWS National Wetlands Inventory (NWI): http://wetlands.fws.gov

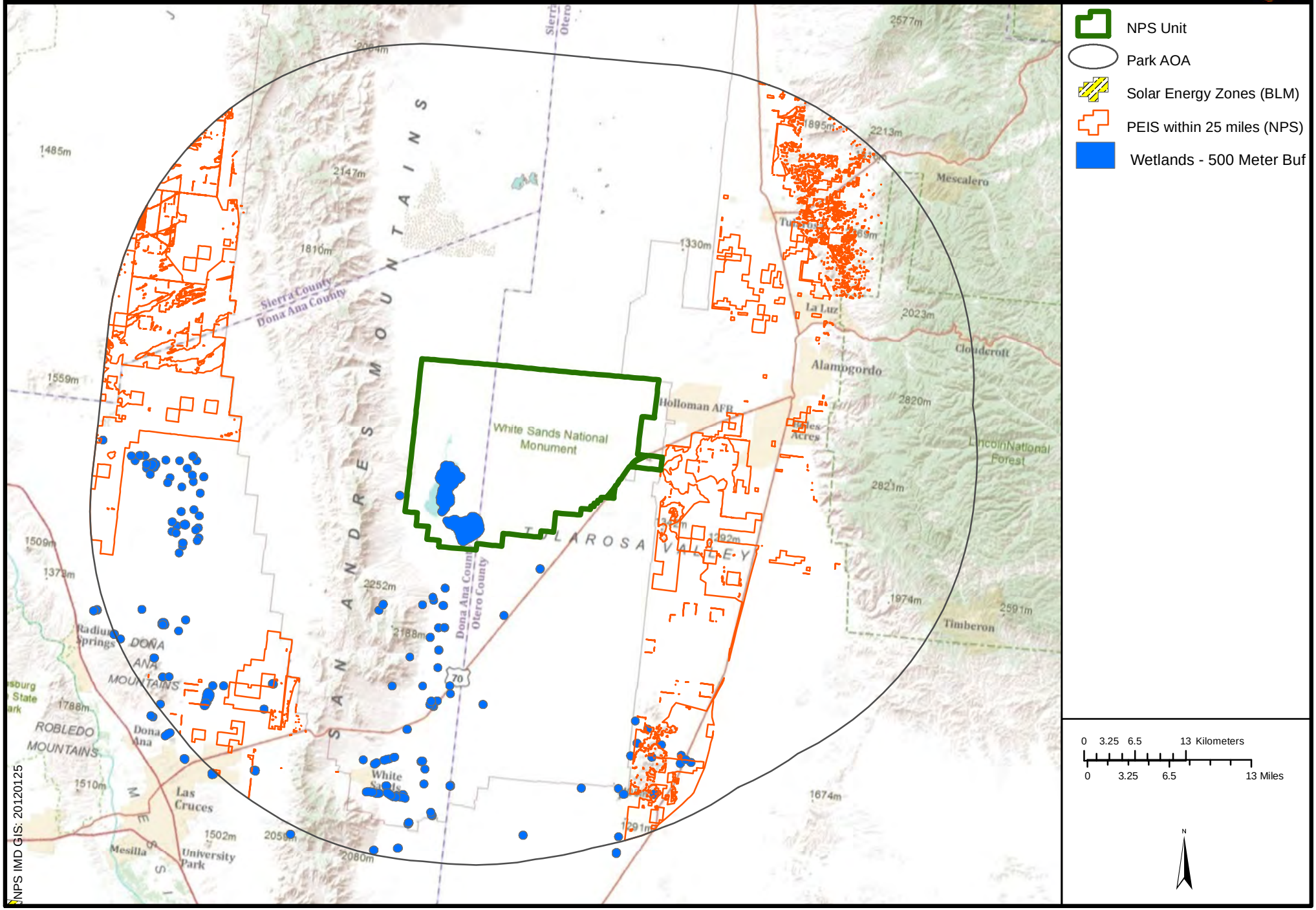
Utility of information for making exclusion recommendations:
The NPS obtained USFWS NWI geospatial data and generated data with 500 meter buffer areas. These areas were overlaid with variance and Solar Energy Zone areas and evaluated against the location of national park areas and potentially sensitive park resources. The NPS applied conservative assumptions that cumulative effects of utility-scale solar energy development on variance lands and within SEZs may not be fully mitigated. NPS units were provided wetland maps to assist in the evaluation of the significance of the development of the variance lands in light of wetland values and identification of lands that should be removed from the preferred solar energy program.

Note about available NWI data: Several park units are in areas where the NWI program has not mapped wetlands yet (e.g., Arches, Canyonlands, and Glen Canyon). In these cases, the prepared NWI maps leave the impression there are no wetlands within the vicinity of a number of park units. As a Bureau we know there are wetlands in these areas, including those associated with seeps, springs, and riverine systems. Development proposed in areas where wetlands have not been delineated would need to be surveyed.

White Sands NM

Wetlands Data (500 Meter Buffer) - U.S. Fish and Wildlife Service

National Park Service
U.S. Department of the Interior



NPS IMD GIS: 20120125

Upstream Watersheds

Resources of concern:
Provision of fresh water is a key ecosystem service provided by many parks, and flowing water directly connects water resources inside and outside park boundaries. Landscape-scale activities beyond park boundaries can particularly affect water resources and the ability of parks to manage and protect these resources. Park upstream watersheds are potentially threatened by a number of landscape-level factors related to park-watershed geometry, land use development, habitat conversion, resource extraction, and deposition. In the majority of cases where parks do not directly control most of their watersheds, both physical and chemical stressors originating beyond park boundaries will likely affect water resources inside park boundaries. Watershed environmental factors potentially affected through site-based development include: sedimentation, nutrient enrichment, contaminant pollution, hydrological alteration, riparian clearing or canopy opening, and loss of large woody debris. The NPS is concerned that site controls occurring in parks' upstream watersheds may not address downstream impacts and implications.

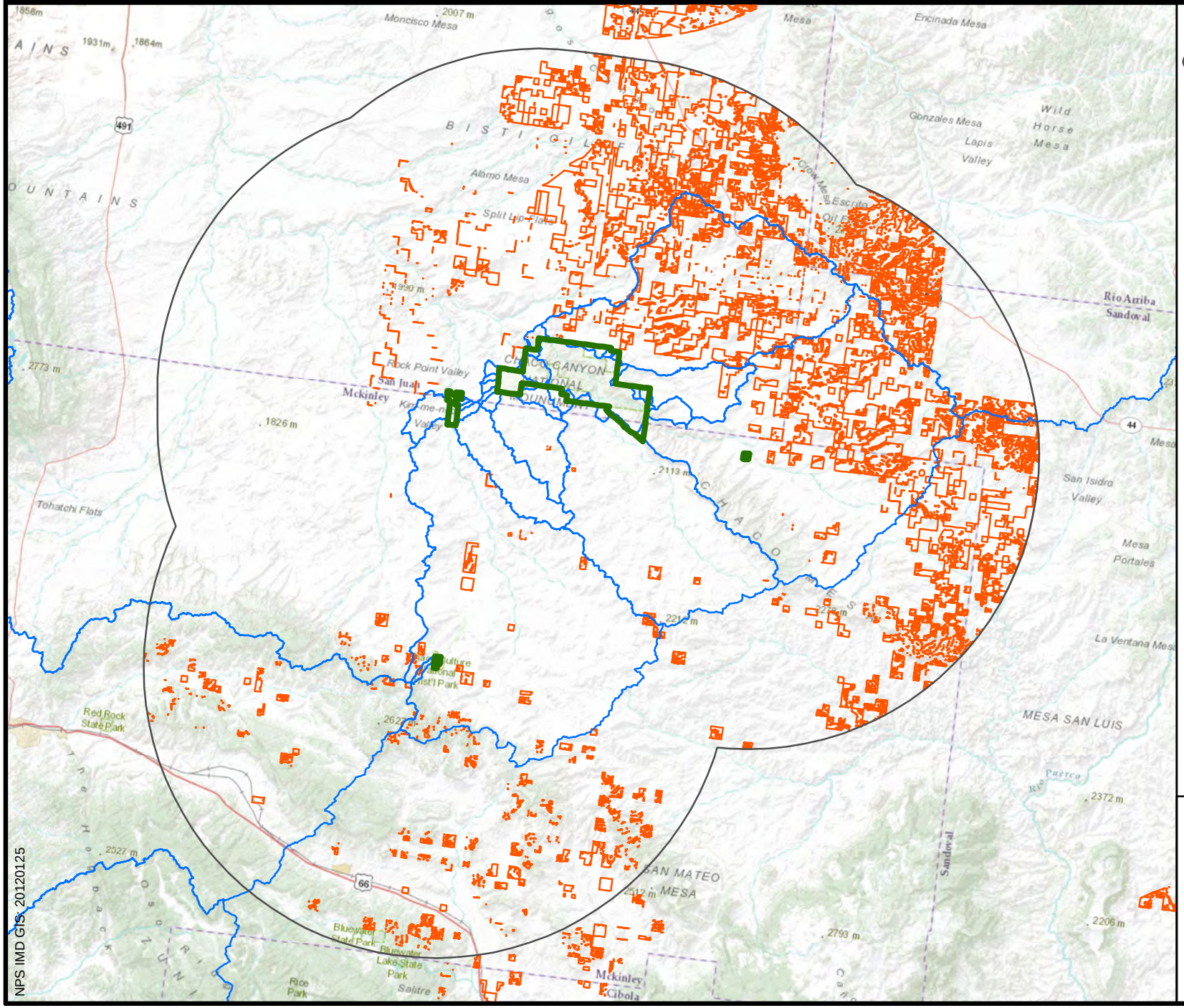
Available data/source:
The process used ArcGIS Spatial Analysis Hydrology tools to delineate watersheds using 30 meter digital elevation model-derived flow accumulation and flow direction rasters and National Hydrography Dataset flowlines. Upstream watersheds were calculated for streams intersecting NPS park boundaries at calculated pour-points. These pour-points are snapped to the NHD flow accumulation raster then watersheds are delineated using the flow direction raster. Watersheds are subsequently converted to polygons and are joined to the source park boundary to provide park-level attributes.

Data Sources utilized, include:
National Hydrography Dataset – NHDPlus: http://www.horizon-systems.com/nhdplus/data.php
Upstream Watershed SOP for NPScape: https://irma.nps.gov/Reference.mvc/Profile?Code=2173077
NPS Administrative Boundaries (9/2010): https://irma.nps.gov/Reference.mvc/Profile?Code=2170522

Utility of information for making exclusion recommendations:
Calculated upstream watershed polygons were intersected on variance lands and Solar Energy Zones to determine if any development of utility-scale solar facilities could potentially impact watershed environmental conditions. NPS units having PEIS lands within their respective upstream watersheds evaluated the significance of these areas in light of lands that should be removed from the preferred solar energy program.

Chaco Culture NHP
Upstream Watersheds

National Park Service
U.S. Department of the Interior



NPS IMD GIS, 20120125

NPS Unit
Park AOA
Solar Energy Zones (BLM)
PEIS within 25 miles (NPS)
Upstream Watersheds

0 4 8 16 Kilometers
0 4 8 16 Miles

N

Protected Areas

Resources of concern:

Proximity to adjacent lands with special protection designations (i.e., those lands managed to protect and preserve biodiversity) is an important measure for assessing a number of environmental conditions. Adjacent conservation lands provide a measure of resource protection from stressors on species that may move between parks and adjacent special areas, enhance visitor experiences and recreation opportunities, and ecological buffering capacity from trans-boundary impacts of external land developments. These conservation benefits are threatened by intervening development that may reduce naturalness, diminish roadless areas, increase landscape permeability, disrupt wetlands, influence habitat connectivity, and alter hydrological regimes of adjacent protected lands. The NPS is concerned that site controls occurring in intervening development areas that exhibit desirable connection with adjacent protection areas may not protect against degradations in connected landscapes.

Available data and sources utilized:

The protected areas map is derived from Protected Areas Database of the United States (PAD-US) version 1.2.
Polygons with one of two status values are displayed:
GAP Status 1: managed for biodiversity – disturbance events proceed or a mimicked
GAP Status 2: managed for biodiversity – disturbance events are mimicked

NPS administration boundary polygons were obtained from the NPS Land Resource Division in late 2011.
Protected Areas Database of the United States (PAD-US) version 1.2 (April, 2011): http://www.protectedlands.net/padus/

Database was developed by the PAD-US Technical Working Group. The group is a consortium of non-government and government researchers including representatives from the Conservation Biology Institute, the Nature Conservancy, NatureServe, the National Geographic Society, Applied Geographics, Inc., IUCN, Bureau of Land Management, USDA Forest Service, Virginia Department of Conservation, USGS GAP Analysis Program, and the US Geological Survey

Identified protected areas data set may not capture all protected areas.

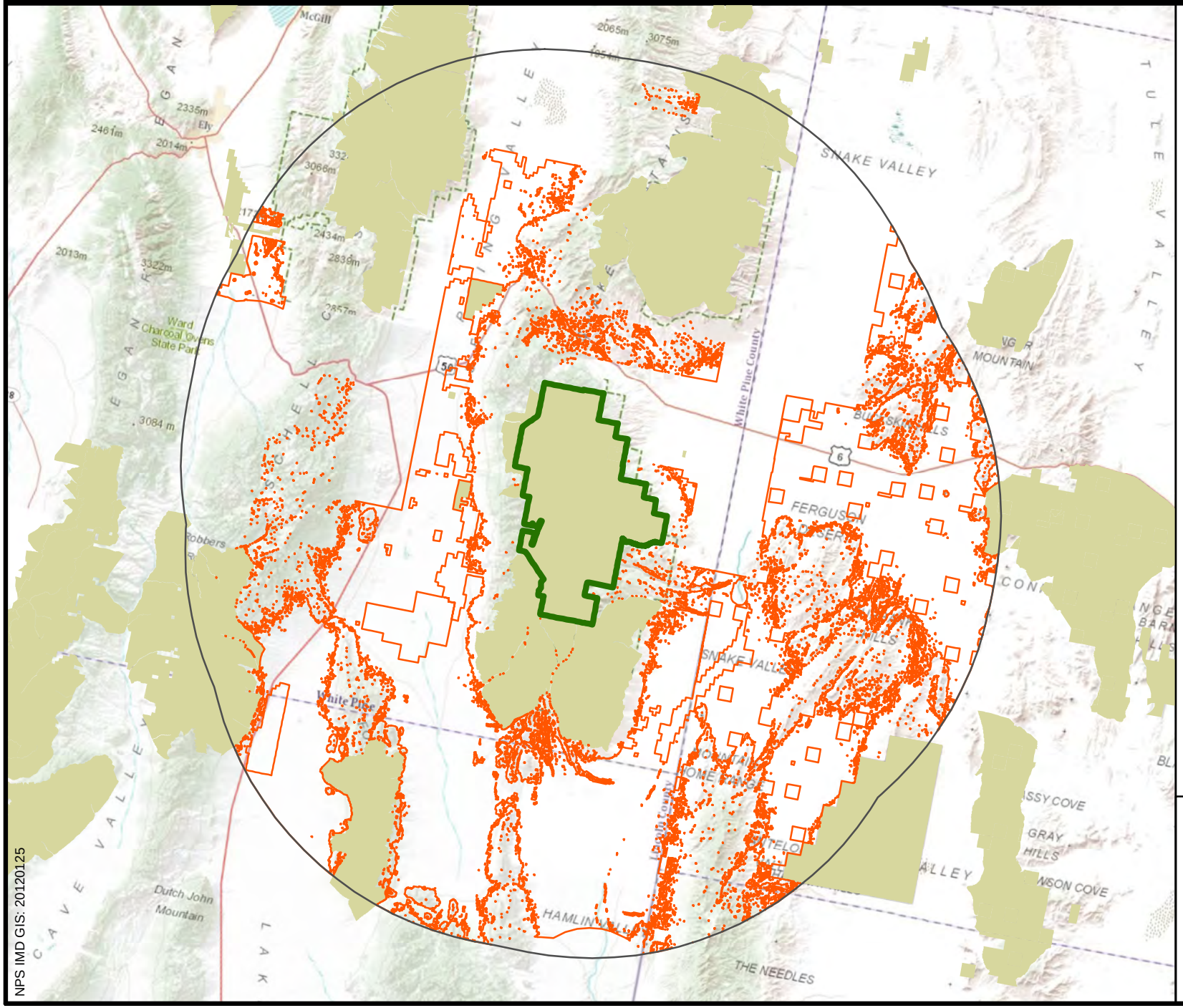
Utility of information for making exclusion recommendations:

Protected area polygons were intersected with variance lands and Solar Energy Zones to determine if any development of utility-scale solar facilities could potentially impact parks and adjacent protected areas. Proximity of development to adjacent protected areas increases the probability of trans-boundary impacts from intervening developed areas, where land currently absent of a development occurs. NPS units having PEIS lands within proximity of their administration areas evaluated the impacts to park managed resources based on the significance of the adjacent protected areas in light of lands that should be removed from the preferred solar energy program.

Great Basin NP

Protected Areas Database (PAD-US 2011)

National Park Service
U.S. Department of the Interior



NPS Unit
Park AOA
Solar Energy Zones (BLM)
PEIS within 25 miles (NPS)
Protected Areas

0 3.5 7 14 Kilometers
0 3.5 7 14 Miles

N

NPS IMD GIS: 20120125

Land Ownership

Resources of concern:
The type and proximity of adjacent lands is an important measure for assessing environmental objectives in the vicinity of park units and collaboratively pursuing opportunities for maintenance of properly functioning natural landscapes. Land ownership data provides an indication of the potential for complementary regional landscape management and protection measures and key stakeholders in securing such measures. This information is generally applied at local, land-use planning levels. The NPS is concerned that availability of variance lands should be identified through local, land-use processes that incorporate detailed assessment of regional landscapes and address multiple stakeholder interests. The programmatic opening of vast tracts of public lands as variance lands, before local land-use assessment and planning processes are accomplished, places cumulative stressors on the landscape without benefit of adequate stakeholder analysis and input. Land ownership data may be paired with other landscape level information to evaluate the potential changes in cultural landscapes, habitat connectivity, habitat quality, wildlife migration and landscape fragmentation.

Available data and sources utilized:
The land ownership map is derived from the Protected Areas Database of the United States (PAD-US) version 1.2. NPS-sourced polygons were updated from the NPS Land Resource Division in late 2010.

NPS administration boundary polygons were obtained from the NPS Land Resource Division in late 2011.

Protected Areas Database of the United States (PAD-US) version 1.2 (April, 2011): http://www.protectedlands.net/padus/

Database was developed by the PAD-US Technical Working Group. The group is a consortium of non-government and government researchers including representatives from the Conservation Biology Institute, the Nature Conservancy, NatureServe, the National Geographic Society, Applied Geographics, Inc., IUCN, Bureau of Land Management, USDA Forest Service, Virginia Department of Conservation, USGS GAP Analysis Program, and the US Geological Survey

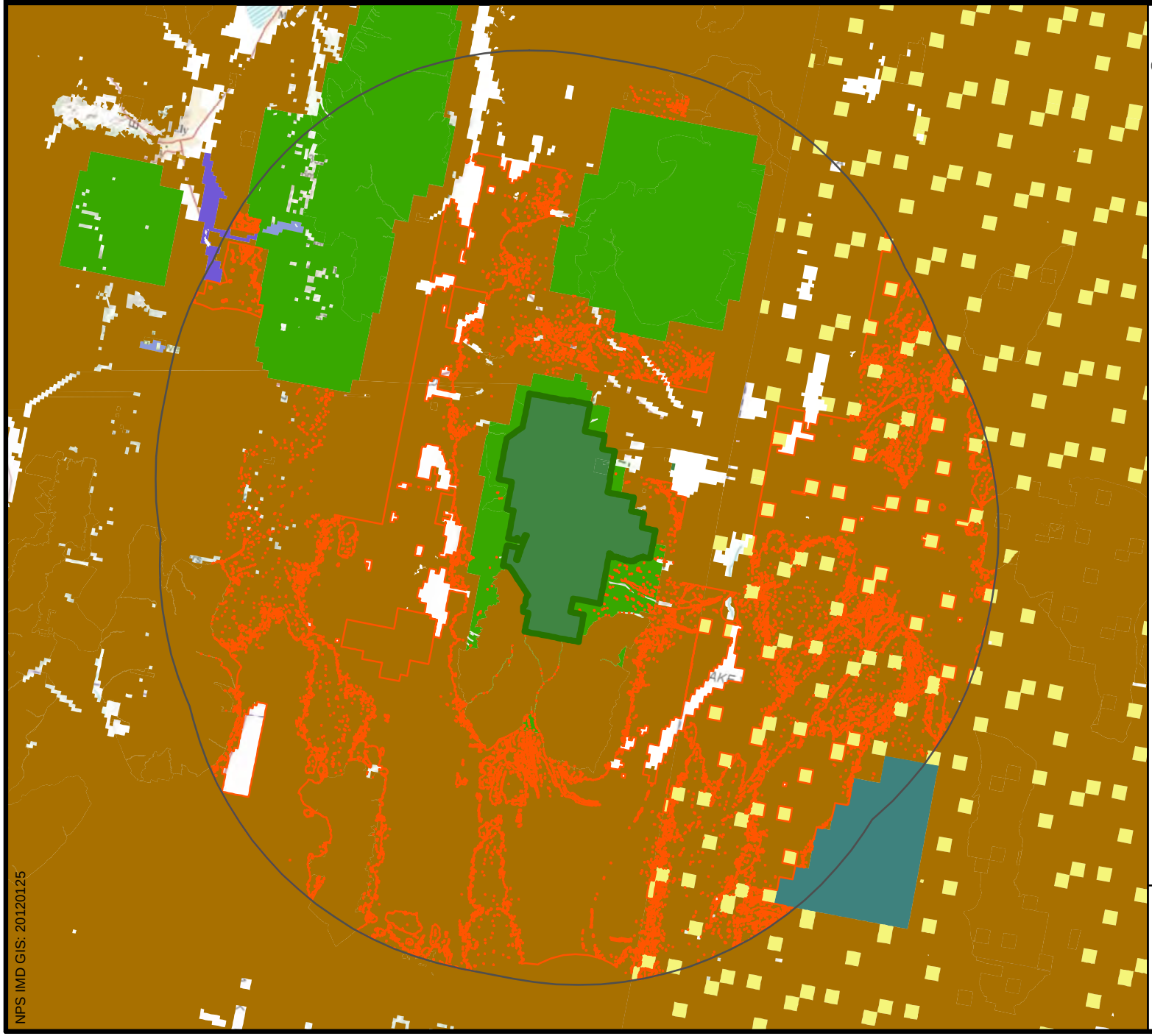
Identified land areas may not capture all land ownership data.

Utility of information for making exclusion recommendations:
Land ownership polygons were intersected with variance lands and Solar Energy Zones to determine if any development of utility-scale solar facilities could potentially impact parks and adjacent protected areas. Proximity of development to adjacent land management units increases the probability of multiple stakeholder interests in transboundary impacts from intervening developed areas, particularly where land currently absent of

a development occurs. NPS units having PEIS lands within proximity of their administration areas evaluated the impacts to park managed natural and cultural resources based on the significance of the adjacent land management units in light of lands that should be removed from the preferred solar energy program.

Great Basin NP
Land Ownership (PAD-US 2011)

National Park Service
U.S. Department of the Interior



NPS Unit
Park AOA
Solar Energy Zones (BLM)
PEIS within 25 miles (NPS)

Owner Name

- Tribal Land
- Bureau of Land Mgt (BLM)
- Bureau of Reclamation (BOR)
- City Land
- Cty Land \ Regional Agency Land
- Dept of Defense/Energy (DOD) (DOE)
- Fish and Wildlife Service (FWS)
- Forest Service (USFS)
- National Park Service (NPS)
- Other Fed (TVA,NRCS,NOAA, etc.)
- Private Conservation
- State Trust Land
- State Fish and Wildlife
- State Parks and Recreation
- Other State (NHP,DOT,HS,etc.)
- The Nature Conservancy (TNC)
- Territorial Land

0 4.5 9 18 Kilometers
0 4.25 8.5 17 Miles

N

NPS IMD GIS: 20120125

Critical Habitat

Resources of concern:

The representation of designated critical habitat areas for Threatened and Endangered species (T&E) is useful for determining the most critical areas for habitat connectivity. These habitats are often designated for their role as feeding or breeding areas at key points of the organism's life histories. A key element in the determination of vulnerability of these T&E species is the assessment of connectivity among their critical habitats, including connectivity between park boundaries and the critical habitats. Facility development within these areas will reduce resilience of populations within parks. Additional indicators of habitat intactness, including naturalness index, roadless area and landscape permeability factors, are applied to determine potential for conflict with critical habitat. The NPS is concerned that site controls for solar energy facilities occurring in important connectivity areas may not protect against degradations in connected habitats. There are also administrative and management considerations that are brought to attention through the critical habitat analysis, such as increased landscape fragmentation that could heighten the risk to sensitive species.

Available data/source:

The critical habitat map is derived from U.S. Fish and Wildlife Service Threatened and Endangered Species Final Critical Habitat Designations data base, maintained by the USFWS Endangered Species Division.

The data source utilized for this map is:
U.S. Fish & Wildlife Service Critical Habitat Portal http://criticalhabitat.fws.gov/crithab/ - Download August 3rd, 2011

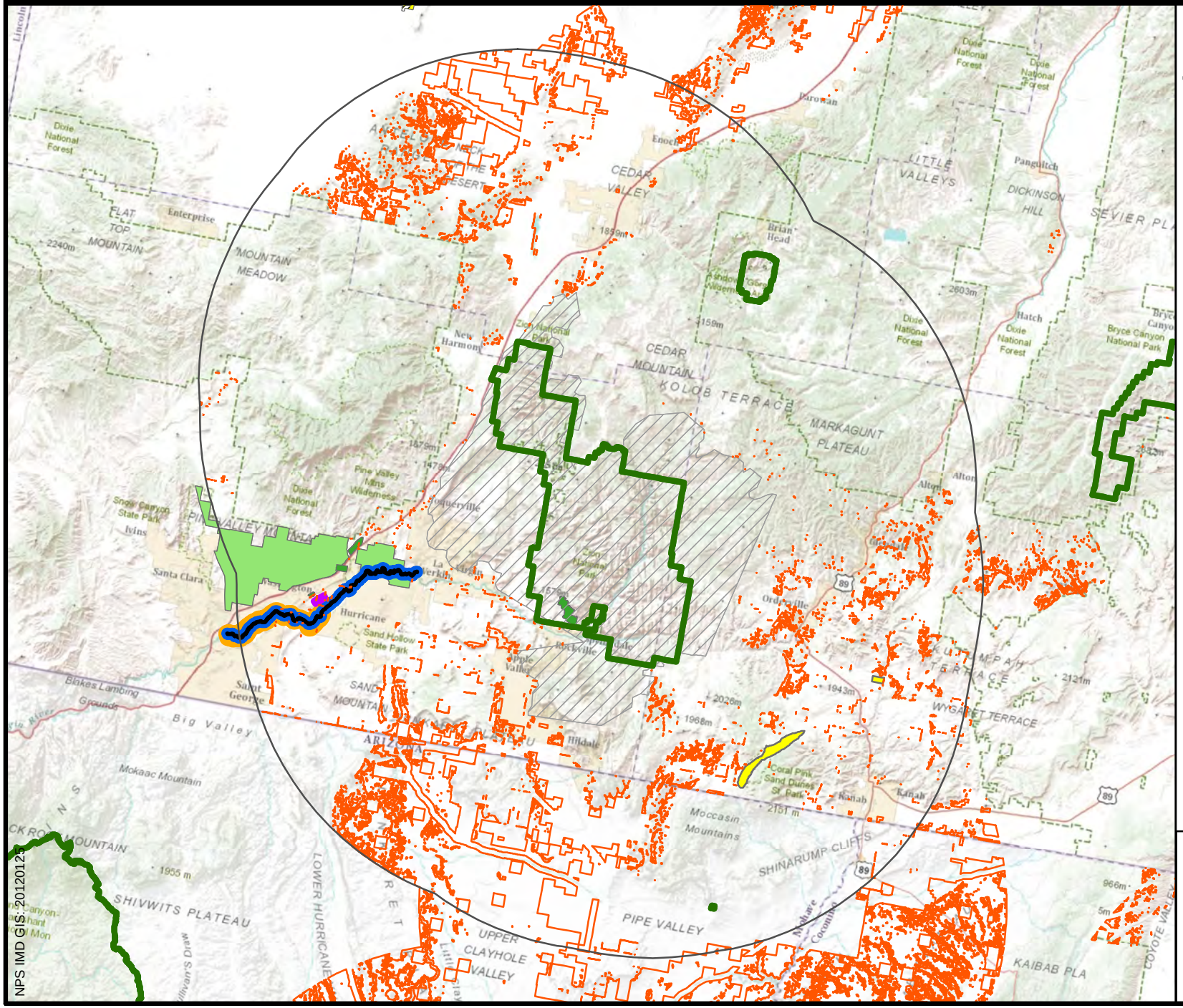
Utility of information for making exclusion recommendations:

Although solar energy facilities would not be located in critical habitat areas (designated and proposed) under the proposed Solar Energy Program, the representation of critical habitat areas, in combination with naturalness index, roadless area and landscape permeability data, superimposed with variance lands and Solar Energy Zones enables a determination of the relative intactness of critical habitat corridors and isolation of protected species populations. Identification of the critical habitats provides some directionality to connectivity analyses for select species, or groups of species associated through habitat needs to the T&E species. The development of utility-scale solar facilities within important habitat connectivity corridors could potentially impact these species within NPS units. The presence of PEIS lands within proximity of critical habitats, adds to the multiple lines of evidence of other landscape-level data relating to important connectivity areas for these habitats, including roadless natural areas and landscape permeability, increasing confidence in the likelihood of impacts to protected species. The goal of such pairings was to evaluate how the critical habitats might change if neighboring utility-scale solar energy development were to occur. In these evaluations, critical habitat would be used as a surrogate for relative changes that might be expected with park-managed resources.

Zion NP

Critical Habitat T & E - U.S. Fish and Wildlife Service

National Park Service
U.S. Department of the Interior



NPS Unit
Park AOA
Solar Energy Zones (BLM)
PEIS within 25 miles (NPS)

Critical Habitat (USFWS) ZION

- Welsh's milkweed
- Desert tortoise
- Holmgren milk-vetch
- Mexican spotted owl
- Shivwits milk-vetch
- SW willow flycatcher
- Virgin River Chub
- Woundfin

0 4 8 16 Kilometers
0 4 8 16 Miles

N

Roadless Natural Areas

Resources of concern:

Distance from roads as well as roadless areas are important measures for assessing a number of environmental conditions. Road metrics provide a measure of stressors on species that may move in and out of national park units and surrounding lands, such as direct mortality and behavioral changes (opportunities to cross roads, predator-prey relations). Areas with roads also provide conduits for invasive species, increased noise, light and chemical pollution, and affect soil erosion. Roadless areas also serve as a landscape pattern metric that relates to the size, shape, and frequency of habitat patches, as well as influencing the connectivity of natural areas. The NPS is concerned that site controls occurring in current roadless areas that exhibit desirable habitat qualities may not protect against degradations in connected landscapes. There are also administrative and cultural resource management considerations that are brought to attention through the roadless areas; increased access to the landscape could result in unauthorized access to park resources and heighten the risk to sensitive cultural resources as a result of vandalism.

Available data/source:

The process for deriving roadless areas replicates a Standard Operation Procedure outlined by the National Park Service Inventory and Monitoring Program's landscape dynamics project (NPScape). Roadless areas were calculated from an existing commercially-available transportation dataset (ESRI's Street Map, 2005). A Euclidean distance raster was calculated with a 30 M cell size snapped to an accompanying National Land Cover Database (NLCD, 2006) landcover raster. Cells greater than 500M from an existing road feature were selected, identified as "roadless" and then converted to polygon features. The NLCD landcover raster was re-classified into Converted vs. Natural landcover categories; converted classes are defined as Developed, Pasture/Hay, and Cultivated Crops. Polygons reflected converted landcover classes were then used to "erase" roadless area polygons to derive a final roadless natural areas dataset.

Data Sources utilized in the analysis include:
ESRI Streets layer; ESRI Map and Data DVD, dated 2005
Road Metric SOP for NPScape: https://irma.nps.gov/Reference.mvc/Profile?Code=2166959
National Land Cover Dataset (2006): http://www.mrlc.gov/nlcd2006.php
Landcover Metric SOP for NPScape: https://irma.nps.gov/Reference.mvc/Profile?Code=2166956

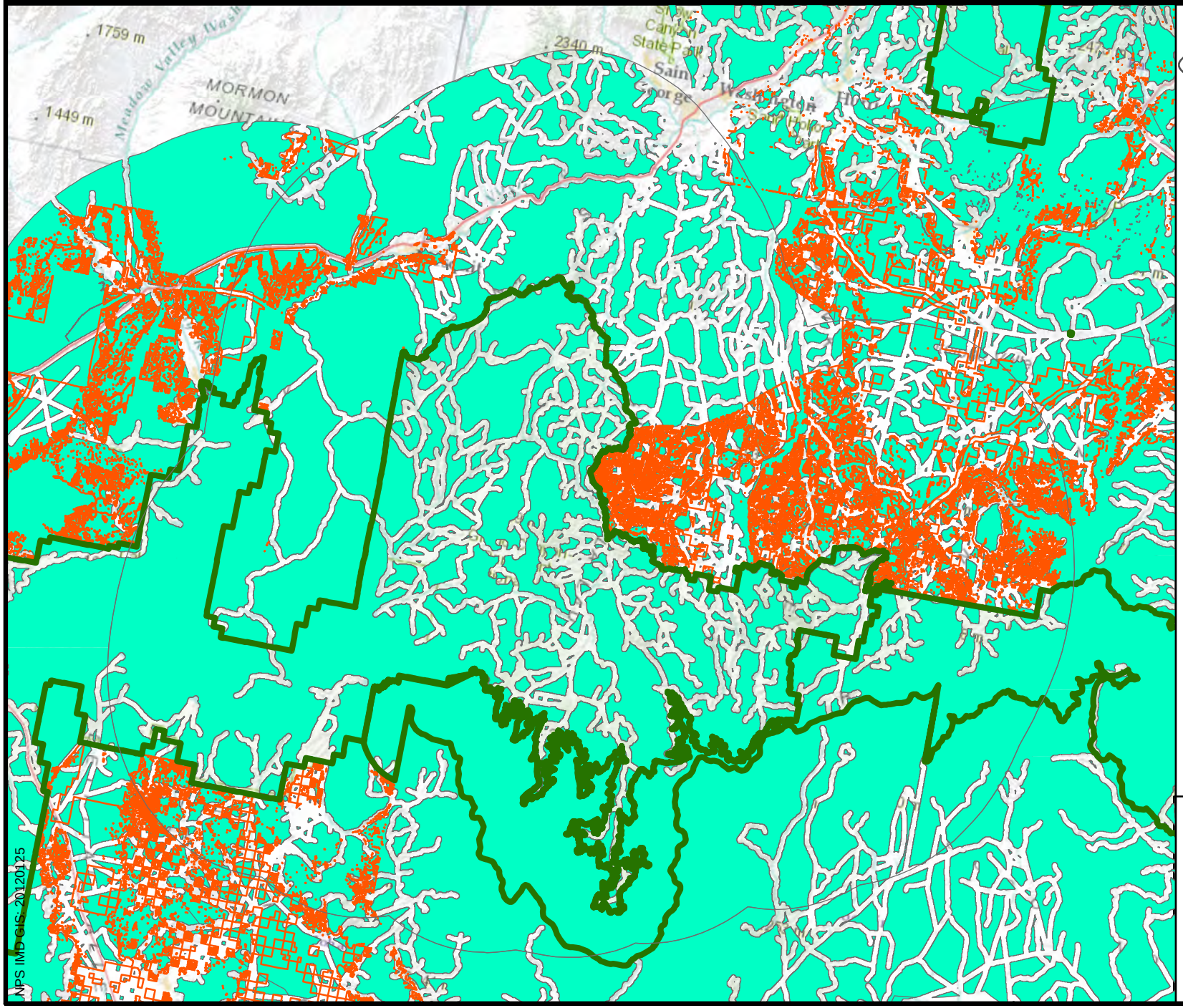
Utility of information for making exclusion recommendations:

Calculated roadless area polygons were intersected with variance lands and Solar Energy Zones to determine if any development of utility-scale solar facilities could potentially impact large tracts of land currently absent of a dissecting transportation network. NPS units having PEIS lands within proximity of their administration areas evaluated the impacts to park managed cultural and natural resources as well as the administrative issues based on the significance of these roadless areas that should be removed from the preferred solar energy program.

Parachant NM

Roadless Natural Areas

National Park Service
U.S. Department of the Interior



NPS Unit
Park AOA
Solar Energy Zones (BLM)
PEIS within 25 miles (NPS)
Roadless Natural Areas

0 5 10 20 Kilometers
0 5 10 20 Miles

N

Naturalness Index

Resources of concern:

The 'naturalness' index is predominantly a function of land cover type, housing density, roads, traffic volume, and to a lesser extent it also considers canopy cover and slope. Strictly speaking, the naturalness index data address the 'naturalness' of a landscape as a resource. In addition, the index may be used to evaluate the effects of anthropogenic development or disturbance on naturalness. For example, the naturalness of an area inside a park or protected area that presently has a high index value will decline if it is within 270 m of the new development, or within 1 km of a new road associated with the development. These thresholds reflect key parameters of the model used to estimate the naturalness index (Theobald et al., in press). As a result, the naturalness index is useful in situations where a park or other management unit is concerned with whether or how planned utility-scale solar energy development near its boundaries (< 1 km) might impact or erode the naturalness (integrity, intactness) of habitats inside its boundaries. The index may also be used with other landscape indices including land ownership, roadless areas, and viewsheds to evaluate whether development stressors threaten cultural resource landscapes.

Available data/source:

A number of data sources were utilized in the model to derive the naturalness index. Range of values resulting from the model are scaled from 0 to 1, where lower values are less natural and increasing values are more natural.

Sources utilized in the analysis and references include:

National Land Cover Dataset (2001 retrofit): http://www.mrlc.gov/nlcd2001.php

Housing Density: Theobald, D. 2005. Landscape patterns of exurban growth in the USA from 1980 to 2010. Ecology and Society 10(1):32

Roads: ESRI Streets, 2006, ESRI Maps and Data DVD.

Highway Traffic Volume: USDOT National Transportation Database 2007 CD.

Theobald (2010). Estimating natural landscape changes from 1992 to 2030 in the conterminous US. Landscape Ecology (25:999-1011).

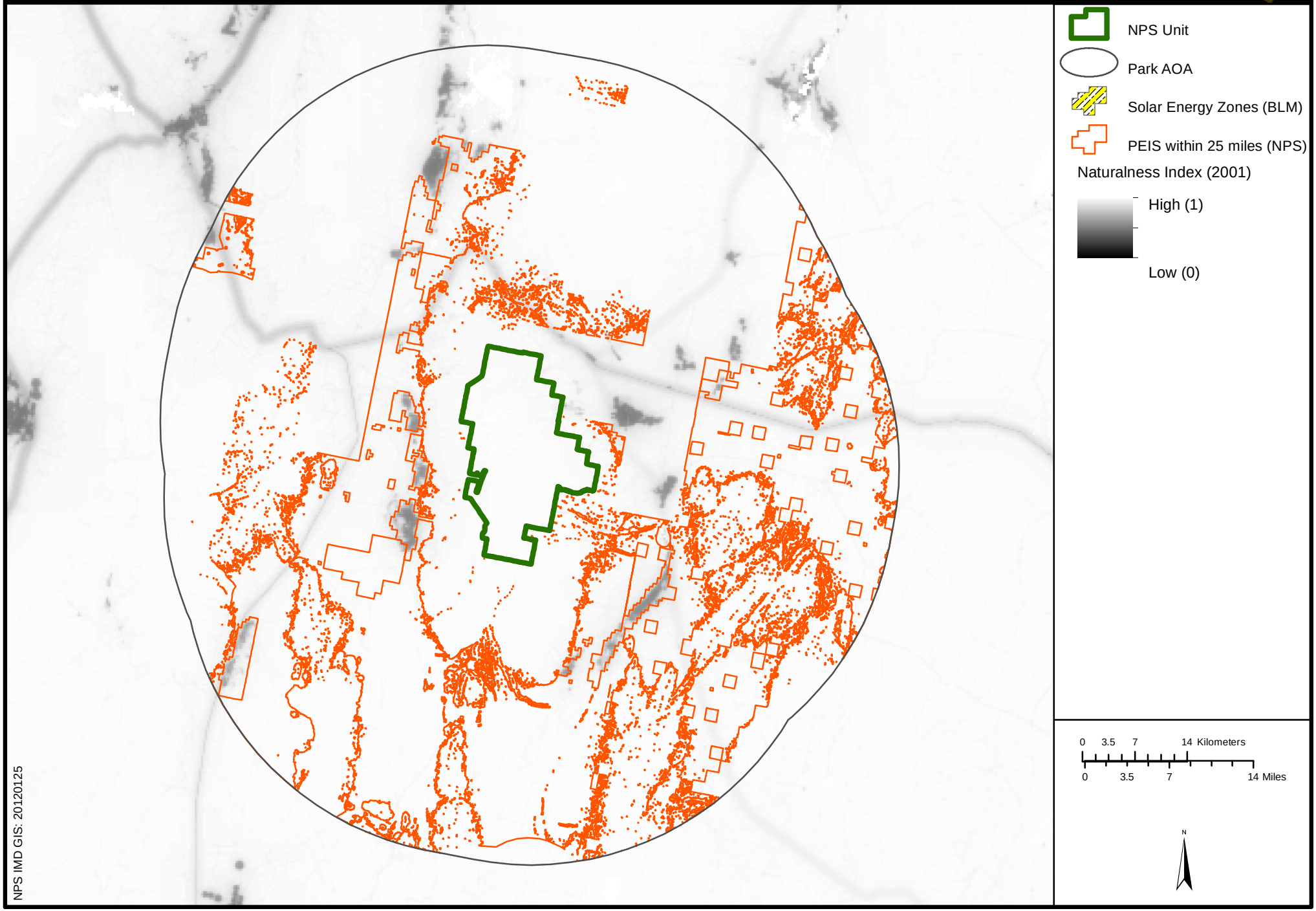
Utility of information for making exclusion recommendations:

The naturalness index raster was superimposed with variance lands and Solar Energy Zones to determine if any development of utility-scale solar facilities could potentially impact landscapes which according to modeled results indicate a high-degree of intact naturalness. NPS units having PEIS lands within proximity of their administration areas paired the naturalness index with other landscape-level data relating to important resources, including but not limited to roadless natural areas and critical habitats of species. The goal of such pairings was to evaluate how the underlying naturalness of the resources might change if neighboring utility-scale solar energy development were to occur. The naturalness index was also paired with other landscape indices to evaluate potential risks to cultural resources. In these evaluations, naturalness would be used as a surrogate for relative changes that might be expected with park-managed resources.

Great Basin NP

Naturalness Index - Theobald (2010)

National Park Service
U.S. Department of the Interior



NPS IMD GIS: 20120125

Landscape Permeability

Resources of concern:
The landscape permeability data are derived from the naturalness index (Theobald et al., in press). Landscape permeability data are invaluable for evaluating possible connectivity post hoc among other resources. For example, the landscape permeability data might be used to evaluate connectivity between two patches of critical habitat or roadless natural areas, and how that connectivity might be altered by some intervening utility-scale solar energy development or related disturbances. The landscape permeability data are especially useful in situations where a park or other management unit is concerned with whether or how an anthropogenic, landscape-level disturbance might impact or disrupt connectivity of critical resources. The index may also be used with other landscape indices including land ownership, roadless areas, and viewsheds to evaluate whether development stressors threaten cultural resource landscapes.

Available data/source:
Landscape permeability measures depicting both local park unit and national level connectivity corridors were extracted for the six-state PEIS study area. Raw landscape permeability average flow accumulation values across the 30 model iterations were: 1) filtered using a three cell radius, 2) normalized using a log2 transformation, 3) converted to integer data type, and 4) all values less than seven were reclassified to -9999. Permeability values across the contiguous US range between 7 and 22; higher permeability values signify greater connectivity.

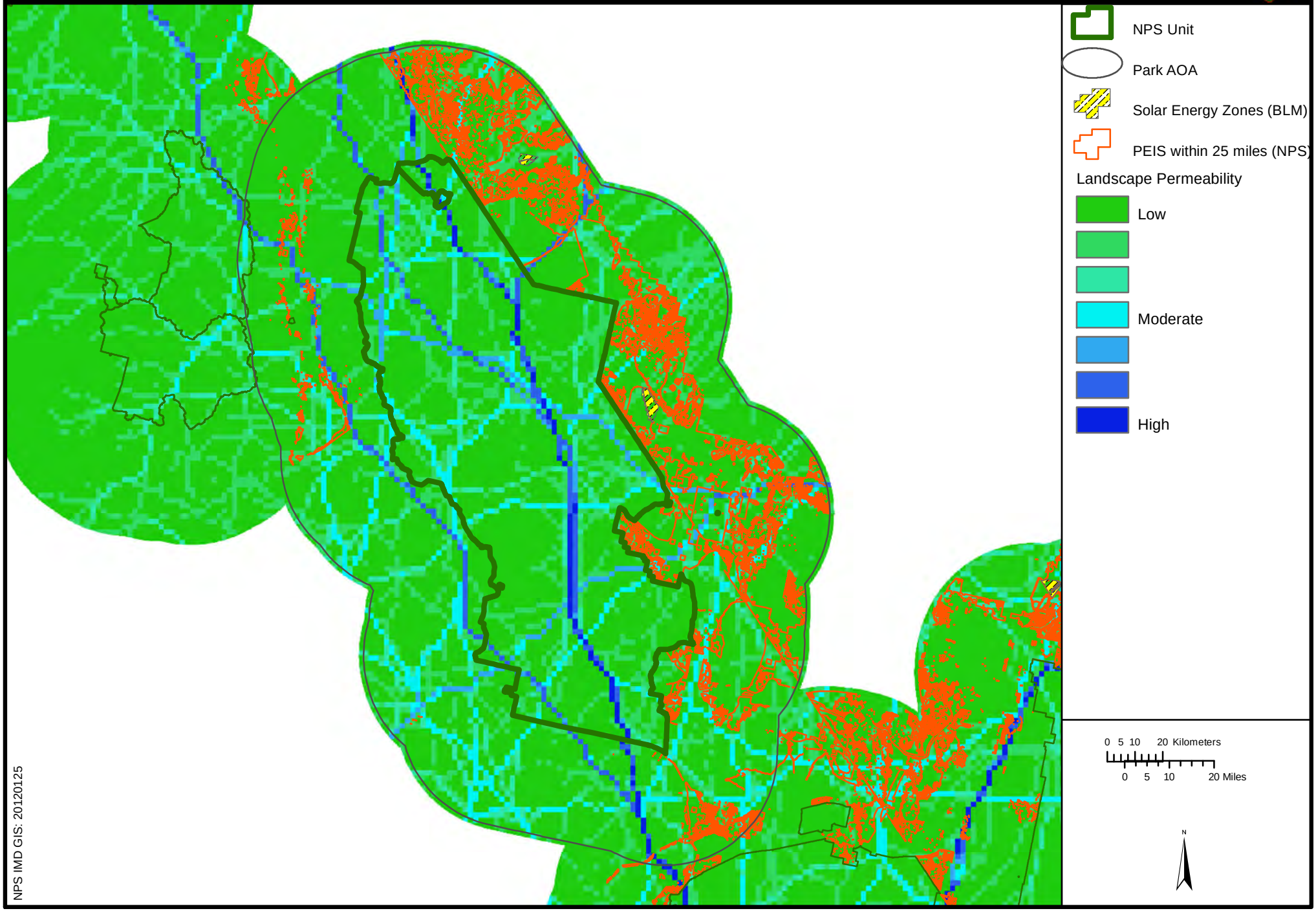
References to the datasets and modeling include:
Theobald D., Reed S., Fields, K., and Soule, M. (in press). Connecting natural landscapes using a landscape permeability model to prioritize conservation activities in the US. Conservation Letters.
Theobald (2010). Estimating natural landscape changes from 1992 to 2030 in the conterminous US. Landscape Ecology (25:999-1011).

Utility of information for making exclusion recommendations:
The landscape permeability raster was superimposed with variance lands and Solar Energy Zones to determine if any development of utility-scale solar facilities could potentially impact landscapes which according to modeled results possess a high-degree of natural connectedness. NPS units having PEIS lands within proximity of their administration areas paired landscape permeability in relation to major habitats or land cover types, critical habitats of species, locations or movements of known species populations, genetic or molecular data on population structure, and other measures of landscape pattern (e.g., core habitat patches).. The goal of such pairings was to evaluate how the underlying connectivity of the resources might change if neighboring utility-scale solar energy development were to occur. The landscape permeability data was also paired with other landscape indices to evaluate potential risks to cultural resources.

Death Valley NP

Landscape Permeability - Connectivity (Theobald In Press)

National Park Service
U.S. Department of the Interior



NPS IMD GIS: 20120125

Nighttime Lights

Resources of concern:

The NPS manages natural lightscapes for the benefit of both humans and ecosystems with a variety of tools. The quality of the night sky is an important resource, both due to its value to human aesthetics and the broader role it plans as a component of the natural habitat. As artificial light is added to a natural night sky via atmospheric scattering, the sky background becomes brighter and the contrast with natural features is reduced. At night, lights are usually seen from much greater distances than the attendant facilities are seen during the day. Even when directly screened by terrain, skyglow can still be seen as the light scatters and diffuses through the atmosphere. The NPS is concerned that development of utility-scale facilities occurring in variance areas without systematic analysis of nighttime light conditions may lead to unintended cumulative visual resource impacts and alteration of the natural light patterns found in the ecosystem.

Available data and sources utilized:

Composite images of nighttime lights are generated using the Defense Mapping Satellite Program – Operational Linescan System (DMSP-OLS) Nighttime Lights Time Series (version 4) to produce global cloud-free at 1-arc second resolution. The digital number values represent cleaned up average visibility values for cities, towns, and other sites including gas flares. The dataset does not include fires or other ephemeral events. Background noise areas are replaced with zero values. The DMSP sensor is not sensitive enough to register the widely scattered artificial light in the atmosphere; the light sources depicted in the images are the result of direct ground reflectance and a small amount of scattering in the vicinity of the light sources. Thus while this satellite imagery adequately captures the location and relative intensity of the light sources, it does not necessarily convey the extent of visible light in the atmosphere. Areas of the imagery shown as darker areas and those areas further from large light sources are predicted to have a darker and higher quality night sky condition.

Source data is found at Defense Meteorological Satellite Program: http://www.ngdc.noaa.gov/dmsp/dmsp.html

Utility of information for making exclusion recommendations:

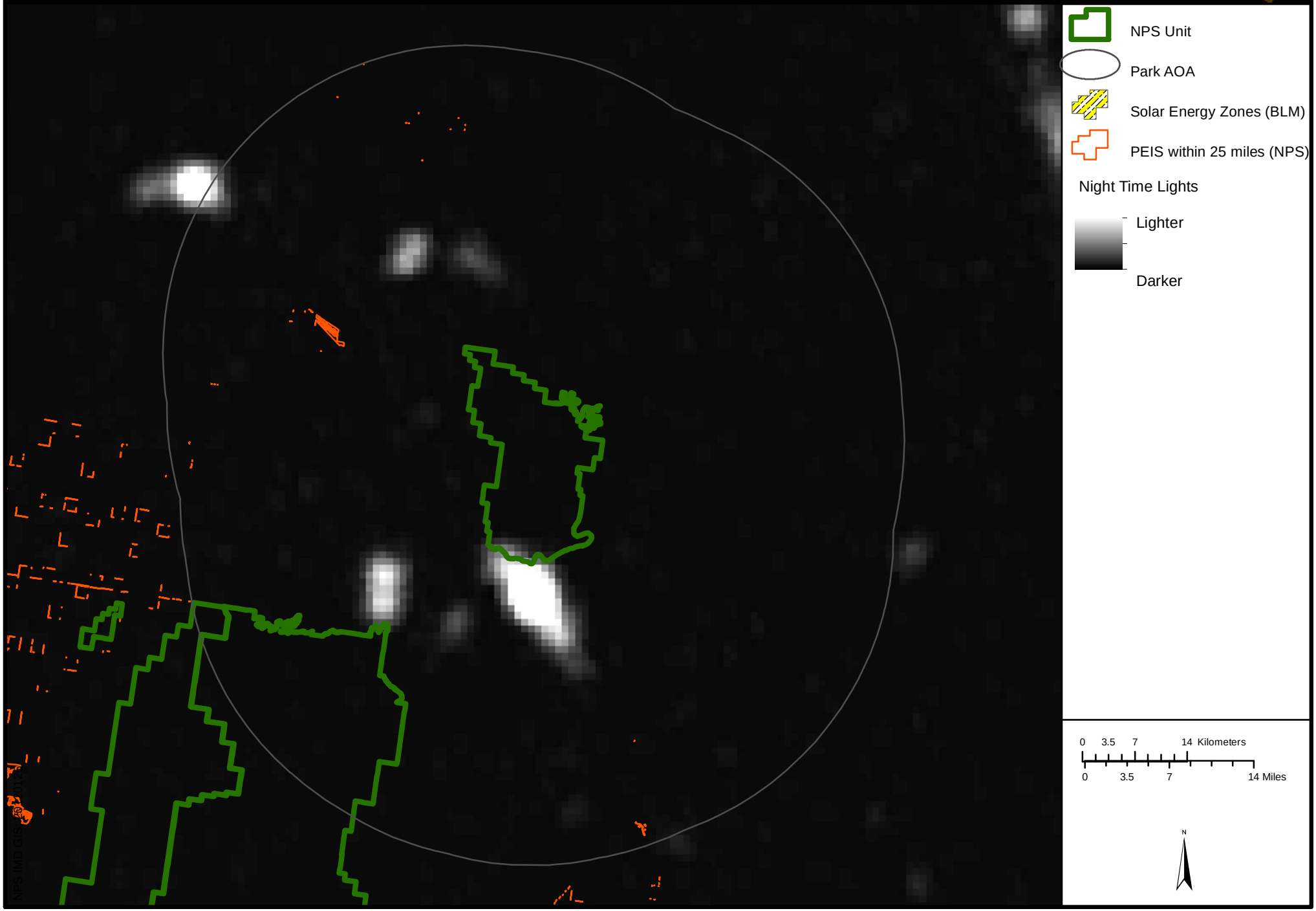
Images of cloud-free nighttime lights were generated for the 53 NPS units that are potentially impacted by the development of solar facilities within SEZs and variance lands within and beyond the 25-mile Area of Interest. The images were intersected with variance lands and Solar Energy Zones to determine if these lands fall within darker or lighter nighttime areas surrounding the park.

These images enable the NPS to gain a sense of the amount of artificial lighting in the external areas surrounding parks and augment ground-based measurements. The maps suggest that in many cases, dark night sky conditions extend well beyond 25 miles from the park. The analysis specifies existing skyglow conditions and where potential increases in artificial nighttime lights may occur coincident with solar development on variance lands. NPS units having PEIS lands within proximity of their administration areas identified as having darker nighttime light conditions need to be protected from the potential cumulative development of these lands for solar energy.

Arches NP

Nighttime Lights - Defense Meterological Satellite Program

National Park Service
U.S. Department of the Interior



Viewshed

Resources of concern:

For many parks, scenic views that extend beyond park boundaries are an important component of the visitor experience. The expanse of these views is often inspirational and iconic of the American spirit and often an important reason why people visit parks. The type, form and contemplated density of utility-scale solar development in the west pose a broad range of unique impacts to these shared scenic landscapes, including alteration of vegetation and landform, release of fine dust, generation of optic effects (e.g., glint and glare), and light pollution. The NPS is concerned that shared scenic landscapes associated with variance lands and SEZs could be lost to this and future generations if their presence and value is not accounted for and protected under the solar energy program ultimately adopted by the BLM. Both site-specific and cumulative impacts of multiple facilities must be addressed via rigorous visual resource analyses to determine if the siting of utility-scale solar facilities near park boundaries and special status areas is in the public interest.

Available data and sources utilized:

In order to identify specific scenic views that extend beyond park boundaries, the NPS conducted a geographic information system (GIS)-based viewshed analysis that generated maps using individual park-identified Key Observation Points (KOPs). The KOPs delineated "visible/not visible" areas in a park to 25-miles beyond park boundaries. The intent of this "line of sight" analysis was to determine 1) which lands outside parks could be seen from these KOPs, and 2) the extent of the acreage of these lands. Note: This was not a definitive analysis and additional work is needed before it would be appropriate to authorize utility-scale solar facilities in proximity to NPS managed areas.

The GIS effort used traditional and composite viewshed analyses. Traditional viewshed analyses evaluate the visibility of locations in a binary manner (i.e., Visible/Not Visible) across an area of interest (AOI) from a single, defined observation point (e.g., the KOP). The AOI is the area for which the viewshed analysis is being performed. In order to correspond to the Draft Solar PEIS, the AOI for the NPS analysis consisted of a 25-mile area surrounding each of the 53 parks. A sample point is a location within the AOI that could potentially be visible from the KOP. For the purposes of this analysis, the sample point was a potential location of a solar energy facility.

Composite viewshed analyses combine the "seen areas" of multiple viewsheds that may be calculated from more than one KOP. A visible value in a composite viewshed implies that at least one of the sample points is visible from, at minimum, one of the KOPs. In this manner, the number of visible KOPs is recorded on a cell-by-cell basis across the AOI. Composite viewsheds are a quick way to synthesize multiple viewsheds into a single map, thus giving a cursory overview of the land areas visible from a park looking out beyond its boundary. In the case of this analysis, identified areas outside a park were visible from at least one of the KOPs.

In order to conduct these types of analyses, the following GIS data was used:

- National Elevation Dataset (NED) 30 meter digital elevation model
- Park defined KOPs
- National Register of Historic Places (Derived from a database of locations within park units)
- Spatially Balanced Sample Points - "Out - In" (ArcGIS - Theobald et al. 2007) https://irma.nps.gov/App/Reference/Profile/2176278

Utility of the derived information for making exclusion recommendations:
Information on individual KOPs was collected from the 53 park units identified as being potentially impacted by the development of solar facilities within SEZs and variance lands. The number of KOPs provided by each park varied, dependent on available information that could be accessed in a short amount of time. The KOPs used in the GIS analyses represent an initial attempt at identifying important viewpoints within the individual park units. Viewshed polygons were intersected with variance lands and Solar Energy Zones to determine if these lands fall within park viewsheds.

While an incomplete effort, using the composite viewshed maps the NPS gained a sense of the amount of external land visible from important locations within the identified parks. The maps confirm that visibility is possible to 25 miles and they suggest that in many cases, visibility extends beyond this distance.[1] The analysis specifies visually sensitive areas outside the parks that overlap with SEZs and variance lands included within the Supplement. Furthermore, the maps indicate locations outside the park boundaries that would be visible from more than one KOP, and therefore have increased sensitivity.

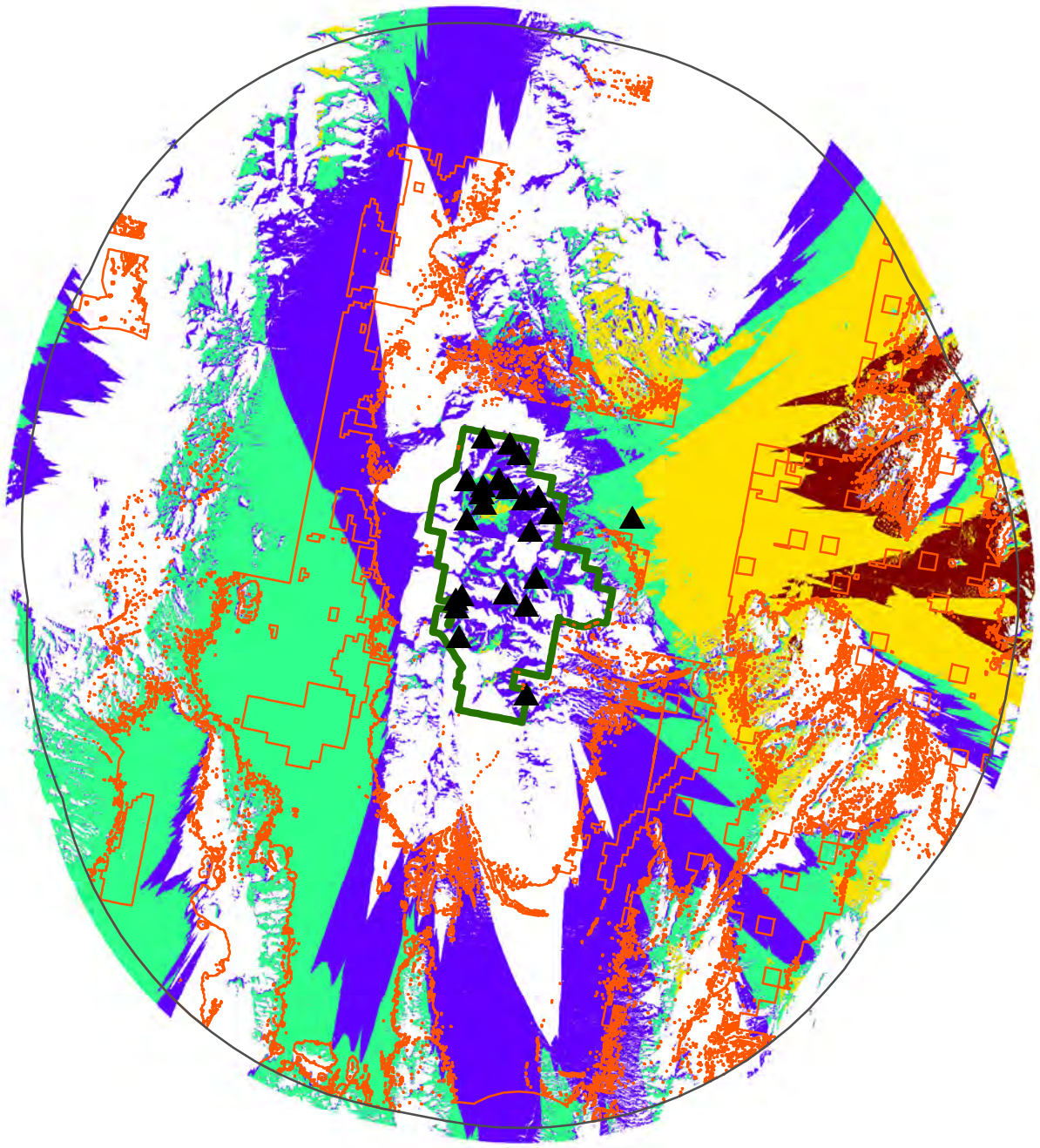
Park resource managers were provided the results of the GIS-analysis to assist them in evaluating these areas in light of park scenic resource values and to identify lands that should be removed as available for utility-scale solar development under the preferred solar energy program.

[1] Work on visibility in the air quality context puts the outer limit of visibility in the west at 140 miles with the typical range at 35 to 90 miles due to air pollution.

Great Basin NP

Viewshed Analysis - Key Observation Points

National Park Service
U.S. Department of the Interior



NPS Unit
Park AOA
Solar Energy Zones (BLM)
PEIS within 25 miles (NPS)
Key Observation Pts (23)

Visible Points

0
1 - 2
3 - 5
6 - 10
11 - 16

0 3.5 7 14 Kilometers
0 3.5 7 14 Miles

N

NPS IMD GIS: 20120125